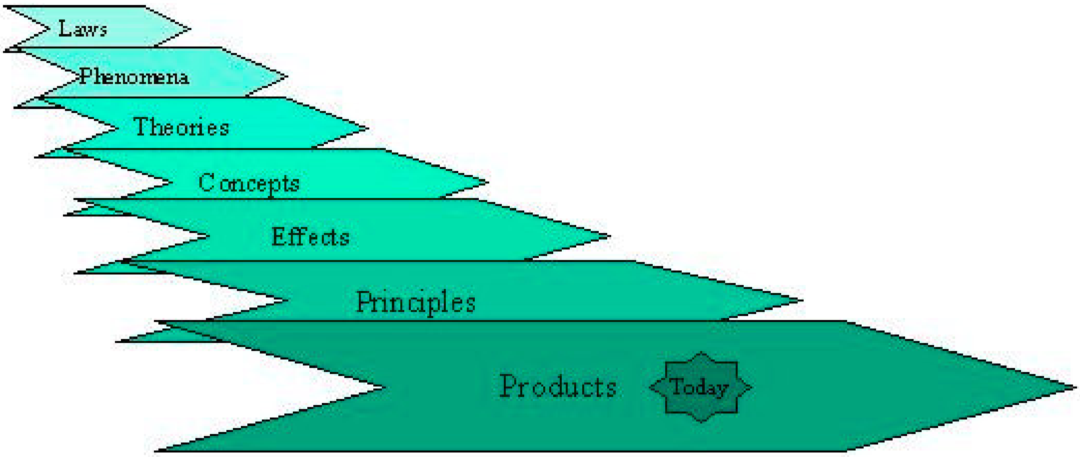

The Innovation Paradigm Replaced

Conceptualise, Idealise, Transform.

"The difference is merely a different set of ideas"

by Waldo Hitcher

THE

INNOVATION

PARADIGM

Replaced

W. HITCHER

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Preface

When viewing Turner's Fighting Temeraire or Michelangelo's David, few would doubt the ability of art to inspire. The emotion engendered by the final departure of a proud warship tugged to its end or David's tangible curves, smoothed from solid marble, are without parallel. However art's exclusivity is also its fundamental weakness. Art has high barriers to entry; it requires inspiration, imagination, learned skills and innate abilities. Worse still at the highest level these skill combinations are extremely limited. Each generation is lucky to produce a handful of great artists.

Innovation too, is said to need inspiration, imagination, learned skills and innate abilities. Innovation is considered an art. This book maintains that Innovation cannot afford such exclusivity and this paradigm must be replaced. The alternative is to sit and wait for the next Great Master of Innovation like Darwin, Maxwell and Einstein or Technologists like Edison, Ford and Deming. Innovation need have no lofty goals and only one entry qualification, that it is useful.

This book applies this qualification throughout, it is written ***to be useful - not true***. A probability, not a fact. On reflection it can be seen that all life is a "probability wave" not a predetermined equation. Even the great truths of Classical Physics bend before the Mechanics of the Quantum scale. No photon or electron is ever more precise than the occasion demands but you need not look to know where it will be, it will go where it is expected. Similarly the mind paints an impression of life with the gentle shades of memory conjured from the elements of experience. Precision is slow and unhelpful when you need to reuse recollections in fresh settings.

This book is a probability wave that lowers the bar on innovation by showing how ideas can be conjured at will to go where they are expected.

Introduction

Innovation is still considered a black art, not a science. Progress a threat, not the hand that feeds us. Overlooked has been the simple fact that without innovation, the planet can perhaps feed only a few million hunter-gathers. With innovation, Earth can provide for a thousand times as many. ***The difference is merely a different set of ideas.***

In the 300,000 years since the dawn of modern man there have been no revolutionary improvements in either material resources or human intellectual capability. The ability to exponentially multiply the population has arisen solely from innovations.

This book attempts to kill the idea that innovation is an art. It explains how the present paradigm of innovation can be replaced.

Section 1 Theory

Chapter.1 The Problem with Innovation today

The Innovation Paradigm

> *Innovation is an art. Innovation cannot be learnt. Innovation has no system, or basic principles. Only gifted people can create. They create and we copy. They are the Gurus and we are the drones. Without people like Newton, Einstein, and Edison, the few that made it would still be living in caves.*

By the end of the book it should be clear that the above innovation paradigm has no validity. Innovation is a science and it is reproducible at will.

Scientific disciplines not only have a theoretical base to explain the cause and effect of the phenomena encountered but also a structural taxonomy to relate elements of the discipline.

We therefore need to move our thinking from art, to science. To follow the simple steps from where we are, to where we want to be. We need to understand how innovation works and what steps we can take to take to reproduce it. We need to start generating practical theories of Innovation with associated taxonomies of structure and a language of use. All such theories will have common elements. They will be an integrated process because Innovation is an integrated process, they will be constructive because they build upon experience, they will be deterministic because every step is logical and reproducible and they will be fast and forward moving.

The underlying basis for all such theories is the continuum of history from past to present and from theory to practice. The Innovation Continuum.

Chapter.2 The Innovation Continuum

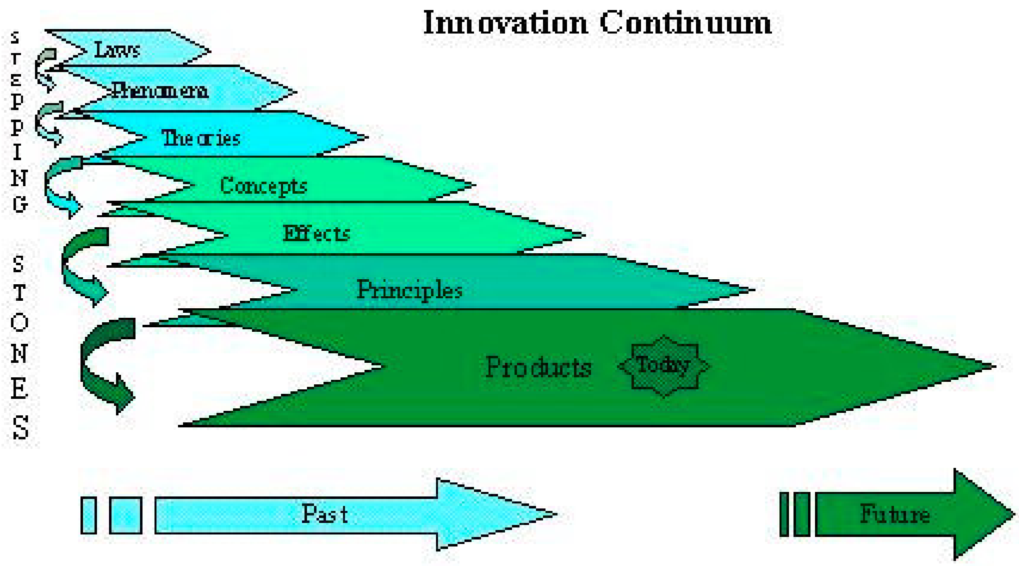

Figure 1 Innovation Continuum from Laws to Reality.

The Innovation Continuum is the basis for all efforts to rationalise material creativity into a scientific platform for future design. As you travel back along the continuum you drill down into the fundamental basis of all intelligent design – the laws of nature. This simplicity taken from natural events and interpreted into scientific laws, is however not the panacea it would first seem. The laws are so abstract when compared to day to day needs that it really would take the intellectual leap of a genius to bridge the gap.

The difficulty in innovation is twofold. The number of possibilities for combining laws that run a universe, with the demand vagaries of six billion people, is statistically overwhelming. Secondly, generating successful product designs from thin air with no design patterns, is the reason 250,000 years of pre history just resulted in a bow and arrow, a comb and some hopeless wall paintings.

Stepping Stones

The innovation continuum has an answer for these difficulties - Stepping stones. Stepping stones are placed every time an idea proves useful and is shared. These stones together are called progress and they are the determinants of the past and future success of the human race.

Stepping Stones are proven ideas that :-

- Can include any Law, Theory, Concept, Product or Service.

- Are recorded and communicated in a useful form.

The fewer the stepping stones, the greater the innovative leap between the abstract and the practical, plus the greater the cost and risk involved. For instance, in times of war military innovation accelerates many fold because great leaps can be made without regard to cost. In war failure is not an option.

The more stepping stone paths followed the better the outcome. Having existing stepping stones in place means that following paths is quick and easy. And as Edison maintained, in the final analysis innovation is a numbers game, the more you try the more you get.

With stepping stones order and position is everything. You need to understand where each stone leads and in which order they are placed. If you want more concrete ideas you move towards the practical end and if you need conceptuality and wider applicability you move to the theoretical end. The law of conservation of momentum will explain many phenomena and in turn countless concepts so you need to get your ducks in a row.

Stepping stones have certain features that have kept progress painfully slow for millennia but show signs of exponential acceleration from here on in. Over the centuries there were few stepping stones but nothing to indicate an intellectual deficiency, so the dearth of technology would indicate communication has been the greater difficulty. Over the last few years the person to person communication explosion has driven this problem into the mists of time. Webs, mobiles, blogs, forums, books, and other media have multiplied the number of good ideas encountered and shared by an individuals on a daily basis.

Luckily, it seems, we are at the productive end of many years of an Innovation Continuum. For hundreds of years people have improved life with all manner of inventions and devices. Where we are now there is a (relative) abundance, produced by countless innovations. We are at the event horizon of a thought timeline that results in milk bottles on the doorstep, mobile phones ringing in your pocket, intelligent agents on your desktop and electronic books on the Ipod.

At the start of this continuum are the laws of the universe and these laws go on to set the rules for everything that follows. Our task is simple, to make stepping-stones from the universal laws, all the way to the product we are improving at the sharp end.

To produce these stepping stones we have an embarrassment of riches. With over two thousand years of recorded history we have technologies that make magic look mundane.

So, rather than start from abstract scientific laws it's much better to focus on a concrete example from one of the millions of innovations we already use. This product focus gives a tangible beginning to what has until now, been a mysterious process. Allowing us to describe a straightforward set of steps leading from present reality to future products[1], compounds our advantage.

Nesting

Stepping stones are nested. They relate to the other elements multi-dimensionally, having causational and dependency links as well as the time ordered relations we see in the continuum. Although these other links can lead to the appearance of a chaotic system, the use of constraints and treatment of the stepping stones as information sources can identify the deterministic nature of this situation.

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[1] Product always includes "Service" throughout this book. Products are just a physical manifestation of the real provision which is always a service. The customer buys what it does. That **is** what it is.

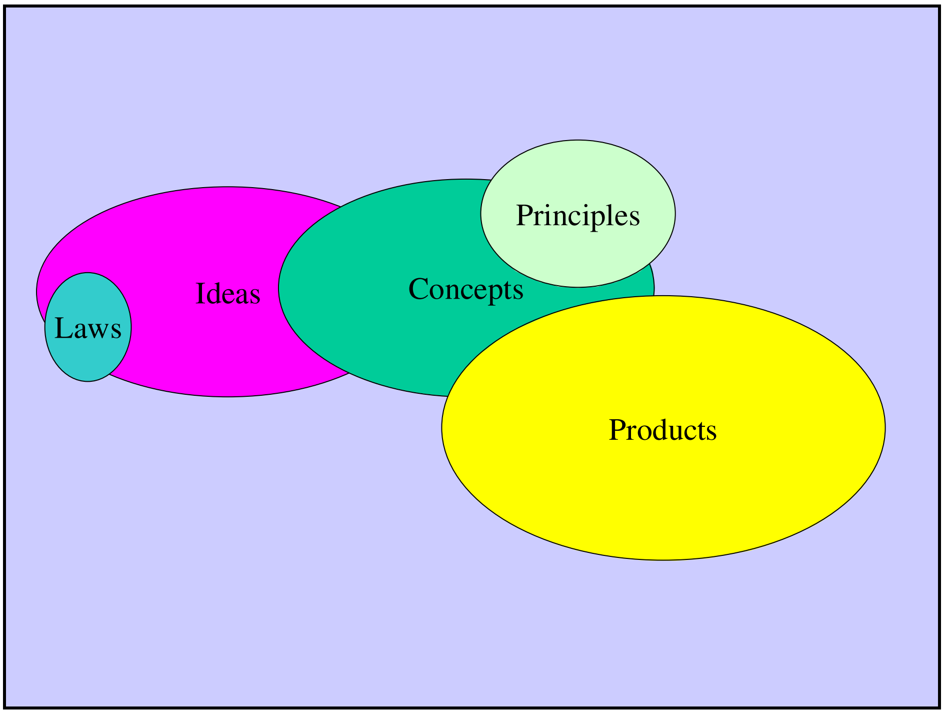

Figure 2 Stepping Stone 3D Nesting

Product Information Inheritance

Products contain information, a lot of information. By their very existence products can tell you many useful things about concepts and customer needs. All products simultaneously monitor both these channels and as stepping stones in the continuum they also imply relations with the other steps.

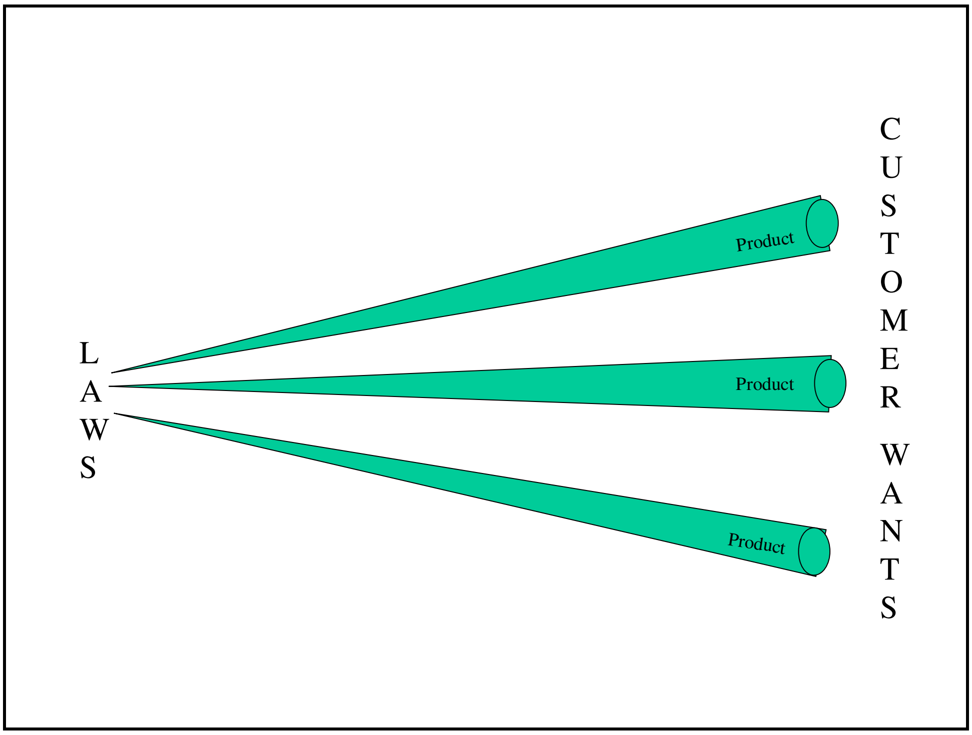

Figure 3 Product Information Inheritance

This information inheritance from other stepping stones (see Nesting) enables us to use the product as both a microscope on its past inheritance and a projector on its future. We can look back at the principles and concepts from which it evolved and project these evolutions onto the canvas of extended customer expectations.

If you were to find a sword from Roman times there is little doubt that before long archaeologists would have identified its known provenance, production technology, normal usage and what told us about the society within which it was used.

With modern products with a fully available provenance it rarely occurs to use to study a product as if it was from ancient times. Familiarity breeds contempt. A dustpan is just there. No thought is given to why it was originally created and what ideas over the years have been rejected in continuing to make it. A dustpan and brush has been in use since before Roman times and has been one of the most enduring designs but unless we dig one up it seems unlikely to be looked at with the archaeologists critical eye. In order to innovate we need to be product archaeologists.

Innovation Ballistics

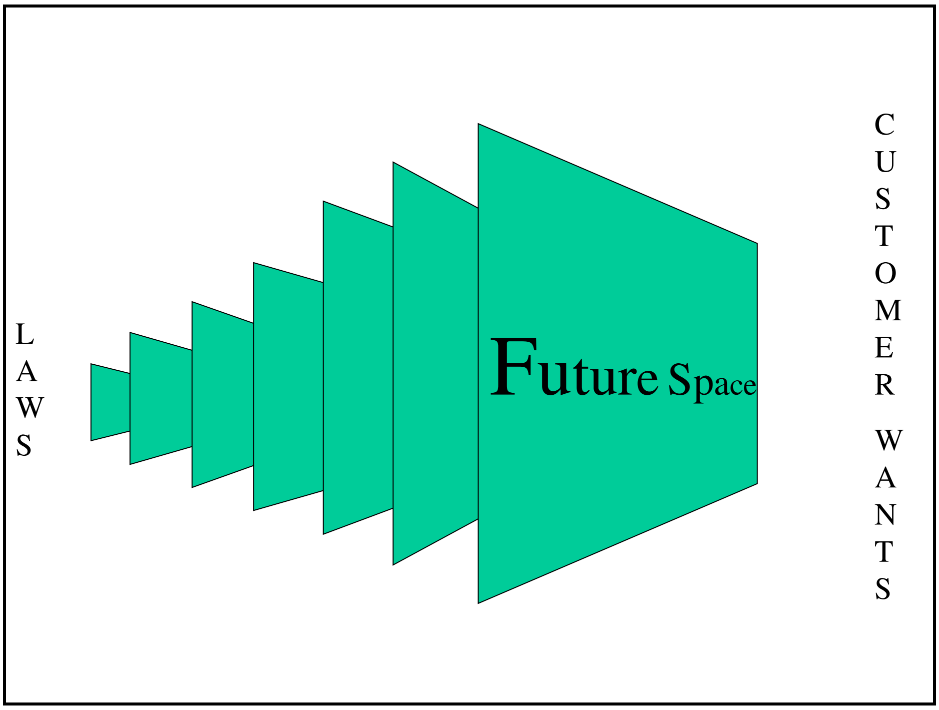

Figure 4 Innovation Ballistics

By Incorporating the ideas of stepping stone 3d nesting and information inheritance a new view on the Innovation Continuum is possible – the ballistic view. In this visualisation, a product or other stepping stone is traced along its transformational path showing the impact holes through a series of ideaspace frames. This has the advantage of identifying the trajectory of the idea from its theoretical inception to the present product incarnation and off into the distant future. Furthermore it "freeze frames" the causations and relations at the level of abstraction required.

INNOVATION BALLISTICS	
1	Shows the idea trajectory
2	Tracks into History
3	Projects into the Future
4	Freeze Frames causations

5	Identifies opportunities i.e. remaining ideaspace in each frame
6	Offers a measure of innovation opportunity
7	Relates the abstract to the tangible.

Table 1 Innovation Ballistics

Chapter.3Analogy

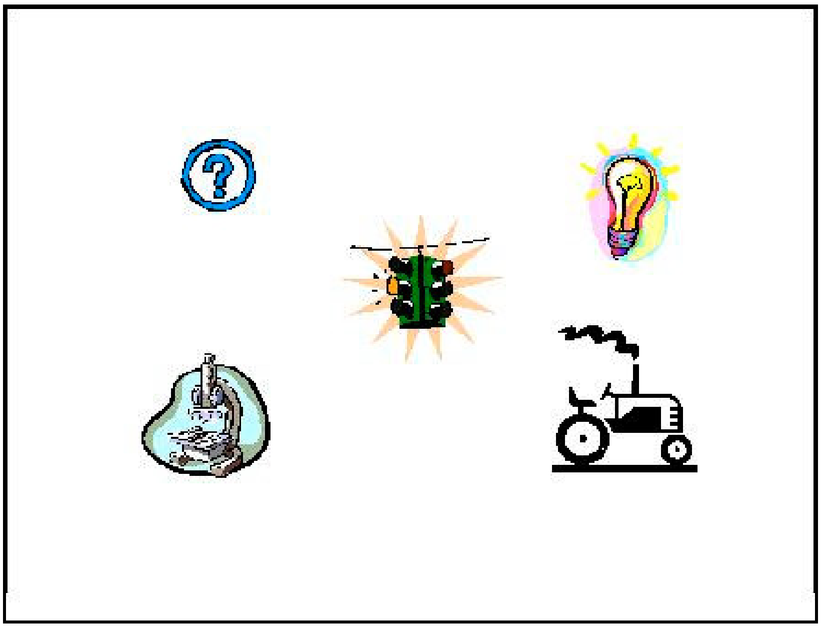

Figure 5 Analogy

> *Our structure-mapping abilities constitute a rather remarkable talent. In creative thinking, analogies serve to highlight important commonalities, to project inferences, and to suggest new ways to represent the domains. Yet, it would be wrong to think of analogy as esoteric, the property of geniuses.*

Dedre Gentner and Arthur B. Markman

Analogy and similarity are central in cognitive processing. We store experiences in categories largely on the basis of their similarity to a category representation or to stored exemplars. New problems are solved using procedures taken from prior similar problems.

First, analogy is a device for conveying that two situations or domains share relational structure despite arbitrary degrees of difference in the objects that make up the domains. Common relations are essential to analogy; common objects are not. This promoting of relations over objects makes analogy a useful cognitive device, for physical objects are normally highly salient in human processing - easy to focus on, recognize, encode, retrieve, and so on.

The process of comparison both in analogy and in similarity - operates so as to favour interconnected systems of relations and their arguments. As the above discussion shows, to capture the process of analogy, we must make assumptions not only about the processes of comparison, but about the nature of typical conceptual cognitive representations and how representations and processes interact. In particular, we must have a representational system that is sufficiently explicit about relational structure to express the causal dependencies that match across the domains. We need a representational scheme capable of expressing not only objects but also the relationships and bindings that hold between them, including higher Structure Mapping in Analogy and Similarity order relations such as causal relations.

There is, in general, an indefinite number of possible relations that an analogy could pick out, and most of these are ignored.

The defining characteristic of analogy is that it involves an alignment of relational structure. There are three psychological constraints on this alignment. First, the alignment must be structurally consistent In other words, it must observe parallel connectivity and one-to-one correspondence. Parallel connectivity requires that matching relations must have matching arguments, and one-to-one correspondence limits any element in one representation to at most one matching element in the other representation structure. This also shows a second characteristic of analogy, namely, relational focus: As discussed above, analogies must involve common relations but need not involve common object descriptions. The final characteristic of analogy is systematicity: Analogies tend to match connected systems of relations. A matching set of relations interconnected by higher order constraining relations makes a better analogical match than an equal number of matching relations that are unconnected to each other. The systematicity principle captures a tacit preference for coherence and causal predictive power in analogical processing. We are not much interested in analogies that capture a series of coincidences, even if there are a great many of them.

In a study, people who were given analogous stories judged that corresponding sentences were more important when the corresponding sentence pairs were matching than when they were not. Alignable differences can be contrasted with nonalignable differences, which are aspects of one situation that have no correspondence at all in the other situation. This means that people should find it easier to list differences for pairs of similar items than for pairs of dissimilar items, because high-similarity pairs have many commonalties and, hence, many alignable differences. Such a prediction runs against the common-sense view - and the most natural prediction of feature - intersection models - that it should be easier to list differences the more dissimilar the two items are. In a study by Gentner and Markman (1994), participants were given a page containing 40 word pairs, half similar and half dissimilar. The results provided strong evidence for the alignability predictions: Participants listed many more differences for similar pairs than for dissimilar pairs. It seems it is when a pair of items is similar that their differences are likely to be important.

Analogical Inference is another effect of use in delivering Innovation. Studies (Clement and Gentner 1991) show analogies lead to new inferences. In analogy, when there is a match between a base and target domain, matching facts about are accepted as candidate inferences. Mapping allows people to predict new information from old and will allow us to use analogy to suggest innovation options by using an existing product as a base domain.

Selecting existing product as a base domain has other benefits. According to structure-mapping theory, inferences are projected from the base to the target. Thus, having the more systematic and coherent item as the base maximises the amount of information that can be mapped from base to target. Consistent with this claim, Bowdle and Gentner found that when participants were given pairs of passages varying in their causal coherence, they (a) consistently preferred comparisons in which the more coherent passage was the base and the less coherent passage was the target, (b) generated more inferences from the more coherent passage to the less coherent one, and (c) rated comparisons with more coherent bases as more informative than the reverse comparisons. The inherent coherence of an existing product in its tangible and viable setting, makes it a superior option to a great leap forward from a law or technological advance.

It is possible that conventional analogies have their metaphoric meanings stored lexically, making it unnecessary to carry out a mental domain mapping. This could be the reason that it is easier to extend an existing domain mapping than to initiate a new one. For example, when electric current is described throughout a passage using the extended analogy of water flow.

Innovators are called on to map information from one situation to another and they must decide which aspects of their prior knowledge apply to the new situation. Schumacher and Gentner (1988) found the speed of learning was affected both by transparency (i.e. resemblances between structurally corresponding elements) and by systematicity (i.e. when they had learned a causal explanation for the procedures). Having a strong causal model can enable innovation even when the objects mismatch perceptually. Both transparency and systematicity are facilitated by drawing analogy between products.

Several findings suggest that similarity-based retrieval from long-term memory is based on overall similarity, with surface similarity heavily weighted. a parallel disassociation has been found in problem-solving transfer: Retrieval likelihood is sensitive to surface similarity, whereas likelihood of successful problem solving is sensitive to structural similarity. This suggests that different kinds of similarity have different psychological roles in transfer. For instance studies of relational comparisons suggest that when participants are required to respond quickly, they base their sense of similarity on local matches rather than on relational matches. At longer response deadlines, this pattern is reversed.

Structural alignment influences which features to pay attention to in choice options. Research suggests that alignable differences are given more weight in choice situations than are nonalignable differences.

In order to find concepts for transforming products the prime method available is to draw analogy with concepts used by other products. Analogy is particularly well suited because of the way the mind builds ideas from images and memory fragments.

Analogy is the quality or state of being alike or: affinity, alikeness, comparison, correspondence, likeness, parallelism, resemblance, similarity, similitude, uniformity, uniformness. Analogies can be used to group analogous relationships into five categories: descriptive, comparative, categorical, serial, and causal.

In our example, we might draw the analogy between the Dustpan and a rotary street sweeper and consider contra-rotating brushes on the brush handle that sweep together as the brush is pulled.

Analogy is about finding similarities, categorizing, and making comparisons.

Chapter.4Insights

Comparison processes foster insight. Analogies highlight commonalities and relevant differences, they invite new inferences, and they promote new ways of construing situations.

Insights are somewhat overlooked stepping stones on the Innovation Continuum. Insights are the distillation of useful concepts from a product or service into principles of value added design or competitive advantage for that opportunity. They are the unique selling propositions that identify an innovative possibility.

The concepts behind Innovation itself can be analysed into Insights in order to identify how it can be improved.

INNOVATION INSIGHTS	
1	Innovation is a continuum
2	Innovation builds on previous knowledge
3	Innovation must be communicated
4	All innovations are logical in retrospect.
5	Innovation looks like magic because it is asymmetrical. It looks easier from the result than from a theory.
6	Innovation is designed for people.
7	There are few natural laws but countless applications
8	Innovation processes are considered mysterious.
9	Small innovation steps are easier than big ones
10	The more innovations you try the more products you get.

Table 2 Innovation Insights

Chapter.5Constraints and Options

Both constraints and options are potentially positive for innovation. Constraints allow focus and avoid wasted effort. Options increase possibilities.

These factors are symbiotic. If options are increased in the absence of constraints then innovation will become a lottery. If constraints are increased to the exclusion of options then little will result.

Constraints should be set to inform and direct the conceptual analysis but not exclude viable possibilities. Options should be maximised within the constrained framework by analogy techniques (see Analogy Patterns below).

Chapter.6Ontology, Taxonomies & Language

As stated at the start the lack of a scientific basis for Innovation has some less expected results. Scientific disciplines not only need an ontology and theoretical base to explain the cause and effect of the phenomena encountered but also a structural taxonomy to relate elements of the discipline.

An ontology is a conceptualisation of a knowledge domain, a controlled vocabulary that describes objects and the relations between them in a formal way, and has a grammar for using the vocabulary terms to express something meaningful within a specified domain of interest. The vocabulary is used to make queries and assertions. Ontological commitments are agreements to use the vocabulary in a consistent way for knowledge sharing

The Innovation continuum relates the main elements of the process as to the order, ownership and direction of development. The book is a definition of the objects and the relations between them in *an informal way in order* to be useful. The next book in the series integrates the continuum in a formal manner.

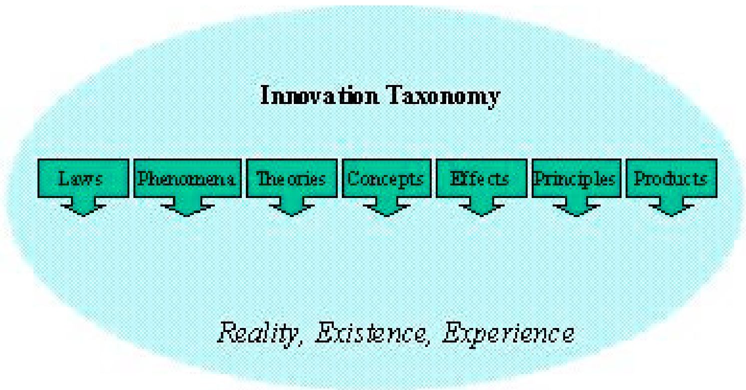

Figure 6 Innovation Taxonomy

Another problem with present day Innovation is that its low defusion into the general population means that the variety of vocabulary is limited. Historically there has not been as much call for the language of innovation as for agricultural, building or even industrial terminology. This is a significant problem in the age of search engines and databases. Inappropriate taxonomies and insufficient vocabulary are causing difficulty in accessing and applying knowledge in the innovation arena. The Inuit have more terms for snow than industrial societies have for innovation.

This problem is addressed in the language section of the appendix by collecting terms from associated disciplines and co-opting appealing terms from the major languages.

Section 2 Practice

Chapter.7 Three Steps to Innovation

Step One – Conceptualise. What does the product do?

Take any product (or service) and ask "What does it to do?"

Identify the key concepts that the product uses to get the job done. Concepts generalise the effect of the product so they can be applied elsewhere. A hammer uses the centrifugal effect of a heavy weight at the end of a shaft. A vacuum cleaner separates dust from floors by using air as a transport.

Step Two – Idealise. What do you want it to do?

Take the product or service and ask "What do you want it to do?"

You will want to do more with less. You may want to avoid a problem, like the hammer hitting your thumb or add in additional stages to the process, like separating the vacuum cleaner from the dust when its finished!

Step Three – Transform. Change the concept

Simply swop over the concepts used in the original product to achieve the new one.

The concepts are all readily available along the innovation continuum. That's it. Three stages that change the product concept to do more with less.

The rest of the book explains the concept changing process and how to make the steps easier.

Chapter.8 Conceptualise

Figure 7 Dustpan and Brush

Conceptualise	***Product: Dust Pan and Brush***
What does it to do?	Separates dust from floors
Make Concept 1	Brush multiple bristles effectively move dust from uneven floors without damaging surfaces.
Make Concept 2	Pan ramp permits only inwards dust movement
Move Concept 1	Pan sides and cover hold in dust during movement
Move Concept 2	Pan Handle allows ramp location and pan emptying
Strengths	Simple, Cheap,
Weaknesses	Manual, Dusty,

Table 3 Conceptualise

Using Analogies

When studying innovation the only reason for us to use an analogy is to access ideas not otherwise available. As we have seen the mind works with analogies to perform cognitive functions, storing memories by association rather than index. This makes it a far more powerful parallel processor than its raw specification would imply. The mind cannot compete with the cycles per second or memory register of even the most basic PC but its ability to associate gives it a unique capability in forming connections.

We do not have the design capability to design a similar electronic computer but we can use analogy to access the one we have each been given – the brain.

Altschuller, De Bono and others have suggested patterns for accessing the brain's associative powers. One of the aims of this book is to delve deeper into this pattern forming function and see if we can understand how to find what we want, when we want.

The success of all the other concepts in the book are dependent on this accessing of information because no matter what stepping stones exist, something must associate them in a constructive manner. I hasten to say we are not back in Michelangelo territory, as the suggested analogic processes should be able to deliver high quality options needing fast comparison of viability not pure blue sky generation. If such association and appraisal could be encapsulated in a software program it would be a valuable asset. However it is not necessary, as by using the right analogies, each of us can follow steps to derive the most satisfactory inventive designs.

Analogy Patterns

Analogies simplify information access by interconnecting relations between entities and ignoring extraneous factors. This simplification is actually adding tremendous value for innovation. A computer could store all the related aspects of millions of objects but the mind stores the useful relations. This makes recall easier but also highlights only the useful concepts. The 3C's of analogy patterns are:-

Comparative (Resemblances)

Comparative elements of the entities can be matched by analogy. The use of the term "than" to connect the statements is all that is required.

Taller than the Eiffel tower. Bigger than a football pitch. Thinner than a human hair.

Categorical

Categorising into a framework enables this patterning approach. The tree like structure is the mind's default but any structure can be invoked. Merely state or imply the structure and elements.

A type of orange. The fastest computer. One of the first year student's

Causal (Systemacity)

Cause effect relations are crucial to innovation. Luckily (well its not luck actually it was built that way) the brain establishes causal links a the base for memory.

Switch and a light. Run along a road. Gravity and weight. Police and behave yourself.

Memory Systems & Heuristics

Knowing the 3c's is of less use if you don't have a key to unlocking them. This is where a certain amount of genius has been shown in deriving systems to access the mind's analogies directly rather than rely on the logical forms that work so poorly.

For instance, losing your car keys is not helped by the inevitable suggestions to look where you had them last. Better still to put the keys out of your mind and employ analogical approaches that move the focus to other entities that have a symbiotic relation with the keys and track their them i.e. the car, your coat, your routine paths and actions, door locks etc Alternatively build an analogical model of every event around the key use but avoiding the now emotionally blocked memory of the keys themselves.

On a more serious note Altschuller, Buzan and De Bono all created analogical memory systems for storing and accessing innovative ideas. All of these systems use pattern analogies for each of the 3C's.

- Altschuller s Triz 40 principles
- Buzan's Memory Maps
- De Bono's CoRT lessons

They each allow transformation of ideas by applying a memorable but flexible pattern. Whether to perform a PMI (Plus , Minus Interesting), contract a mind map of relations, of consider the effect of Matreska (a doll within a doll). The brain already has these relations stored and is very pleased to be asked to use them instead of facing yet another mountain of useless information.

These pattern systems are applicable to any innovation stage. They are the equivalent of using a Google interface for the mind when up until now you thought you had to learn Cobol queries. These and similar patterns will access and store any comparative, categorical, or causal analogy in the mind. That's everything; nothing's in tables, it's all in analogies.

I'm surprised that this isn't the biggest area of research in Universities, enhancing the language for interfacing with the brain seems quite important but just like Mr De Bono, it seems we are to be disappointed in this area.

I won't attempt to summarise the systems here but the reference list includes the keynote books.

Product Archaeology

Product Archaeology enables us to use the product as both a microscope on its past and a projector on its future. We can look back at the principles and concepts from which it evolved and project these evolutions into the future.

Taking an existing product you need to identify its provenance, production technology, normal usage and what it tell us about its usage.

Product Ballistics

Using information and by following relations and from the archaeology, we can extract each of the freeze frames along the product trajectory. We can identify features, generalise them to remove artefacts and distil them back into their concepts and then laws. We should be left with a set of cards showing two dimensional relations in place of the network of three dimensional nested relationships. It is difficult to conceive of three dimensional relationships, so this simplification will gain more in value than it loses in information.

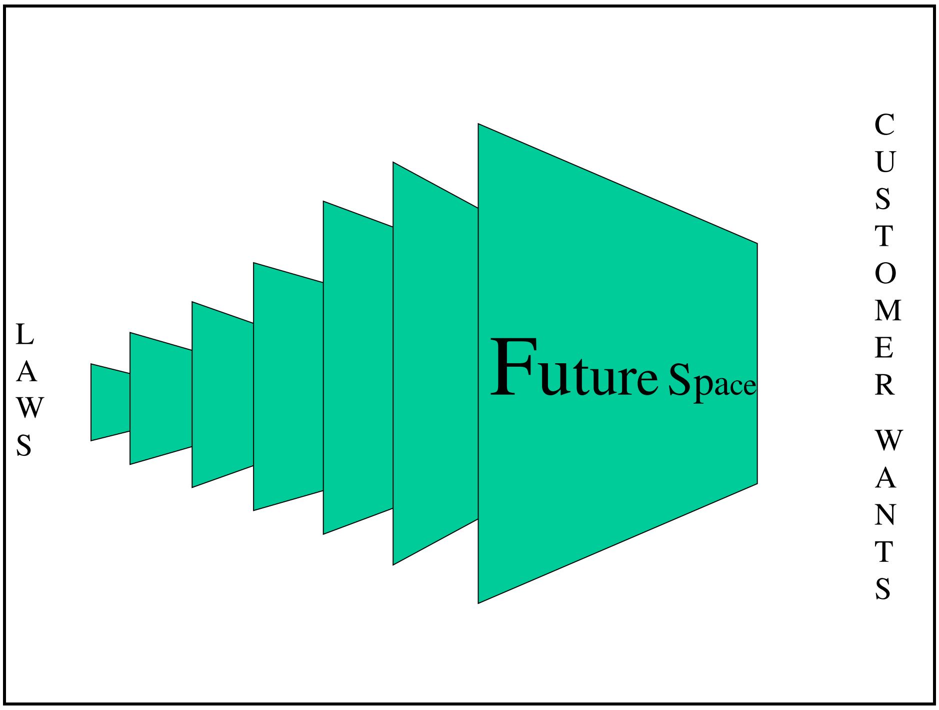

Figure 8 Product Ballistics

The number of abstractions required and the relations mapped is solely determined by the use to which the ballistic track is being put. If we have a space shuttle and we would like it to indicate our development trajectory for space then we will end up with sub tracks for each of the key elements (configuration, dynamics, objectives). Our dustpan has a considerable provenance but a single track with a few frames should suffice.

Ideaspace

Each of the two dimensional cards represents an Ideaspace target. The targets track the innovation idea all the way from laws to product and on to the Ideal Final Result.

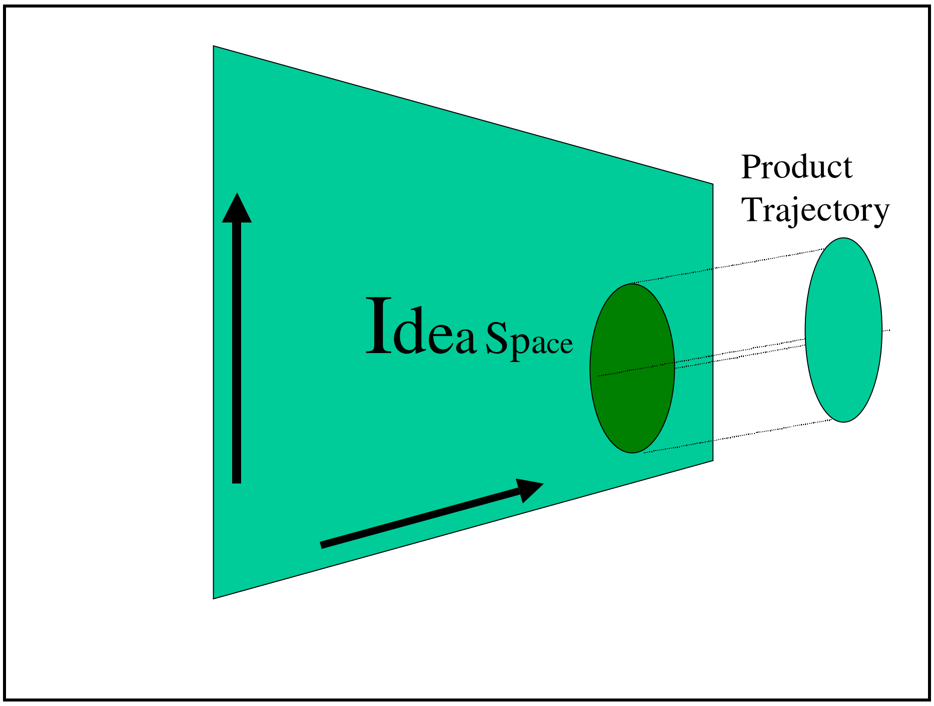

Figure 9 Ideaspace Target Card

The ideaspace can include any set of relations that together indicate positive factors for the product trajectory. The plan can be: -

1. Specialist. To identify specialist areas of the ideaspace where there is less competition and more innovative opportunity. The conceptspace is gradually filled. The space remaining indicates where the opportunities are.

2. Broad. To identify broader areas of the ideaspace with game changing concepts that replace all pre existing niche or specialist solutions.

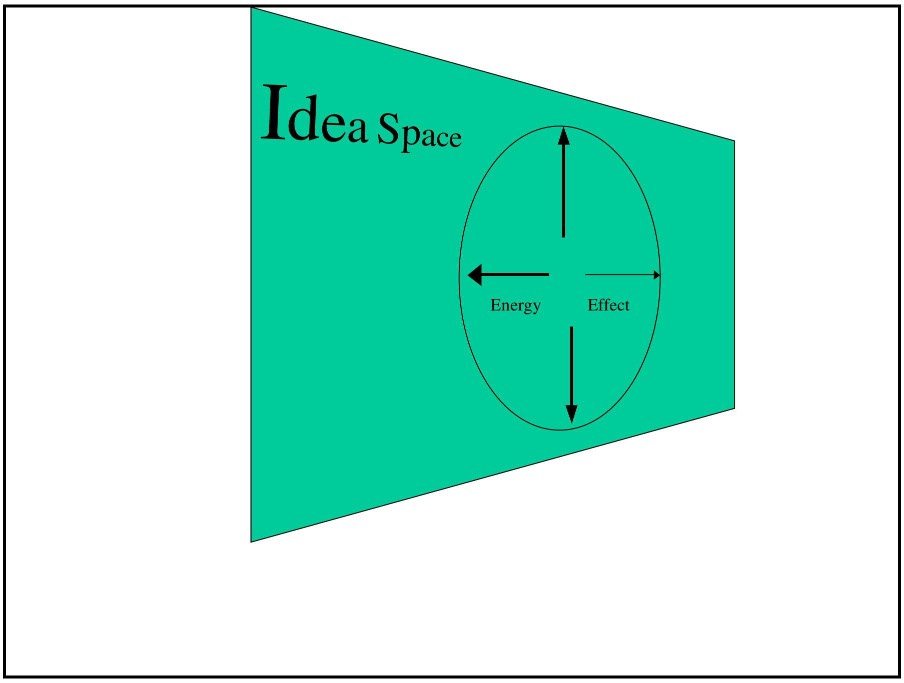

Figure 10 Ideaspace

The product trajectory in the ideaspace is delimited by a spider diagram that represents each of the elements that produce benefits. Enhancing each element pushes out the product trajectory boundaries. You need to identify as many elements as possible that together can push back the product trajectory boundaries to occupy either a specialist or broad ideaspace.

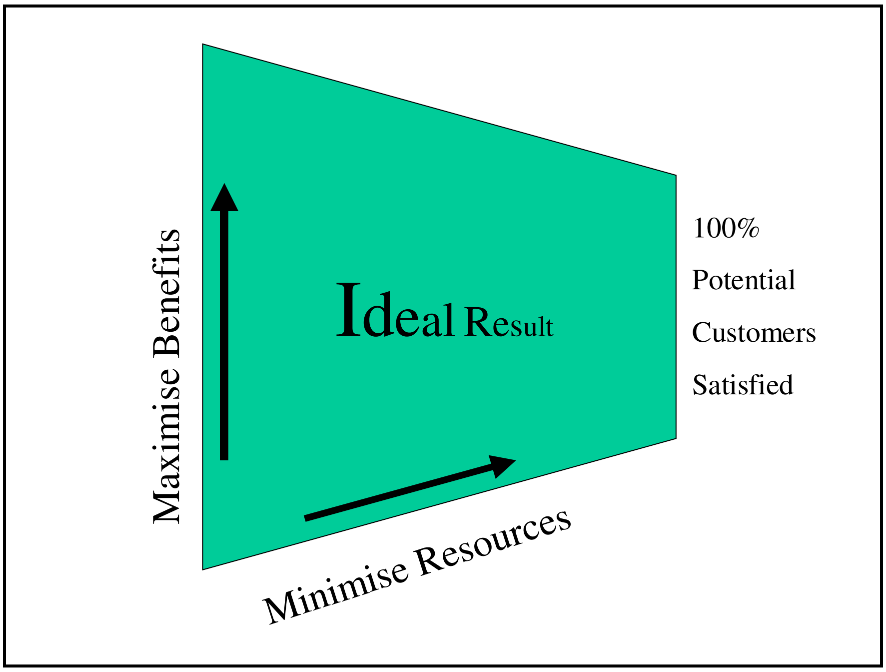

Figure 11 Ideal Final Result Target

The objective of the product ballistics activity is to identify product opportunities that can project a large footprint onto the Ideal result target card. The Ideal Result target card is on the horizon of the innovation continuum. The ideal result

- Asks the question,
- Aligns the target,
- Constrains the objective and
- Sets the vision.

PRODUCT BALLISTICS – DUSTPAN TARGET CARD EXAMPLE SERIES

The first card shown is the vision card – the Ideal Final Result for the product ballistic series.

What is the ideal, within the constraints, that could be used by a dustpan replacement to deliver cleaning? The opportunity space remaining we have called the idealspace. The idealspace also includes a wider area outside of the metrics shown in the polygon. This wider area is further opportunity space for other products able to meet the constraints.

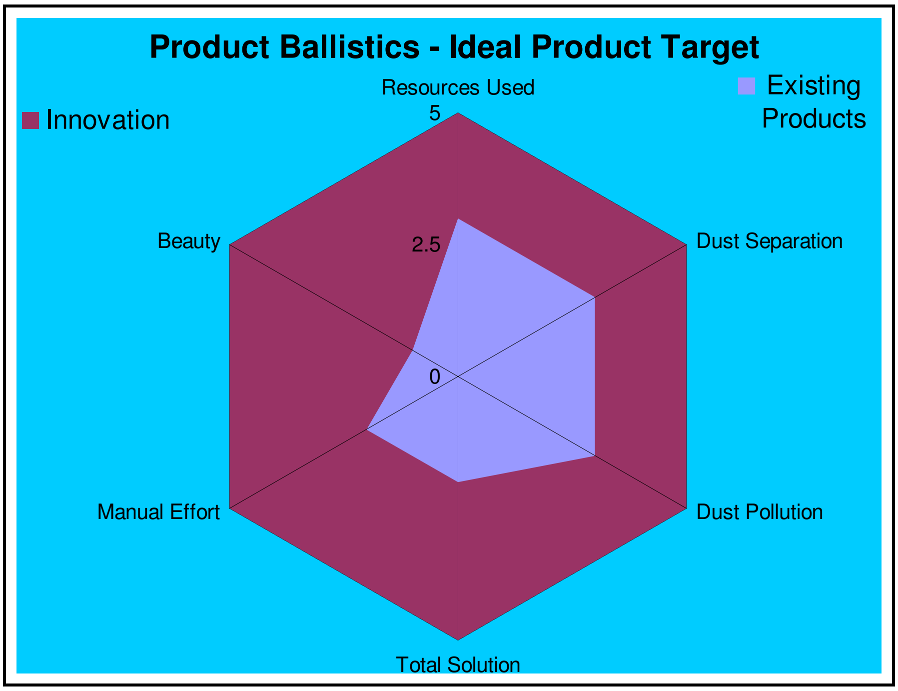

Figure 12 Ideal Product Target

The result can only be considered against the the constraints applied to the market for the original product. The constraints in the case of the Dustpan and Brush are shown in the second card.

Constraints are actually the most positive aspect of the innovation ballistic. Constrainst should exclude unacceptable designs that customers would not consider in this product trajectory (Dustpan replacements). The alternative would be to be completely in the dark as to which analogy to match against the multitude of customer wants.

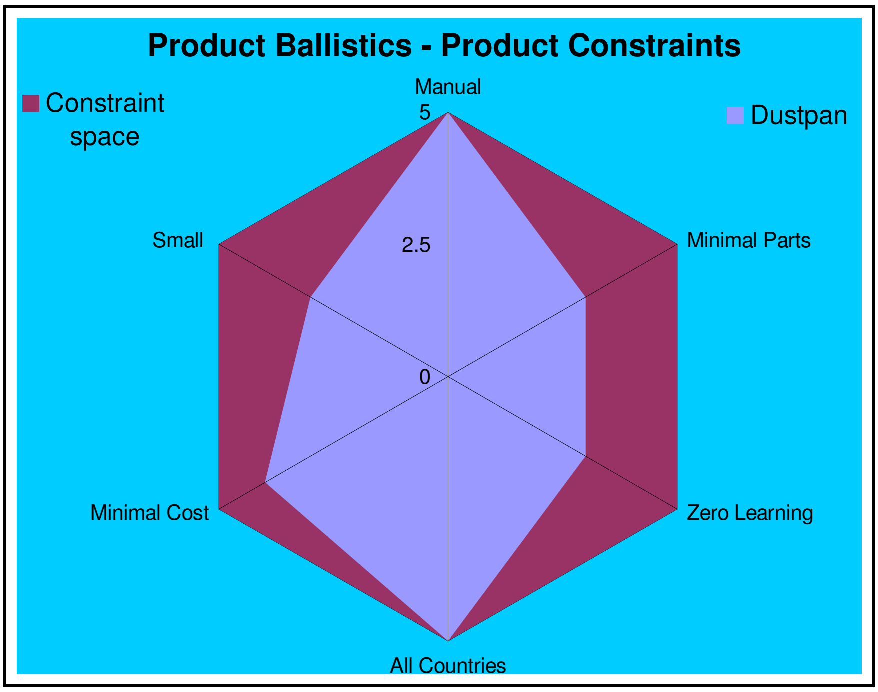

Figure 13 Product Constraints

What effects, within the constraints, are being used by a dustpan to deliver cleaning? The opportunity space remaining we have called the effectspace. The effectspace also includes the wider area outside of the polygon. This wider area is further opportunity space for other effects not presently used by the dustpan but able to meet the constraints.

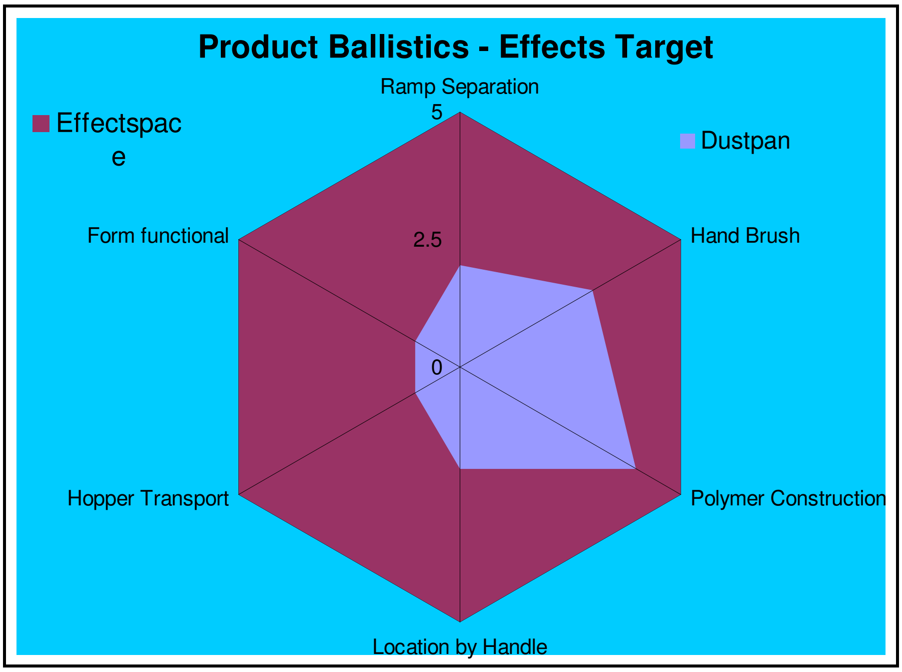

Figure 14 Effects Target

What analogy types, within the constraints, are being used by a dustpan to deliver cleaning? The analogy target groups the categories of analogy that the product uses. The opportunity space remaining we have called the analogyspace. The analogyspace also includes the wider area outside of the polygon. This wider area is further opportunity space for other analogy types not presently used by the dustpan but able to meet the constraints. This is the engine room of the product ballistics where usable options are generated.

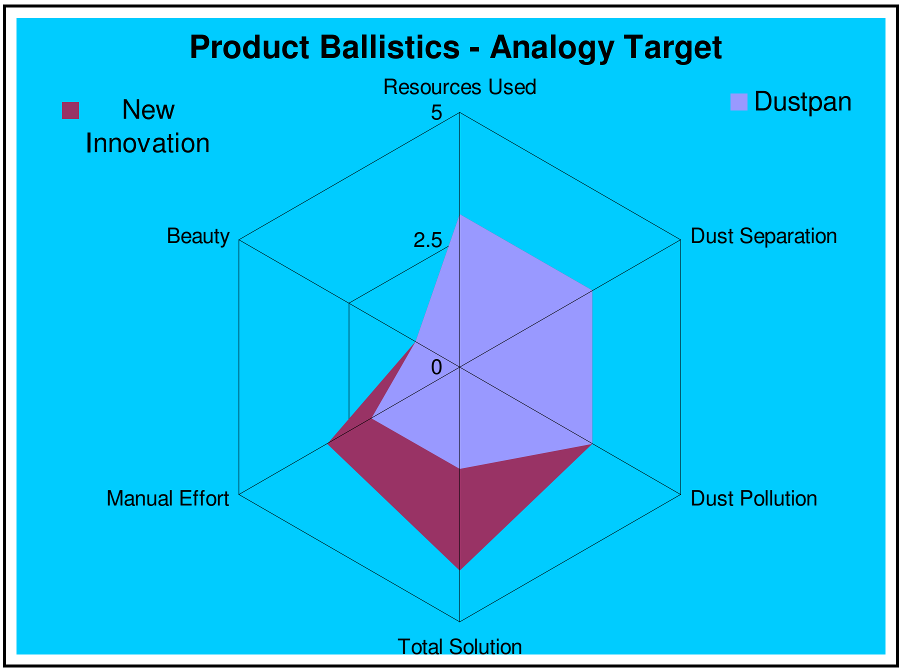

Figure 15 Analogy Target

What concept types, within the constraints, are being used by a dustpan to deliver cleaning? The analogy target groups the categories of analogy that the product uses. The opportunity space remaining we have called the conceptspace. The conceptspace also includes the wider area outside of the polygon. This wider area is further opportunity space for other concept types not presently used by the dustpan but able to meet the constraints. The concepts are more generalisable than the analogies but not so rarefied as laws. The concepts help bridge the gap between the theory of laws and the application of products. They translate into effects when applied further up the chain so there is no need to be precious about demarcation here.

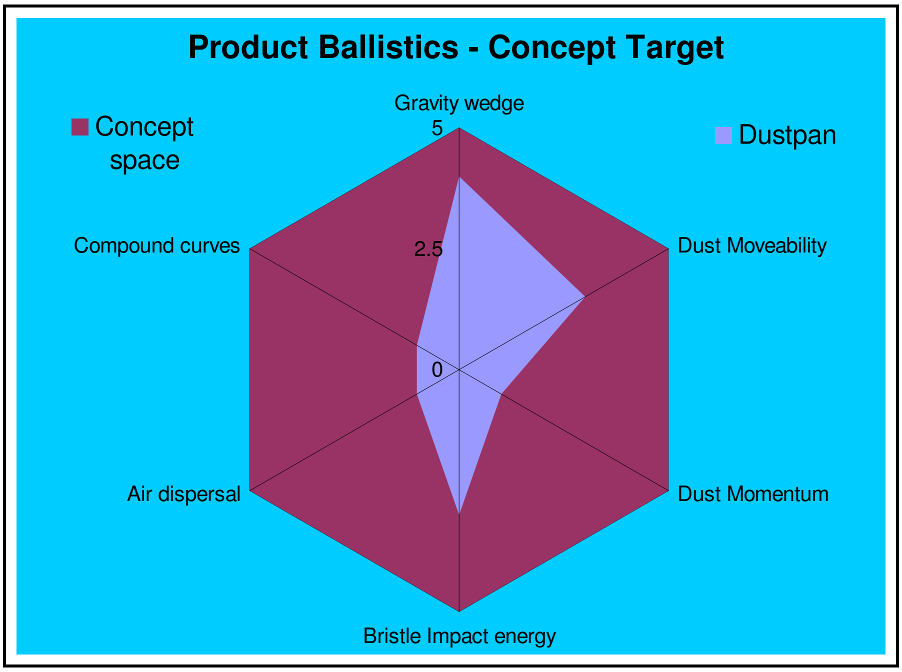

Figure 16 Concept Target

The final choice of metrics and cards is purely dependent on time, application and your tolerance for complexity. Unless the "product" is already at high theoretical level (eg A scientific development) or in a groundbreaking arena then it is best to avoid delving into phenomena and laws. Phenomena and laws have already been translated into useful concepts therefore such work can be nugatory.

Having run through a ballistic trajectory for the product of interest it should be possible to create updated cards for your innovation. The objective is simply to extend the Idealspace covered by the innovation or move the polygons axis to a new unmet target.

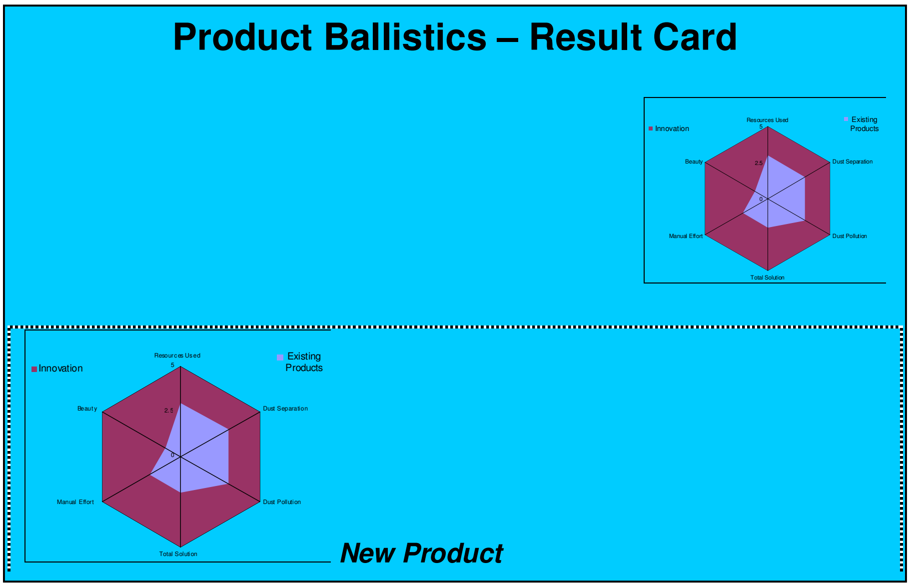

Figure 17 Result Card

Mathematical Analogies

At present, mathematics is the purest language we have for separating relations from objects. Mathematics is an analogy system, it abstracts of relations using symbolic forms. Our objective is to make innovation reproducible at will by use of analogy systems. As yet there are no mathematical formulas that can generate finished innovations because of the lack of a scientific basis for understanding but they certainly can help generate and select options. Examples include Darwinistic "survival of the fittest" algorithms and optimisation techniques like game theory.

We can use mathematical techniques to focus in on the best analogy areas by identifying the remaining ideaspace that a product, concept, or idea has. The 3d relations on the product trajectory are reduced to 2d targets or cards in order to simplify the mapping. Using set theory or linear programming we can identify the most promising areas of the remaining ideaspace for each of the chosen relations. A simple form of this was introduced by area mapping using spider diagrams on the target cards.

The benefits of Mathematical Innovation are clear from the insights table below: -

MATHEMATICAL ANALOGIES - INSIGHTS	
1	Mathematical Analogies generate options
2	Mathematical Analogies identify ideaspace
	Mathematical Analogies can provide innovation metrics
3	Mathematical Analogies define relations and exclude noise
4	Mathematical Analogies are a step towards reproducibility and a scientific base

Table 4 Mathematical Analogies Insights

Chapter.9 Idealise

Idealise	*Product: Dust Pan and Brush* *Removal of Weaknesses and Extension of Process*
What do you want it to do?	Remove dust from floors to bin without pushing dust into air.

Table 5 Idealise

Ideality and IFR

The Law of Increasing Ideality. This law states that technical systems evolve toward increasing degrees of ideality, where ideality is defined as the quotient of the sum of the **system's useful effects, divided by the sum of its harmful effects**

Useful effects include all the valuable results of the system's functioning. Harmful effects include undesired inputs such as cost, footprint, energy consumed, pollution, danger, etc. The ideal state is one where there are only benefits and no harmful effects. It is to this state that product systems will evolve. From a design point of view, engineers must continue to pursue greater benefits and reduce cost of labour, materials, energy, and harmful side effects. Normally, when improving a benefit results in increased harmful effects, a trade-off is made, but the Law of Ideality drives designs to eliminate or solve any trade-offs or design contradictions. The ideal final result will eventually be a product where the beneficial function exists but the machine itself does not. The evolution of the mechanical spring-driven watch into the electronic quartz crystal watch is an example of moving towards ideality.

Chapter.10 Transform

Transform	*Product: Dust Pan and Brush*
Idealise	Separates dust from floors
Make Concept 1	Drag Contra Rotate twin round brushes
Make Concept 2	Static charging polymer attracting dustpan
Move Concept 1	Flexible roll-up dustpan trapping
Move Concept 2	Water mist trap, liquid hold and pour away dust

Table 6 Transform

Concept Changing

The basic concepts are the laws of nature but more conveniently these have been turned into more and more specific stepping stones along the innovation continuum. At the scientific end, concepts have universal applicability but no application detail. At the real world end, the concepts are incorporated into specific applications that are the excellent 3 dimensional examples of possible applications you can use. The more scientific and groundbreaking you wish to be the more stepping stones you go back. The best thing about all this is that all the concepts you ever need are freely available in books, websites and brochures. The concepts cannot even be monopolised by patents, only the useful device is patentable not the idea.

To simplify things still more there are several processes that help generate ideas by using the mind's unique pattern making abilities.

Make and Move

Remember innovations are just make and move machines. You need only explain the concepts used to make its useful outcome and move it.

Whether innovation is in transport, television pictures, or take over bids, realisation will involve just two stages - make and move. Innovation is the art of conceiving "make and move" machines. A car is built then transported to customers, a television picture is shot and transmitted, take over bids are created then released.

All things “make and move”. Nothing less, nothing more. Things are made then moved for use and continue to make and move during their life.

The aim of innovation is to design these machines to make more with less.

Perspective

Figure 18 Perspective

Perspective in theory of cognition is the choice of a context or a reference (or the result of this choice) from which to sense, categorise, measure or codify experience, typically for comparing with another. One may further recognize a number of subtly distinctive meanings, close to those of point of view, Weltanschauung, or paradigm.

To choose a perspective is to choose a value system. When we look at a business perspective, we are looking at a monetary base values system. When we look at a human perspective, it is a more social value system.

The design methodology utilises attention focusing "perspectives" to increase innovation and allow for the difference in reality depending on personal narrative, perception, and aspect. Selection of perspective is dependent on the stage, business philosophy, risk return attitude and familiarity.

In innovation a vantage point for the perspective is selected. A vantage point is a position that affords a broad overall view or perspective, as of a place or situation.

Perspective enables the innovator to instantly access sets of analogies. Perspective is the viewpoint of an actor within the process such as a teenage customer, a specialist or a combination character. The advantage of taking perspectives is that it affords an holistic, animated, and end to end process input into the transformation.

In our example, we might think how the Dustpan might be difficult to use by a frail older person bending to clear up breadcrumbs from the kitchen floor.

Effects Database

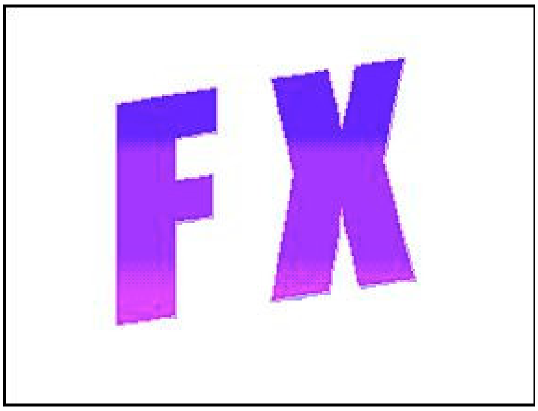

Figure 19 Effects

Reuse is the key to innovation. Little, if anything, is ever designed that doesn’t incorporate past principles and concepts. The effects database takes useful concepts from the past and states their useful effects in a reusable way. The effects can be anything in the field of innovation that can be used in make and move machines.

In our example the effect of static electricity that can build up from rubbing a non conducting material like a plastic dustpan might well be of interest.

Principles

Conceptualise

IS IT USEFUL?

WORK BACKWARDS FROM THE RESULT

MAKE MORE WITH LESS

Idealise

IFR IDEAL FINAL RESULT

THINK OF 10 IDEAS CHOOSE 1.

ONLY MAKE WHAT YOU CAN'T STEAL

CREATE OPTIONS.

PRE-EMPT THE FUTURE.

REUSE EVERYTHING

Transform

INVISIBLE INNOVATIONS

MASSIVELY PARALLEL WORKING

NEXT TIME FASTER

Chapter.11 Appendix

Source methods

FWTC

An alternative breakthrough business improvement methodology. The Fastest way to certainty encapsulates the Customer story in the fewest steps possible to meet their needs. By applying many differing perspectives, the Fastest way to certainty approach, builds a funnel that turns Customer opportunities into certainties.

Fastest way to certainty is the corollary of the approach given in this book. Whereas both operate in the innovation continuum, Fastest way to certainty starts with the World and works forward to certainty rather than starting with certainty (a product), as we do here. Refer FWTC Fastest way to certainty 2005 for further details.

QFD - Quality Function Deployment

Quality Function Deployment is the best approach for linking the objectives of inbound marketing with the requirements of engineering - in other words, converting customer wishes into specific corporate goals so that product/process designers know the right things to do. Voice of the Customer is the cornerstone of developing any winning product or service, and how to gather the VOC is one of the biggest differences between QFD and traditional practices. Traditionally, companies utilize marketing and customer service functions to obtain customer information - their wants and don't wants (complaints). While this information is important, it does not address the whole picture .

Based on the Kano Model in QFD, there is a lot more than what the customers are saying. The Kano Model was developed by Dr Kano in Japan while he was researching customer requirements for commercial airliners. The Kano Model is an axes system where the horizontal axis represents the level of a company's fulfilment regarding a given customer want - not fulfilled at all on the left side to fulfilled completely on the right side - and the vertical represents the degree of customer satisfaction - very satisfied at the top to very dissatisfied at the bottom .

Synectics

Synectics is an problem solving approach (rather method or system) consisting of problem-stating and problem-solution based on creative thinking that involves free use of metaphor and analogy in informal interchange within a carefully selected group of individuals of diverse personality and areas of specialisation.

Synectics is a relatively unknown problem solving approach that stimulates thought processes of which the subject is generally unaware. This method, developed by William Gordon, has as its central principle: "Trust things that are alien, and alienate things that are trusted." This encourages, on the one hand, fundamental problem-analysis and, on the other hand, the alienation of the original problem through the creation of analogies. It is thus possible for new and surprising solutions to emerge. Synectics is more demanding of the subject than brainstorming, as the many steps involved mean that the process is more complicated and requires more time and effort.

PROCEDURE

Analysis and definition of the problem

Spontaneous solutions

Reformulation of the problem

Creation of direct analogies

Personal analogies (identification)

Symbolic analogies (contradictions)

Direct analogies

Analysis of the direct analogies

Application to the problem

Development of possible solutions

Triz

40 Innovation principles.

By Genrich S. Altshuller, born in the former Soviet Union in 1926. His first invention, for scuba diving, was when he was only 14 years old. His hobby led him to pursue a career as a mechanical engineer. Serving in the Soviet Navy as a patent expert in the 1940s, his job was to help inventors apply for patents. He found, however, that often he was asked to assist in solving problems as well. His curiosity about problem solving led him to search for standard methods. What he found were the psychological tools that did not meet the rigors of inventing in the 20th century. At a minimum, Altshuller felt a theory of invention should satisfy the following conditions:

1. be a systematic, step-by-step procedure

2. be a guide through a broad solution space to direct to the ideal solution

3. be repeatable and reliable and not dependent on psychological tools

4. be able to access the body of inventive knowledge

5. be able to add to the body of inventive knowledge

6. be familiar enough to inventors by following the general approach to problem solving

Altshuller screened over 200,000 patents looking for inventive problems and how they were solved. Of these (over 1,500,000 patents have now been screened), only 40,000 had somewhat inventive solutions; the rest were straight forward improvements. Altshuller more clearly defined an inventive problem as one in which the solution causes another problem to appear, such as increasing the strength of a metal plate causing its weight to get heavier. Usually, inventors must resort to a trade-off and compromise between the features and thus do not achieve an ideal solution. In his study of patents, Altshuller found that many described a solution that eliminated or resolved the contradiction and required no trade-off.

Altshuller categorised these patents in a novel way. Instead of classifying them by industry, such as automotive, aerospace, etc., he removed the subject matter to uncover the problem solving process. He found that often the same problems had been solved over and over again using one of only forty fundamental inventive principles. If only later inventors had knowledge of the work of earlier ones, solutions could have been discovered more quickly and efficiently.

In the 1960s and 1970s, he categorised the solutions into five levels.

* Level one. Routine design problems solved by methods well known within the speciality. No invention needed. About 32% of the solutions fell into this level.

* Level two. Minor improvements to an existing system, by methods known within the industry. Usually with some compromise. About 45% of the solutions fell into this level.

* Level three. Fundamental improvement to an existing system, by methods known outside the industry. Contradictions resolved. About 18% of the solutions fell into this category.

* Level four. A new generation that uses a new principle to perform the primary functions of the system. Solution found more in science than in technology. About 4% of the solutions fell into this category.

* Level five. A rare scientific discovery or pioneering invention of essentially a new system. About 1% of the solutions fell into this category.

He also noted that with each succeeding level, the source of the solution required broader knowledge and more solutions to consider before an ideal one could be found.

What Altshuller tabulated was that over 90% of the problems engineers faced had been solved somewhere before. If engineers could follow a path to an ideal solution, starting with the lowest level, their personal knowledge and experience, and working their way to higher levels, most of the solutions could be derived from knowledge already present in the company, industry, or in another industry.

For example, a problem in using artificial diamonds for tool making is the existence of invisible fractures. Traditional diamond cutting methods often resulted in new fractures which did not show up until the diamond was in use. What was needed was a way to split the diamond crystals along their natural fractures without causing additional damage. A method used in food canning to split green peppers and remove the seeds was used. In this process, peppers are placed in a hermetic chamber to which air pressure is increased to 8 atmospheres. The peppers shrink and fracture at the stem. Then the pressure is rapidly dropped causing the peppers to burst at the weakest point and the seed pod to be ejected. A similar technique applied to diamond cutting resulted in the crystals splitting along their natural fracture lines with no additional damage.

Altshuller distilled the problems, contradictions, and solutions in these patents into a theory of inventive problem solving which he named TRIZ.

De Bono

Maltese Physician Edward De Bono (born 1933) writes prolifically on the subject of thinking and conducts training in the same field. Many people know him as having coined the term lateral thinking, of which they consider him the pioneer.

In 1969 De Bono founded the Cognitive Research Trust (CoRT) which continues to produce and promote material based on his ideas. He has written "62 books with translations into 37 languages". He has spent the last 30 years teaching thinking, including working with governments, corporations, organisations and individuals, speaking publicly or privately on many matters. He has started to set up SITO - the 'Supranational Independent Thinking Organisation' based in Malta, which he describes as a "kind of intellectual Red Cross".

De Bono has detailed a range of 'deliberate thinking methods' - applications emphasizing thinking as a deliberate act rather than a reactive one. He uses a clear and practical writing style. Avoiding academic terminology, he has advanced applied psychology by making theories about creativity and perception into usable tools. He does not reference others' epistemology, preferring instead to build upon his own (the main tenets in his book The Mechanism of the Mind (1969) underpin all his subsequent work). This self-referential style has helped define the published genre of popular psychology.

De Bono's work has become particularly popular in the sphere of business - perhaps because of the perceived need to restructure corporations, to allow more flexible working practices and to innovate in products and services. The methods have migrated into corporate training courses designed to help employees and executives ' think outside the box'.

De Bono has a network of trainers who administer officially-trained De Bono thinking methods, but many other trainers will use them or parts of them even when not specifically trained..

Buzan

Tony Buzan (1942-) is the original promoter of mind mapping and coined the term mental literacy. He was born in London and received double Honours in psychology, English, mathematics and the General Sciences from the University of British Columbia in 1964. He is probably best known for his book, Make the Most of Your Mind, his promotion of mnemonic systems and his mind-mapping techniques.

Following his 1970s series for the BBC, many of his ideas have been set into his series of five books: Use Your Memory, Master Your Memory, Use Your Head, The Speed Reading Book and The Mind Map Book.

He has gained somewhat of a cult following due to his evangelical and promotional vision of world mental literacy, spiritual intelligence, and sensual intelligence, among other controversial topics such as mental stimulation through sensuality, synchronization of left and right brain, and the belief in intellectual abundance. As such, he is often known as the "mind map guru". A great deal of his ideas have originated in debunked pseudoscience, and more recently, the rhetorical re-definition of multiple intelligences by Howard Gardner.

Clayton Christensen - 4 Paradigms

No single paradigm has emerged in the study of patterns of innovation that would enable all researchers or managers to predict with certainty how technology is likely to evolve or what types of companies are likely to emerge victorious from innovative battles of various sorts.

Clayton Christensen

Christensen, like many innovation authors, uses studies as the base for his work. This eliciting of innovation principles by historical review to has enviably held innovation in a pseudo scientific loop. The very “experts” who you would hope could nail down the scientific basis for the discipline, have held views that support the artistic paradigm.

These are the weather forecasters or worse still, shaman of innovation. Describing innovation as a chaotic and complex event that rolls in under certain meteorological conditions, like a winter weather front. The worst are pleased to produce endless HBS or Business Week articles extolling the wonders of innovation snake oil and forecasting last years innovation weather in a mythical land where companies can think. They only consider the situation at the corporate level because they consider innovation has no existence on the scale of the individual. It needs to be agglomerated into a volume that subsumes the chaotic nature into industry generalisations. The innovation weathermen have overlooked the fact that companies don’t think or innovate. A company is just a legal name for a lot of individuals who like to sit together and do stuff. It is a long way from the Borg or the Collective. They all think for themselves and if they don’t understand innovation, they can’t do it. The weathermen hold out no hope of understanding this deterministic & driven form of innovation, only to tap the barometer of change to see what macro conditions blew in the latest weather.

Having said all that, as a weatherman Christiansen is one of the best. He may not, like us, be looking for the laws or even the source patterns like De Bono or Altschuller but he can spot a fair weather for innovation in any industry.

His four paradigms of innovation:

1. The **dominant** design theory, which asserts that the nature of innovation shifts markedly after a dominant design has emerged.

2. The technology **s-curve** theory, which states that the pace of performance improvement utilising a particular technological approach will follow an S-curve pattern, flattening as certain natural limits to further improvement are reached. Theories of punctuated equilibrium are related to movement along a technology S-curve, intersected occasionally by a new S-curve.

3. The theory that patterns of innovation are determined by intersecting **trajectories** of performance demanded in the market, vs. performance supplied by technologists.

4. The study of how **modularization** of design can create options for the future, how it affects the optimal scope of the firm, and how it changes the nature of the competitive advantages that can and cannot be developed.

Dominant design:

An explicit or de facto industry-wide standard architectural configuration of the components in an assembled product, in which the ways in which components interface with others in the product's architecture is well understood and established.

Modularization:

A process by which the way that components and subsystems within an assembled product interact with each other becomes so well understood that standards emerge, defining how each component must interface with others in the system. When these standard interfaces exist, components and subsystems from multiple suppliers can be mixed and matched in designing and assembling a product, with predictable results for final system performance.

Although I know of no studies that measure this phenomenon directly, I suspect that the industry of designing and assembling personal computers was very nearly in this situation in the early and mid-1990s. The components from which they were built interfaced with each other according to such well-established standards that it was difficult for any manufacturer to sustainably assert that they offered proprietary cost-performance advantages in their products.

Punctuated equilibrium:

A model of progress in which most of an industry's history is characterised by relatively steady, incremental, predictable improvement. This predictability is occasionally interrupted, or "punctuated", by brief, tumultuous periods of radical, transformational change.

S-curves:

An empirical relationship between engineering effort and the degree of performance improvement achieved in a product or process. The improvement produced by an incremental unit of engineering effort typically follows an S-curve pattern.

Disruptive Technology?

A disruptive technology is a new technological innovation, product, or service that eventually overturns the existing dominant technology in the market, despite the fact that the disruptive technology is both radically different than the leading technology and that it often initially performs worse than the leading technology according to existing measures of performance. A disruptive technology comes to dominate an existing market by either filling a role in a new market that the older technology could not fill or by successively moving up-market through performance improvements until finally displacing the market incumbents.

Disruptive technology, was a concept put forth by Harvard Business School professor Clayton Christensen and explained in his book The Innovator's Dilemma. A disruptive technology is defined as a low-performance, less expensive technology that enters a heated-up scene where the established technology is outpacing people's ability to adapt to it. The new technology gains a foothold, continues to improve, and then bumps the older, once-better technology into oblivion. Sounds good. The problem is that there is not one example of this ever happening. The theory goes on and on, with a seemingly reasoned explanation of how this unfolds. Christensen says the idea stems from his fascination with the collapse of Digital Equipment Corp. The microcomputer came along as the cheap, inferior, disruptive technology, eventually supplanting the mini. No matter that HP, IBM, and Sun continued to prosper selling "minicomputers"

The microcomputer was never a "less expensive" and "inferior" replacement for minicomputers. It was a more expensive and superior replacement for calculators and slide rules. It was never used "instead of" a minicomputer (or mainframe for that matter) but "in addition to." Even the spreadsheet, which is what actually made the desktop computer popular, had no real antecedent except a pad and pen. It didn't replace anything better.

Dawkins

Meme

British biologist and author, introduced the concept of a "meme" in The Selfish Gene (Oxford Univ. Press, 1976). With Oliver Goodenough, interpreted a DL letter using viral analogies ("The St. Jude Mind Virus," Nature, Sept. 1, 1994).

As defined in The Selfish Gene "a unit of cultural transmission, or a unit of imitation." "Examples of memes are tunes, ideas, catch-phrases, clothes fashions, ways of making pots or of building arches. Just as genes propagate themselves in the gene pool by leaping from body to body via sperms or eggs, so memes propagate themselves in the meme pool by leaping from brain to brain via a process which, in the broad sense, can be called imitation.

Induced innovation

Induced innovation is a macroeconomic hypothesis first proposed in 1932 by Dr. J. R. Hicks in his work The Theory of Wages. He proposed that "a change in the relative prices of the factors of production is itself a spur to invention, and to invention of a particular kind—directed to economising the use of a factor which has become relatively expensive."

Considerable literature has been produced on this hypothesis, which is often presented in terms of the effects of wage increases as an encouragement to labour-saving innovation. The hypothesis has also been applied to viewing increases in energy costs as a motivation for a more rapid improvement in energy efficiency of goods than would normally occur.

Innovation diffusion

Diffusion is the process by which a new idea or new product is accepted by the market. The rate of diffusion is the speed that the new idea spreads from one consumer to the next.

MODELS OF DIFFUSION

There are several theories that purport to explain the mechanics of diffusion:

1) The two-step hypothesis - information and acceptance flows, via the media, first to opinion leaders, then to the general population

2) The trickle-down theory - products tend to be expensive at first, and therefore only accessible to the wealthy social strata - in time they become less expense and are diffused to lower and lower strata

3) The Everett Rogers Diffusion of innovations theory - for any given product category, there are five categories of product adopters:

innovators

venturesome, educated, multiple info sources

early adopters

social leaders, popular, educated

early majority

deliberate, many informal social contacts

late majority

sceptical, traditional, lower socio-economic status

laggards

neighbours and friends are main info sources, fear of debt

4) Crossing the Chasm model developed by G. Moore - This is basically a modification of Everett Rogers' theory applied to technology markets and with a chasm added. According to Moore, the marketer should focus on one group of customers at a time, using each group as a base for marketing to the next group.

The most difficult step is making the transition between visionaries (early adopters) and pragmatists (early majority). This is the chasm that he refers to. If successful a firm can create a bandwagon effect in which the momentum builds and the product becomes a defacto standard.

5) Technology driven models - These are particularly relevant to software diffusion. The rate of acceptance of technology is determined by factors such as ease of use and usefulness.

THE RATE OF DIFFUSION

According to Everett M. Rogers, the rate of diffusion is influenced by:

the product's perceived advantage or benefit

riskiness of purchase

ease of product use - complexity of the product

immediacy of benefits

observability

trialability

price

extent of behavioural changes required

return on investment in the case of industrial products

DIFFUSION RATE MODELS

There are several types of diffusion rate models:

1) Penetration models - use test market data to develop acceptance equations of expected sales volume as a function of time - Three examples of penetration models are:

Bass trial only model

Bass declining trial model

Fourt and Woodlock model

2) Trial/Repeat models - number of repeat buyers is a function of the number of trial buyers

3) Deterministic models - assess number of buyers at various states of acceptance - later states are determined from calculations to previous states

4) Stochastic models - recognize that many elements of the diffusion process are unknown but explicitly incorporate probabilistic terms

Tools for Thinking

Robert Root-Bernstein and Michele Root-Bernstein at the University of Michigan actually disagree with the premis of this book in a very odd way. They actually propose consider:-

"The emotional, intuitional, pre-verbal nature of creative thinking does not place it beyond comprehension. Just as logic and language build upon skills that can be learned and practiced, so does intuition. Hundreds of autobiographical and archival sources, interviews, and formal psychological studies reveal that every creative person uses some subset of a common imaginative 'tool kit'."

They actually go on to propose tools that can be used to enhance intuition. Whilst this seems strange to codify structured methods that create supposedly inherrent skills, all assistance is gratefully received

This tool kit consists of thirteen pre-logical, pre-verbal skills:

(1) observing;

(2) imaging;

(3) abstracting;

(4) pattern recognizing;

(5) pattern forming;

(6) analogising;

(7) bodily kinesthetic thinking;

(8) empathizing;

(9) dimensional thinking;

(10) modeling;

(11) playing;

(12) transforming;

(13) synthesizing.

These tools drill into the process of analogous thinking and are helpful in expanding this theme.

OBSERVING

Observing is perhaps the first and most basic of thinking tools. As human beings we are all equipped to sense the world, but observing is a skill that requires additional patience, concentration and curiosity. The American painter Georgia O'Keeffe looked carefully at things, and forces us to do so, too, in her very large paintings of flowers. "Still—in a way—" she said, "nobody sees a flower—really—it is so small—we haven't the time—and to see takes time, like to have a friend takes time". Observing is paying close attention to what is seen, but also what is heard, touched, smelled, tasted and felt within the body. In dense jungles, biologists such as Jared Diamond observe and identify birds by sound; in the absence of sight, the blind biologist Geermat Vermeij observes seashells with his hands, by touch; bacteriologists and doctors observe bacteria by smell; chemists and doctors have— historically at least—observed sugar in the urine by taste. Inventors and engineers, and the mechanics they rely on, similarly observe kinesthetically by cultivating hands-on experience with tools and machines—they know how tightly the nut is screwed onto the bolt by the feel of it.

IMAGING

Imaging, also a primary thinking tool, depends upon our ability to recall or imagine the sensations and feelings we observe in the absence of external stimulation. We can image visually and also aurally, and with smells, tastes, tactile and muscular feelings as well. If you can close your eyes and see a thing, or imagine the taste, touch, smell, or sound of it when it is not present, then you are imaging. For example, those of us who are already good at visualizing can close our eyes and see a triangle—and if we're practiced, we can make it change color and dimension, rotate it, etc. And if we're really good at visualizing, we can imagine an object with a triangular profile from all sides—or the much more complex object Charles Steinmetz, inventor of electrical generators, was asked to envision. A group of colleagues at General Electric once approached him with a problem they could not solve: “If you take a rod two inches in diameter and cut it (in half) by drilling a two-inch hole through it, what is the cubic content of the metal that’s removed?” Steinmetz was able to answer the question quickly, first by visualizing the removed core, then by applying equations that calculated its volume. Such visualizing, Eugene Ferguson argues in Engineering and the Mind’s Eye, plays a central role in engineering and invention. Without it, the engineer cannot foresee the invention he wishes to make. By the same token, the chef cannot foretaste the delicacy she wishes to create in the absence of imaging; the musician cannot forehear the symphony she wishes to write down.

ABSTRACTING

Abstracting is yet another important thinking tool. Because sense experience and sense imagery are so rich and complex, creative people in all disciplines use abstracting to concentrate their attention. Abstracting means focusing on a single property of a thing or process in order to simplify it and grasp its essence. Scientists and engineers work with abstractions all the time, for instance stripping a physical situation of all extraneous characteristics such as shape, size, color, texture, etc. and zeroing in on point mass, spring and distance. “I’ll tell you what you need to be a great scientist” says physicist Mitchell Wilson.

“You have to be able to see what looks like the most complicated thing in the world and . . . find the underlying simplicity”. Similarly, in the arts, abstracting means choosing which simplicity captures the essence of some concrete reality. Pablo Picasso tells us how: To arrive at abstraction, it is always necessary to begin with a concrete reality You must always start with something. Afterward you can remove all traces of reality And he does just that in a series of etchings called ‘The Bull’. Searching for the essence of bull, its minimal suggestion, he finally finds it in the simple linear description of its tellingly distorted shape, the tiny head surmounted by enormous horns, the massive body balanced by a short, hanging tail. Abstracting often works in tandem with patterning, a tool with two parts. We organize what we see, hear, or feel by grouping things all the time. Sometimes we do so visually, as in a quilt or a graph, but of course, we can group things with all our senses.

Pattern Recognising

Recognising patterns means perceiving a (repetitive) form or plan in apparently random sets of things and processes, whether in the natural world or in our man-made world. While the ability to recognize faces, and patterns that look like faces, seems to be ingrained in every normal human being, recognising patterns is often influenced by culture. Westerners are inclined to hunt for a linear, back and forth, or up and down arrangement of information and our tables, graphs, books, and even architecture mirrors this predilection. Thus, although spirals are a common natural form (snails, sea shells, tornadoes, pinecones, whorls of hair on head), Westerners seldom use this pattern to design buildings, graphs or tables. Culture therefore plays a major role in what patterns we recognize and expect to perceive.

Pattern Forming

Recognising patterns is also the first step toward creating new ones. Novel pattern forming always begins by combining two or more elements or operations in some consistent way that produces a (repetitive) form. For instance, the pattern found in 'watered' silk is created by folding the fabric at a slight bias and then pressing it under high heat and steam with great force. This process imprints the rectilinear pattern of the warp and woof of each fold of the fabric onto the opposing material at a slight offset. The result is what is known as a Moiré pattern. Such Moiré patterns can be produced by overlapping almost any regular grid over another, as when we look through two window screens or two sections of link fencing. The creation of novel Moiré patterns is limited only by the imagination of the individual choosing what regular patterns to overlay. Pattern forming is also at work when engineers design complex machines. There are only a very small number of basic machines—levers, wheels, screws, cogs and so forth—from which every mechanical device is constructed. Technological invention is the process of forming new patterns with simpler components by combining elements and operations in novel patterns.

Analogising

Recognising and forming patterns leads directly to analogising, that is, recognising a functional likeness between two or more otherwise unlike things. We use analogies all the time to broaden our understanding of things. For instance, biologists often describe different bird beaks as if they work like human tools. A nutcracker and a particular bird beak may not look the same, but they function similarly and therefore are analogous. Analogy also has an important place in engineering and invention. Velcro, as no doubt everyone knows, was developed by analogy to the grasping properties of the common bur. Biomimicry, the use of nature as source of ideas, has in fact, become a well recognised method of innovation.

KINAESTHETIC THINKING

One of the more striking, recent examples of bio-analogy in architecture and engineering is the Gateshead Millennium Bridge. Chris Wilkinson Architects in Great Britain took the human eyelid for its analogical model and designed a drawbridge that works like the eyelid. When the 'lid' is closed, the bridge is down and people can move across. When a ship approaches, the lid is raised and ships can pass under the resulting arch. While reading the above description of the Gateshead Bridge, you may have paid unusual attention to the way your eyelid functions and feels. This is an example of body or kinaesthetic thinking. Body thinking means just that: thinking with the body. It is based upon sensations of muscle, sinew and skin—sensations of body movement, body tensions, body balance, or, to use the scientific term, proprioception. For instance, if you can imagine how it feels in your hand to set various gears in motion, if you can imagine in your muscles how they feel in motion, you are thinking with your body. Charles 'Boss' Kettering, director of research at General Motors for many decades, is said to have chided his engineers when they became overly analytical and mathematical. Always remember, he told them, "what it feels like to be a piston in an engine". Cyril Stanley Smith, the chief metallurgist for the Manhattan Project, clearly understood his creative debt to body thinking: In the long gone days when I was developing alloys, I certainly came to have a very strong feeling of natural understanding, a feeling of how I would behave if I were a certain alloy, a sense of hardness and softness and conductivity and fusibility and deformability and brittleness—all in a curiously internal and quite literally sensual way.

The same kinaesthetic and tactile imagination is at work, too, in what is often considered the abstract reasoning of mathematics. The mathematician Stanislaw Ulam said he calculated "not by numbers and symbols, but by almost tactile feelings . ". While at work on the atomic bomb at Los Alamos he imagined the movements of atomic particles visually and proprioceptively, feeling their relationships with his whole body well before he was able to express the quantum equations in numbers. This same muscular sense for the body in motion may also provide insight into engineering and architecture. At Princeton University one architecture student recently combined a dance production called 'The Body and the Machine' with a senior thesis, explaining that "exploring conceptual issues (in architecture) kinetically helps me understand them".

EMPATHISING

Empathising, our next tool, is related to body thinking, for this imaginative skill involves putting yourself in another's place, getting under their skin, standing in their shoes, integrating 'I' and 'it', feeling the objective world subjectively. Empathising with other people, with animals, with characters on stage or in a book is standard fare for novelists, actors, and even physicians. But artists and scientists also empathise with non human, even non-animal things and processes. Isamu Noguchi reified this sort of empathy in his sculpture, 'Core', a piece in basalt with carved holes. "Go ahead", he told visitors to his studio. "Put your head into it. Then you will know what the inside of a stone feels like". By putting her head 'in there', focusing her attention at the level of the corn chromosomes she studied, Nobel laureate Barbara McClintock was able to develop a 'feeling for the organism' so complete that she described herself as being down inside her preparations, and their genes became her 'friends'. And astrophysicist Jacob Shaham talked of 'reading' his equations like scripts for a play in which the 'actors'—energy, mass, light and so on— have intents and motives that he could physically act out.

DIMENSIONAL THINKING

Yet another tool that we most often learn unconsciously is dimensional thinking, rooted in our experience of space and time. Creative individuals think dimensionally when they alter the scale of things, as artists Claes Oldenburg and Coosje van Bruggen did in their Bat column in Chicago. Their ten-story-high rendition of a baseball bat strikes us very differently than the three-foot version. As any architect knows, size and mass can be altered to convey anything from flowery delicacy to dominating power. Moreover, the engineering of scale changes can be complex: different structural designs and different materials are almost certainly required as artist-engineers work dimensionally with properties such as strength and durability. Inventive individuals also think dimensionally when they map things that exist in three dimensions onto two dimensions, for instance in maps or blueprints. Indeed, this kind of dimensional thinking is at the heart of drawing in perspective. Artists, scientists and engineers also think dimensionally when they try to reconstruct three-dimensional phenomena from information recorded in two dimensions.

Construction engineers interpret and build three-dimensional structures from two-dimensional instructions. In fact, how we orient ourselves in space has implications for the patterns we form in two and three dimensions. Cartesian co-ordinates assume a world of right angles; polar co-ordinates map a spherical universe. Buckminster Fuller rejected both in favour of a tetrahedral coordinate system and, based upon that system, invented his geodesic dome. Each coordinate system permits us to recognize and solve a different set of problems. The tools for thinking briefly sketched up to this point are what might be called primary tools. They can be learned and practised somewhat independently, though they are always interacting. Body thinking is a kind of imaging; observing feeds into abstracting and patterning; patterning in turn merges with analogising and so forth. The last four tools for thinking, however, are clearly tools that rely upon the acquisition of primary tools and integrate them into composite tools

MODELLING

The first of these composite tools is modelling, that is, plastically representing a thing or a process in abstract, analogical and/or dimensionally altered terms. The point of modelling is to depict something real or imagined in actual or hypothetical terms in order to study its structure or function. Artists make and use models all the time by preparing maquettes, smaller conceptualisations of pieces in planning. Scientists and engineers also create simplified models of objects and processes. In the case of flight simulators, engineers model the hands-on experience of flying planes for educational purposes by imitating the reality of that experience in space and time. Molecules that can never actually be seen or touched are built millions of times their actual size out of plastic or wood. Stars, which are beyond our ability to comprehend in any realistic sense, become a series of equations describing their actions over time frames beyond the entire experience of humanity.

Modelling, as many practitioners have said, is like playing god, toying with reality in order to discover its unexpected properties.

PLAYING

Playing, of course, is itself another integrative tool that builds upon the other primary skills. We play when we do something for the fun of it, when we break or bend the rules of serious activity and elaborate new ones. Play is the exercise of our minds, bodies, knowledge, and skills for the pure emotional joy of using them. Unlike work, play has no set, serious goal; yet by encouraging fun, play is useful, for when creative individuals play with techniques and ideas they very often open up new areas of understanding through serendipitous discovery. Among the greatest of players was the sculptor Alexander Calder, whose early training was in engineering.

One manifestation of his play was a lifelong habit of designing toys for children (and for himself, too) out of wire and wood. In fact, Calder's first true success in the art world was as a result of having built himself a working model of a circus, complete with animals, props, entertainers with movable parts, a trapeze with a net and a tent. He actually played circus, too, inviting friends and acquaintances in the Parisian intelligentsia to watch him enact sights, sounds and stories under the big top. He was just having fun, yet his toys have been called a 'laboratory' for his subsequent, ground-breaking work. From movable toy figures he graduated to kinetic sculptures— hand driven, then motor-driven—and finally to free-floating mobiles. In keeping with his playful spirit, however, he always refused to call his sculpture 'art', deeming the word too serious for his intentions. Even the most serious innovations often have their origins in play. Alexander Fleming's discovery of penicillin has been traced to his hobby of collecting coloured microbes for the 'palette' with which he created microbial 'paintings' on nutrient agar.

Charles 'Fay' Taylor, the MIT engineer who made major strides in automotive engine design, explored mechanical objects by playing with kinetic sculptures. And Nobel laureate Richard Feynman said that his Nobel-winning work in quantum mechanics began when he started playing with the rotation of plates thrown in the air. Play teaches us that how one learns something has no bearing on the importance of the lesson learned. What counts is the practice gained in extending the abilities and experience of one's mind and body. What counts is the practice gained in the use of more than one thinking tool at a time.

TRANSFORMING

Playing thus feeds into yet another imaginative tool, transforming, the serial or simultaneous use of multiple imaginative tools in such a way that one tool or set of tools acts upon another. To play is to transform, for one takes an object, observes it, abstracts essential characteristics from it, dimensionally alters the scale, and then, using body skills, creates a physical or mental representation of the object with which one can play.

Take a look at any creative endeavour and you'll find such combinations of thinking tools being used to transform ideas and insights into one or more expressive languages. In order to invent strobe photography, for example, engineer Harold Edgerton of MIT first transformed his mental image for a strobe light for ultrafast flash photography into a visual diagram, and then transformed the diagram into a working model. He played around with different versions of the strobe until he achieved one that matched his mental picture. Then, using his prototype, he played with set-up conditions, different kinds of subjects and motions until, finally, he transformed all these components—film, camera, strobe, subject—into the results he wanted: a photograph that was both a scientific experiment and a work of art.

In retrospect we can see that Edgerton made use of several imaginative tools: visualising, modelling, playing, and something more, too, for without the ability to translate his ideas into words, diagrams, strobe and photograph his imaginative invention of ultrafast flash photography would have come to naught. Indeed, such transformations are typical even of data, as Edward Tufte has beautifully demonstrated in his books on visual information. Every table or graph or illustrated set of instructions for assembling something is a transformation of one kind of knowledge into another.

SYNTHESISING

The necessary consequence of transformational thinking is our final mental tool: synthesising, the combining of many ways of thinking into a synthetic knowing. When one truly understands something, emotions, feelings, sensations, knowledge and experience all combine in a multimodal, unified sense of comprehension. One feels that one knows and knows what one feels. Einstein, for example, claimed that when he sailed he felt the equations of physics playing out through the interactions of the boat, the wind, and the water. He became a little piece of nature.

Similarly, artists and writers describe the creative process as a melding of sight, sound, taste, touch, smell, and emotion in which all become interwoven in an experience so powerful that they lose their sense of self. Feeling and thinking become one in a process that is often described as 'synesthetic'. Synesthesia is a neurological term that refers to the experience that some people have of seeing colours when they hear certain sounds, or perceiving tactile feelings when tasting various foods.

The Verifier approach

With the verifier approach, Gordon Rugg begins by asking experts to draw a mental map of their field. From there, he stitches together many maps to form an atlas of the universe of knowledge on the subject similar to our spider diagrams. "You look for an area of overlap that doesn't contain much detail," he says. "If it turns out there's an adjoining area which everyone thinks is someone else's territory, then that's a potential gap."

The verifier method has seven steps:

- 1) amass knowledge of a discipline through interviews and reading;
- 2) determine whether critical expertise has yet to be applied in the field;
- 3) look for bias and mistakenly held assumptions in the research;
- 4) analyse jargon to uncover differing definitions of key terms;
- 5) check for classic mistakes using human-error tools;
- 6) follow the errors as they ripple through underlying assumptions;
- 7) suggest new avenues for research that emerge from steps one through six.

Language

Innovate	Create
Machine	Idea
Brainchild	Brainwave
Notion	Perception
Vision	Design
Ideation	Inspiration
A Bluski – First new product in new field. (source Blue sky).	To Storm – Brainstorm ideas (source Brainstorm).

V8 or Visionate – To envision new ideas (source vision innovate)	Ultravez Think of something more extreme (source Spanish)
Evangineer - A person who seeks to change some aspect of society and who has the high level of technical expertise required to make that change	Disruptive
Yestertech	
Analogy	
alike, comparable, corresponding, equivalent, like, parallel, similar, uniform., contrast, difference , distinction , inequality, uniqueness, variation, variety, different, distinct, distinctive, uneven, unique, various, versatile, differ, distinguish , substitute, counterpart, couple, double , equivalence, integration, likeness, mate, mimic, model, parallel, peer, precedent, sameness, equal, even, imitative, like, symmetrical, twin, copy, echo, equalise, follow, imitate, integrate, liken, copy, comparative, typical, associate, compare	

Effects Database (extract)

ID	Element	Type	Field

Building

1916 ridge pole Effect Building

The horizontal supporting member placed along the ridge of a roof.

7165 king post truss Effect Building

A wooden roof truss having two principal rafters held by a horizontal tie beam, a king post upright between tie beam and

ridge, and usually two struts to the rafters from a thickening at the king post foot.

Chemical Engineering

4924 oxo process Effect Chemical Engineering

Catalytic process for production of alcohols, aldehydes, and other oxygenated organic compounds by reaction of olefin vapours with carbon monoxide and hydrogen.

3330 Reich process Effect Chemical Engineering

Process to purify carbon dioxide produced during fermentation; organic impurities in the gas are oxidized and absorbed, then the gas is dehydrated.

13379 Wulff process Effect Chemical Engineering

A chemical process to make acetylene and ethylene by cracking a hydrocarbon gas (for example, butane) with high-temperature steam in a regenerative furnace.

3796 low-temperature carbonization Effect Chemical Engineering

Low-temperature destructive distillation of coal to produce liquid products.

8357 wetting agent Effect Chemical Engineering

A substance that increases the rate at which a liquid spreads across a surface when it is added to the liquid in small

amounts.

12134 Reppe process Effect Chemical Engineering

A family of high pressure, catalytic acetylene-reaction processes yielding (depending upon what the acetylene reacts with) butadiene, allyl alcohol, acrylonitrile, vinyl ethers and derivatives, acrylic acid esters, cyclo octatraene, and resins.

620 Ostwald process Effect Chemical Engineering

An industrial preparation of nitric acid by the oxidation of ammonia; the oxidation takes place in successive stages to nitric oxide, nitrogen dioxide, and nitric acid; a catalyst of platinum gauze is used and high temperatures are needed.

8895 Ziegler process Effect Chemical Engineering

A process for the low-pressure linear polymerization of ethylene and stereospecific polymerization of propylene; the product is a high-density polymer or elastomer. zigzag rule

7119 MMSCFH Law Chemical Engineering

Abbreviation for million standard cubic feet per hour; usually refers to gas flow.

7118 MMSCFM Law Chemical Engineering

Abbreviation for million standard cubic feet per minute; usually refers to gas flow.

Civil Engineering

4063 Abrams' law Law Civil Engineering

In concrete materials, for a mixture of workable consistency the strength of concrete is determined by the ratio of water to

cement.

Control Systems

9428 photoelectric register control Effect Control Systems

A register control using a light source, one or more phototubes, a suitable optical system, an amplifier, and a relay to actuate control equipment when a change occurs in the amount of light reflected from a moving surface due to register marks, dark areas of a design, or surface defects.

Design Engineering

7938 star drill Effect Design Engineering

A tool with a star-shaped point, used for drilling in stone or masonry Stark number See Stefan number.

7910 ball race Effect Design Engineering

A track, channel, or groove in which ball bearings turn.

7957 ratchet tool Effect Design Engineering

A tool in which torque or force is applied in one direction only by means of a ratchet.

5776 shackle Effect Design Engineering

An open or closed link of various shapes with extended legs; each leg has a transverse hole to accommodate a pin, bolt, or the like, which may or may not be furnished.

8637 hand drill Effect Design Engineering

A small, portable drilling machine which is operated by hand.

7622 concave bit Effect Design Engineering

A type of tungsten carbide drill bit having a concave cutting edge; used for percussive boring.

10227 hinge Effect Design Engineering

A pair of metal leaves forming a jointed device on which a swinging part turns.

10175 compensated pendulum Effect Design Engineering

A pendulum made of two materials with different coefficients of expansion so that the distance between the point of suspension and center of oscillation remains nearly constant when the temperature changes.

7649 flat drill Effect Design Engineering

A type of rotary drill constructed from a flat piece of material.

7798 funnel Effect Design Engineering

A tube with one conical end that sometimes holds a filter; the function is to direct flow of a liquid or, if a filter is present, to direct a flow that was filtered.

5063 clamp Effect Design Engineering

A tool for binding or pressing two or more parts together, by holding them firmly in their relative positions. See clamping circuit.

7218 cogwheel Effect Design Engineering

A wheel with teeth around its edge.

765 double-cone bit Effect Design Engineering

A type of roller bit having only two cone-shaped cutting members. double-core barrel drill

8860	handsaw	Effect	Design Engineering

A saw operated by hand, with a backward and forward arm movement. handset

7758	Graham's pendulum	Effect	Design Engineering

A type of compensated pendulum having a hollow bob containing mercury whose thermal expansion balances the thermal expansion of the pendulum rod.

7804	pipe	Effect	Design Engineering

A tube made of metal, clay, plastic, wood, or concrete and used to conduct a fluid, gas, or finely divided solid.

12729	squeegee	Effect	Design Engineering

A device consisting of a handle with a blade of rubber or leather set transversely at one end and used for spreading, pushing, or wiping liquids off or across a surface.

1177	worm gear	Effect	Design Engineering

A gear with teeth cut on an angle to be driven by a worm; used to connect nonparallel, nonintersecting shafts.

14382	hammer	Effect	Design Engineering

1. A hand tool used for pounding and consisting of a solid metal head set crosswise on the end of a handle. 2. An arm with a striking head for sounding a bell or gong.

7244	deflection wedge	Effect	Design Engineering

A wedge-shaped tool inserted into a borehole to direct the drill bit.

13316	wheel	Prime Effect	Design Engineering

A circular frame with a hub at the center for attachment to an axle, about which it may revolve and bear a load.

Electrical

1289	electron flow	Effect	Electrical

A current produced by the movement of free electrons toward a positive terminal; the direction of electron flow is opposite to that of current.

3767	resistance material	Effect	Electrical

Material having sufficiently high resistance per unit length or volume to permit its use in the construction of resistors.

1810	film	Effect	Electrical

The layer adjacent to the valve metal in an electrochemical valve, in which is located the high voltage drop when current flows in the direction of high impedance.

14463 charge Effect Electrical

1. A basic property of elementary particles of matter; the charge of an object may be a positive or negative number or zero; only integral multiples of the proton charge occur, and the charge of a body is the algebraic sum of the charges of its constituents; the value of the charge may be inferred from the Coulomb force between charged objects. Also known as electric charge, quantity of electricity. 2. To convert electrical energy to chemical energy in a secondary battery. 3. To feed electrical energy to a capacitor or other device that can store it.

150 intrinsic contact potential difference Effect Electrical

True potential difference between two perfectly clean metals in contact.

14027 reflection loss Effect Electrical

1. Reciprocal of the ratio, expressed in decibels, of the scalar values of the volt-amperes delivered to the load to the voltamperes that would be delivered to a load of the same impedance as the source. 2. Apparent transmission loss of a line which results from a portion of the energy being reflected toward the source due to a discontinuity in the transmission

43 voltage drop Effect Electrical

The voltage developed across a component or conductor by the flow of current through the resistance or impedance of that component or conductor.

12716 resistor Effect Electrical

A device designed to have a definite amount of resistance; used in circuits to limit current flow or to provide a voltage drop. Also known as electrical resistor.

10229 voltage-current dual Effect Electrical

A pair of circuits in which the elements of one circuit are replaced by their dual elements in the other circuit according to the duality principle; for example, currents are replaced by voltages, capacitances by resistances.

4833 electron conduction Law Electrical

Conduction of electricity resulting from motion of electrons, rather than from ions in a gas or solution, or holes in a solid.

2660 amperage Law Electrical

The amount of electric current in amperes. Abbreviated amp.

2317 corona current Law Electrical

The current of electricity equivalent to the rate of charge transferred to the air from an object experiencing corona

3132 resonant resistance Law Electrical

Resistance value to which a resonant circuit is equivalent.

12268 corona discharge Prime Effect Electrical

A discharge of electricity appearing as a bluish-purple glow on the surface of and adjacent to a conductor when the voltage gradient exceeds a certain critical value; due to ionization of the surrounding air by the high voltage. Also known as aurora; corona; electric corona.

13822 principle of superposition Prime Effect Electrical

1.The principle that the total electric field at a point due to the combined influence of a distribution of point charges is the vector sum of the electric field intensities which the individual point charges would produce at that point if each acted

Electronic

7862 junction transistor Effect Electronic

A transistor in which emitter and collector barriers are formed between semiconductor regions of opposite conductivity

165 point-junction transistor Effect Electronic

Transistor having a base electrode and both point-contact and junction electrodes.

7708 enhancement-mode junction Effect Electronic

A type of gallium arsenide fieldeffect transistor in which the gate consists of the junction between the n-type gallium arsenide forming the conducting channel and p-type material implanted under a metal electrode. Abbrevate E-JFET enqueue

7773 varistor Effect Electronic

A two-electrode semiconductor device having a voltage-dependent nonlinear resistance; its resistance drops as the applied voltage is increased. Also known as voltagedependent resistor.

7774 diode matrix Effect Electronic

A two-dimensional array of diodes used for a variety of purposes such as decoding and read-only memory.

8600 electrochromic display Effect Electronic

A solid-state passive display that uses organic or inorganic insulating solids which change color when injected with positive or negative charges.

798 synchronous gate Effect Electronic

A time gate in which the output intervals are synchronized with an incoming signal.

15 grounded-grid-triode mixer Effect Electronic

Triode in which the grid forms part of a grounded electrostatic screen between the anode and cathode, and is used as a mixer for centimeter wavelengths.

7788 very high frequency tuner Effect Electronic

A tuner in a television receiver for reception of stations transmitting in the very high frequency band; it generally has 12 discrete positions corresponding to channels 2-13.

7850 Schottky transistor-transistor logic Effect Electronic

A transistor-transistor logic circuit in which a Schottky diode with forward diode voltage is placed across the base-collector junction of the output transistor in order to improve the speed of the circuit.

8412 quantum wire Effect Electronic

A strip of conducting material about 10 nanometers or less in width and thickness that displays quantum-mechanical effects such as the Aharanov-Bohm effect and universal conductance fluctuations.

10103 bulk photoconductor Effect Electronic

A photoconductor having high power-handling capability and other unique properties that depend on the semiconductor and doping materials used.

7864 point-contact transistor Effect Electronic

A transistor having a base electrode and two or more point contacts located near each other on the surface of an n-type Semiconductor.

7888 symmetrical transducer Effect Electronic

A transducer is symmetrical with respect to a specified pair of terminations when the interchange of that pair of terminations will not affect the transmission.

163 conductivity modulation transistor Effect Electronic

Transistor in which the active properties are derived from minority carrier modulation of the bulk resistivity of the semiconductor.

8026 chip resistor Effect Electronic

A thick-film resistor constructed in chip form, with metallized terminations to facilitate direct bonding on hybrid integrated circuits.

7852 unipolar transistor Effect Electronic

A transistor that utilizes charge carriers of only one polarity, such as a field-effect transistor.

7855	triode transistor	Effect	Electronic

A transistor that has three terminals.

8017	quantum well	Effect	Electronic

A thin layer of material (typically between 1 and 10 nanometers thick) within which the potential energy of an electron is less than outside the layer, so that the motion of the electron perpendicular to the layer is quantized.

786	silicon transistor	Effect	Electronic

A transistor in which silicon is used as the semiconducting material.

7866	grounded-emitter connection	Effect	Electronic

A transistor circuit in which the emitter electrode is common to both the input and output circuits; the emitter need not be directly connected to circuit ground. Also known as common-emitter connection.

12534	current regulator	Effect	Electronic

A device that maintains the output current of a voltage source at a predetermined, essentially constant value despite changes in load impedance.

11327	rate-grown transistor	Effect	Electronic

A junction transistor in which both impurities (such as gallium and antimony) are placed in the melt at the same time and the temperature is suddenly raised and lowered to produce the alternate p-type and ntype layers of rate-grown junctions. Also known as graded-junction transistor.

11330	power transistor	Effect	Electronic

A junction transistor designed to handle high current and power; used chiefly in audio and switching circuits.

11455	hot hole	Effect	Electronic

A hole that can move at much greater velocity than normal holes in a semiconductor.

11509	enhancement-mode	Effect	Electronic

A high-electron-mobility transistor in which application of a positive bias to the gate electrode is required for current to flow between the source and drain electrodes.

1165	array	Effect	Electronic

A group of components such as antennas, reflectors, or directors arranged to provide a desired variation of radiation transmission or reception with direction.

12160	rectifier stack	Effect	Electronic

A dry-disk rectifier made up of layers or stacks of disks of individual rectifiers, as in a selenium rectifier or copperoxide rectifier.

12284 surface-barrier diode Effect Electronic

A diode utilizing thin-surface layers, formed either by deposition of metal films or by surface diffusion, to serve as a rectifying junction.

70 diode-triode Effect Electronic

Vacuum tube having a diode and a triode in the same envelope. diode voltage See diode forward voltage.

9640 pulse stretcher Effect Electronic

A pulse shaper that produces an output pulse whose duration is greater than that of the input pulse and whose 432 purlin amplitude is proportional to the peak amplitude of the input pulse.

12486 magnistor Effect Electronic

A device that utilizes the effects of magnetic fields on injection plasmas in semiconductors such as indium antimonide.

10905 cavity magnetron Effect Electronic

A magnetron having a number of resonant cavities forming the anode; used as a microwave oscillator.

12610 CMOS device Effect Electronic

A device formed by the combination of a PMOS (p-type-channel metal oxide semiconductor device) with an NMOS (n-type-channel metal oxide semiconductor device). Derived from complementary metal oxide semiconductor device.

12635 electron-beam ion trap Effect Electronic

A device for producing the highest possible charge states of heavy ions, in which impact ionization or excitation by successive electrons is efficiently achieved by causing the ions to be trapped in a compressed electron beam by the electron beam's space charge. Abbreviated EBIT electron-beam lithography

12702 pulse modulator Effect Electronic

A device for carrying out the pulse modulation of a radio-frequency carrier signal.

12764 heterodyne detector Effect Electronic

A detector in which an unmodulated carrier frequency is combined with the signal of a local oscillator having a slightly different frequency, to provide an audiofrequency beat signal that can be heard with a loudspeaker or headphones; used chiefly for code reception.

12899 silicon diode Effect Electronic

A crystal diode that uses silicon as a semiconductor; used as a detector in ultra-high- and super-high-frequency circuits. Also known as silicon detector.

12900 switching diode Effect Electronic

A crystal diode that provides essentially the same function as a switch; below a specified applied voltage it has high resistance corresponding to an open switch, while above that voltage it suddenly changes to the low resistance of a closed switch.

13078 point contact Effect Electronic

A contact between a specially prepared semiconductor surface and a metal point, usually maintained by mechanical pressure but sometimes welded or bonded. point-contact diode

13174 very large scale integrated circuit Effect Electronic

A complex integrated circuit that contains between 20,000 and 1,000,000 transistors. Abbreviated VLSI circuit.

12368 solid-state device Effect Electronic

A device, other than a conductor, which uses magnetic, electri- 512 sonar boomer transducer cal, and other properties of solid materials, as opposed to vacuum or gaseous devices.

10213 electron-beam parametric amplifier Effect Electronic

A parametric amplifier in which energy is pumped from an electrostatic field into a beam of electrons traveling down the length of the tube, and electron couplers impress the input signal atone end of the tube and translate spiraling electron motion into electric output at the other.

8742 chip capacitor Effect Electronic

A single-layer or multilayer monolithic capacitor constructed in chip form, with metallized terminations to facilitate direct bonding on hybrid integrated circuits.

8995 light valve Effect Electronic

1. A device whose light transmission can be made to vary in accordance with an externally applied electrical quantity, such as volatage, current, electric field, or magnetic field, or an electron beam. 2. Any directview electronic display optimized for reflecting or transmitting an image with an independent collimated light source for projection purposes.

9079 compliant substrate Effect Electronic

A semiconductor substrate into which an artificially formed interface is introduced near the surface which makes the substrate more readily deformable and allows it to support a defect-free semiconductor film of essentially any lattice constant, with dislocations forming in the substrate instead of in the film. Also known as sacrificial compliant substrate.

909 charge-coupled device Effect Electronic

A semiconductor device wherein minority charge is stored in a spatially defined depletion region (potential well) at the surface of a semiconductor and is moved about the surface by transferring this charge to similar adjacent wells. Abbreviated CCD.

9094 current-controlled switch Effect Electronic

A semiconductor device in which the controlling bias sets the resistance at either a very high or very low value, corresponding to the "off" and "on" conditions of a switch.

9097 varactor Effect Electronic

A semiconductor device characterized by a voltage-sensitive capacitance that resides in the space-charge region at the surface of a semiconductor bounded by an insulating layer. Also known as varactor diode; variable- capacitance diode; varicap; voltage-variable capacitor.

9388 silicon resistor Effect Electronic

A resistor using silicon semiconductor material as a resistance element, to obtain a positive temperature coefficient of resistance that does not appreciably change with temperature; used as a temperaturesensing element.

9856 surface barrier Effect Electronic

A potential barrier formed at a surface of a semiconductor by the trapping of carriers at the surface.

11105 full subtracter Effect Electronic

A logic element which operates on three binary input signals representing a minuend, subtrahend, and borrow digit, producing as output a different digit and a new borrow digit. Also known as three-input subtracter.

10165 rectifier rating Effect Electronic

A performance rating for a semiconductor rectifier, usually on the basis of the root-mean-square value of sinusoidal voltage that it can withstand in the reverse direction and the average current density that it will pass in the forward

11103 full adder Effect Electronic

A logic element which operates on two binary digits and a carry digit from a preceding stage, producing as output a sum digit and a new carry digit. Also known as threeinput adder.

10257 core stack Effect Electronic

A number of core arrays, next to one another and treated as a unit.

10299 equalizer Effect Electronic

A network designed to compensate for an undesired amplitude-frequency or phase-frequency response of a system or component; usually a combination of coils, capacitors, and resistors. Also known as equalizing 200 equivalent nitrogen pressure circuit.

10344 logarithmic multiplier Effect Electronic

A multiplier in which each variable is applied to a logarithmic function generator, and the outputs are added together and applied to an exponential function generator, to obtain an output proportional to the product of two inputs.

10453 diode mixer Effect Electronic

A mixer that uses a crystal or electron tube diode; it is generally small enough to fit directly into a radio-frequency transmission line.

112 stray capacitance Effect Electronic

Undesirable capacitance between circuit wires, between wires and the chassis, or between components and the chassis of electronic equipment.

10624 surface passivation Effect Electronic

A method of coating the surface of a p-type wafer for a diffused junction transistor with an oxide compound, such as silicon oxide, to prevent penetration of the impurity in undesired regions.

10810 injection efficiency Effect Electronic

A measure of the efficiency of a semiconductor junction when a forward bias is applied, equal to the current of injected minority carriers divided by the total current across the junction.

10817 hole mobility Effect Electronic

A measure of the ability of a hole to travel readily through a semiconductor, equal to the average drift velocity of holes divided by the electric field.

8689 logic card Effect Electronic

A small fiber chassis on which resistors, capacitors, transistors, magnetic cores, and diodes are mounted and interconnected in such a way as to perform some computer function; computers employing this type of construction may be repaired by removing 332 loop the faulty card and replacing it with a new card.

6710 logarithmic amplifier Effect Electronic

An amplifier whose output signal is a logarithmic function of the input signal.

3466 oxide passivation Effect Electronic

Passivation of a semiconductor surface by producing a layer of an insulating oxide on the surface.

2959 reverse current Effect Electronic

Small value of direct current that flows when a semiconductor diode has reverse bias.

3022 compensated semiconductor Effect Electronic

Semiconductor in which one type of impurity or imperfection (for example, donor) partially cancels the electrical effects on the other type of impurity or imperfection (for example, acceptor).

3066 scope Effect Electronic

See cathode-ray oscilloscope; radarscope.

3122 recycling Effect Electronic

Returning to an original condition, as to 0 or 1 in a counting circuit.

3128 microelement Effect Electronic

Resistor, capacitor, transistor, diode, inductor, transformer, or other electronic element or combination of elements mounted on a ceramic wafer 0.025 centimeter thick and about 0.75 centimeter square; individual microelements are stacked, interconnected, and potted to form micromodules.

432 diode forward voltage Effect Electronic

The voltage across a semiconductor diode that is carrying current in the forward direction; it is usually approximately constant over the range of currents commonly used. Also known as diode drop; diode voltage; forward voltage drop.

3237 injection electroluminescence Effect Electronic

Radiation resulting from recombination of minority charge carriers injected in a pn or pin junction that is biased in the forward direction. Also known as Losseveffect; recombination electroluminescence.

3263 electrode admittance Effect Electronic

Quotient of dividing the alternating component of the electrode current by the alternating component of the electrode voltage, all other electrode voltages being maintained constant.

4338 AND-OR circuit Effect Electronic

Gating circuit that produces a prescribed output condition when several possible combined input signals are applied; exhibits the characteristics of the AND gate and the OR gate.

3429 junction phenomena Effect Electronic

Phenomena which occur at the boundary between two semiconductor materials, or a semiconductor and a metal, such as the existence of an electrostatic potential in the absence of current flow, and large injection currents which may arise when external voltages are applied across the junction in one direction.

2492 quantum electronics Effect Electronic

The branch of electronics associated with the various energy states of matter, motions within atoms or groups of atoms, and various phenomena in crystals; examples of practical applications include the atomic hydrogen maser and the cesium atomicbeam resonator.

3495 enhancement mode Effect Electronic

Operation of a field-effect transistor in which no current flows when zero gate voltage is applied, and increasing the gate voltage increases the current.

3588 magnetron Effect Electronic

One of a family of crossed-field microwave tubes, wherein electrons, generated from a heated cathode, move under the combined force of a radial electric field and an axial magnetic field in such a way as to produce microwave radiation in the frequency range 1-40 gigahertz; a pulsed microwave radiation source for radar, and continuous source for microwave cooking.

3634 pump Effect Electronic

Of a parametric device, the source of alternating-current power which causes the nonlinear reactor to behave as a timevarying reactance.

3660 atmospheric noise Effect Electronic

Noise heard during radio reception due to atmospheric interference.

3789 vertical recording Effect Electronic

Magnetic recording in which bits are magnetized in directions perpendicular to the surface of the recording medium, allowing the bits to be smaller. Also known as perpendicular recording.

3813 core logic Effect Electronic

Logic performed in ferrite cores that serve as inputs to diode and transistor circuits.

3885 integrated injection logic Effect Electronic

Integratedcircuit logic that uses a simple and compact bipolar transistor gate structure which makes possible large-scale integration on silicon for logic arrays, memories, watch circuits, and various other analog and digital applications. Abbreviated I2L. Also known as merged-transistor logic.

3887 isolith Effect Electronic

Integrated circuit of components formed on a single silicon slice, but with the various components interconnected by beam leads and with circuit parts isolated by removal of the silicon between them.

6832 inverting amplifier Effect Electronic

Amplifier whose output polarity is reversed as compared to its input; such an amplifier obtains its negative feedback by a connection from output to input, and with high gain is widely used as an operational amplifier inverting function

329 wide band Effect Electronic

Property of a tuner, amplifier, or other device that can pass a broad range of frequencies.

1527 compressor Effect Electronic

The part of a compandor that is used to compress the intensity range of signals at the transmitting or recording end of a circuit.

773 maximum available gain Effect Electronic

The theoretical maximum power gain available in a transistor stage; it is seldom achieved in practical circuits because it can be approached only when feedback is negligible. Abbreviated MAG.

807 microelectronics Effect Electronic

The technology of constructing circuits and devices in extremely small packages by various techniques. Also known as microminiaturization; microsystem electronics.

657 electron-beam pumping Effect Electronic

The use of an electron beam to produce excitation for population inversion and lasing action in a semiconductor laser.

999 intermediate-frequency amplifier Effect Electronic

The section of a superheterodyne receiver that amplifies signals after they have been converted to the fixed intermediate-frequency value by the frequency converter. Abbreviated i-f amplifier.

1055 transistor input resistance Effect Electronic

The resistance across the input terminals of a transistor stage. Also known as input resistance.

1063 chopping Effect Electronic

The removal, by electronic means, of one or both extremities of a wave at a predetermined level.

1229 setup Effect Electronic

The ratio between the reference black level and the reference white level in television, both measured from the blanking level; usually expressed as a percentage.

1283 photoemissivity Effect Electronic

The property of a substance that emits electrons when struck by light.

129 hole injection Effect Electronic

The production of holes in an n-type semiconductor when voltage is applied to a sharp metal point in contact with the surface of the material.

2585 anticathode Effect Electronic

The anode or target of an x-ray tube, on which the stream of electrons from the cathode is focused and from which x-rays are emitted.

583 hybrid microcircuit Effect Electronic

Microcircuit in which thin-film, thick-film, or diffusion techniques are combined with separately attached semiconductor chips to form the circuit.

2496 heterojunction Effect Electronic

The boundary between two different semiconductor materials, usually with a negligible discontinuity in the crystal

1628 laser threshold Effect Electronic

The minimum pumping energy required to initiate lasing action in a laser.

1772 base line Abbreviated BL. Effect Electronic

The line traced on amplitude-modulated indicators which corresponds to the power level of the weakest echo detected by t h e radar; it is retraced with every pulse transmitted by the radar but appears as a nearly continuous display on the

1902 cavity impedance Effect Electronic

The impedance of the cavity of a microwave tube which appears across the gap between the cathode and the anode.

1930 hot junction Effect Electronic

The heated junction of a thermocouple.

1985 intermediate frequency Effect Electronic

The frequency produced by combining the received signal with that of the local oscillator in a superheterodyne receiver. Abbreviated i-f.

2002 current gain Effect Electronic

The fraction of the current flowing into the emitter of a transistor which 139 current generator flows through the base region and out the collector.

213 n-type conduction Effect Electronic

The electrical conduction associated with electrons, as opposed to holes, in a semiconductor.

2202 collector voltage Effect Electronic

The direct-current voltage, obtained from a power supply, that is applied between the base and collector of a transistor.

collet

4408 vertical metal oxide semiconductor Effect Electronic

For semiconductor devices, a technology that involves essentially the formation of four diffused layers in silicon and etching of a V-shaped groove to a precisely controlled depth in the layers, followed by deposition of metal over silicon dioxide in the groove to form the gate electrode. Abbreviated VMOS technology.

1308 gating Effect Electronic

The process of selecting those portions of a wave that exist during one or more selected time intervals or that have magnitudes between selected limits.

6486 heater Effect Electronic

An electric heating element for supplying heat to an indirectly heated cathode in an electron tube. Also known as electrontube heater.

5803 npin transistor Effect Electronic

An npn transistor which has a layer of high-purity germanium between the base and collector to extend the frequency

5850 boundary Effect Electronic

An interface between pand n-type semiconductor materials, at which 71 boundary friction donor and acceptor concentrations are equal.

5854 bulk resistor Effect Electronic

An integrated-circuit resistor in which the n-type epitaxial layer of a semiconducting substrate is used as a noncritical high-value resistor; the spacing between the attached terminals and the sheet resistivity of the material together determine the resistance value.

5855 current-mode filter Effect Electronic

An integrated-circuit filter in which the signals are represented by current levels rather than voltage levels.

5862 BiCMOS technology Effect Electronic

An integrated circuit technology that combines bipolar transistors and CMOS devices on the same chip.

622 enhancement Effect Electronic

An increase in the density of charged carriers in a particular region of a semiconductor.

624 electron holography Effect Electronic

An imaging technique using the wave nature of electrons and light, in which an interference pattern between an object wave and a reference wave is formed using a coherent field-emission electron beam from a sharp tungsten needle, and is recorded on film as a hologram, and the image of the original object is then reconstructed by iilluminating a light beam equivalent to the reference wave onto the hologram.

6270 n-type semiconductor Effect Electronic

An extrinsic semiconductor in which the conduction electron density exceeds the hole density.

4276 light-sensitive Effect Electronic

Having photoconductive, photoemissive, or photovoltaic characteristics. Also known as photosensitive.

6449 injector Effect Electronic

An electrode through which charge carriers (holes or electrons) are forced to enter the high-field region in a spacistor.

5733 lockout circuit Effect Electronic

A switching circuit which responds to concurrent inputs from a number of external circuits by responding to one, and only one, of these circuits at any time. Also known as finding circuit; hunting circuit.

6492 rectifier filter Effect Electronic

An electric filter used in smoothing out the voltage fluctuation of an electron tube rectifier, and generally placed between the rectifier's output and the load resistance.

6615 programmed logic array Effect Electronic

An array of AND/OR logic gates that provides logic functions for a given set of inputs programmed during manufacture and serves as a read-only memory.

6697 diode gate Effect Electronic

An AND gate that uses diodes as switching elements.

6708 silicon retina Effect Electronic

An analog very large scale integrated circuit chip that performs operations which resemble some of the functions performed by the retina of the human eye.

6716 summing amplifier Effect Electronic

An amplifier that delivers an output voltage which is proportional to the sum of two or more input voltages or currents.

13183 antenna circuit Effect Electronic

A complete electric circuit which includes an antenna.

6958 chopper-stabilized amplifier Effect Electronic

Adirectcurrent amplifier in which a direct-coupled amplifier is in parallel with a chopper amplifier. chopper transistor

7307 diode voltage regulator Effect Electronic

A voltage regulator with a Zener diode, making use of its almost constant voltage over a range of currents.

228 degauss Effect Electronic

To remove, erase, or clear information from a magnetic tape, disk, drum, or core.

6427 grounded-grid amplifier Effect Electronic

An electrontube amplifier circuit in which the control grid is at ground potential at the operating frequency; the input signal is applied between cathode and ground, and the output load is connected between anode and ground.

4765 electrode current Effect Electronic

Current passing to or from an electrode, through the interelectrode space within a vacuum tube.

447 bypass filter Effect Electronic

Filter which provides a low-attenuation path around some other equipment, such as a carrier frequency filter used to bypass a physical telephone repeater station.

4474 magnetostrictive filter Effect Electronic

Filter network which uses the magnetostrictive phenomena to form high-pass, low-pass, band-pass, or bandelimination filters; the impedance characteristic is the inverse of that of a crystal.

4488 trisistor Effect Electronic

Fast-switching semiconductor consisting of an alloyed junction pnp device in which the collector is capable of electron injection into the base; characteristics resemble those of a thyratron electron tube, and switching time is in the nanosecond range.

4548 suppression Effect Electronic

Elimination of any component of an emission, as a particular frequency or group of frequencies in an audio-frequency of a radio-frequency signal.

4558 photoelectromotive force Effect Electronic

Electromotive force caused by photovoltaic action. photoelectron

4566 junction isolation Effect Electronic

Electrical isolation of a component on an integrated circuit by surrounding it with a region of a conductivity type that forms a junction, and reverse-biasing the junction so it has extremely high resistance.

4639 diode switch Effect Electronic

Diode which is made to act as a switch by the successive application of positive and negative biasing voltages to the anode (relative to the cathode), thereby allowing or preventing, respectively, the passage of other applied waveforms within certain limits of voltage.

466 pulse repeater Effect Electronic

Device used for receiving pulses from one circuit and transmitting corresponding pulses into another circuit; it may also change the frequencies and waveforms of the pulses and perform other functions.

4672 pulse-width discriminator Effect Electronic

Device that measures the pulse length of video signals and passes only those whose time duration falls into some predetermined design tolerance. pulsometer

5800 symmetrical O attenuator Effect Electronic

An O attenuator in which the impedance near the input terminals equals the corresponding impedance near the output terminals.

4695 Gunn effect Effect Electronic

Development of a rapidly fluctuating current in a small block of a semiconductor (perhaps n-type gallium arsenide) when a constant voltage above a critical value is applied to contacts on opposite faces.

579 base electrode Effect Electronic

An ohmic or majority carrier contact to the base region of a transistor.

479 locking Effect Electronic

Controlling the frequency of an oscillator by means of an applied signal of constant frequency.

4803 photoelectric control Effect Electronic

Control of a circuit or piece of equipment by changes in incident light.

486 solid-state circuit Effect Electronic

Complete circuit formed from a single block of semiconductor material.

5053 passive transducer Effect Electronic

Atransducer containing no internal source of power.

5082 semiconductor thermocouple Effect Electronic

Athermocouple made of a semiconductor, which offers the prospect of operation with high-temperature gradients, because semiconductors are good electrical conductors but poor heat conductors.

5588 optical relay Effect Electronic

An optoisolator in which the output device is a light-sensitive switch that provides the same on and off operations as the contacts of a relay.

564 switching gate Effect Electronic

An electronic circuit in which an output having constant amplitude is registered if a particular combination of input signals exists; examples are the OR, AND, NOT, and INHIBIT circuits. Also known as logical gate.

5642 electron-beam tube Effect Electronic

An electron tube whose performance depends on the formation and control of one or more electron beams.

192 modulate Effect Electronic

To vary the amplitude, frequency, or phase of a wave, or vary the velocity of the electrons in an electron beam in some characteristic manner.

4680 compatible monolithic integrated Effect Electronic

Device in which passive components are deposited by thin-film techniques on top of a basic silicon-substrate circuit containing the active components and some passive parts.

13985 subcarrier oscillator Effect Electronic

1. The crystal oscillator that operates at the chrominance subcarrier or burst frequency of 3.579545 megahertz in a color television receiver; this oscillator, synchronized in frequency and phase with the transmitter master oscillator, furnishes the continuous subcarrier frequency required for demodulators in the receiver. 2. An oscillator used in a telemetering system to translate variations in an electrical quantity into variations of a frequencymodulated signal at a subcarrier

13919 quenching Effect Electronic

1. The process of terminating a discharge in a gas-filled radiationcountertubeby inhibiting reignition. 2. Reduction of the intensity of resonance radiation resulting from deexcitation of atoms, which would otherwise have emitted this radiation, in collisions with electrons or other atoms in a gas.

13936 injection Effect Electronic

1. The method of applying a signal to an electronic circuit or device. 2. The process of introducing electrons or holes into a semiconductor so that their total number exceeds the number present at thermal equilibrium.

13483 chopper amplifier Effect Electronic

A carrier amplifier in which the direct-current input is filtered by a low-pass filter, then converted into a squarewave alternating-current signal by either one or two choppers.

14349 grinding Effect Electronic

1. A mechanical operation performed on silicon substrates of semiconductors to provide a smooth surface for epitaxial deposition or diffusion of impurities. 2. A mechanical operation performed on quartz crystals to alter their physical size and hence their resonant frequencies.

14396 air gap Effect Electronic

1. A gap or an equivalent filler of nonmagnetic material across the core of a choke, transformer, or other magnetic device. 2. A spark gap consisting of two electrodes separated by air. 3. The space between the stator and rotor in a motor or generator.

13970 cutoff voltage Effect Electronic

1. The electrode voltage value that reduces the dependent variable of an electron-tube characteristic to a specified low value. 2. See critical voltage.

13748 reverse bias Effect Electronic

A bias voltage applied to a diode or a semiconductor junction with polarity such that little or no current flows; the opposite of forward bias.

13886 switching time Effect Electronic

1. The time interval between the reference time and the last instant at which the instantaneous voltage response of a magnetic cell reaches a stated fraction of its peak value. 2. The time interval between the reference time and the first instant at which the instantaneous integrated voltage response of a magnetic cell reaches a stated fraction of its peak

13742 heterojunction bipolar transistor Effect Electronic

A bipolar transistor that has two or more materials making up the emitter, base, and collector regions, giving it a much higher maximum frequencythan a silicon bipolar transistor. Abbreviated HBT.

13918 transmission Effect Electronic

1. The process of transferring a signal, message, picture, or other form of intelligence from one location to another location by means of wire lines, radio, light beams, infrared beams, or other communication systems.

13983 output Effect Electronic

1. The current, voltage, power, driving force, or information which a circuit or device delivers. 2. Terminals or other places

where a circuit or device can deliver current, voltage, power, driving force, or information.

13350 NOR circuit Effect Electronic

A circuit in which output voltage appears only when signal is absent from all of its input terminals.

13340 scrambler Effect Electronic

A circuit that divides speech frequencies into several ranges by means of filters, then inverts and displaces the frequencies in each range so that the resulting reproduced sounds are unintelligible; the process is reversed at the receiving apparatus to restore intelligible speech. Also known as speech inverter; speech scrambler.

13243 AND NOT gate Effect Electronic

A coincidence circuit that performs the logic operation AND NOT, under which a result is true only if statement A is true and statement B is not. Also known as A AND NOT B gate.

14070 threshold voltage Effect Electronic

1. In general, the voltage at which a particular characteristic of an electronic device first appears. 2. The voltage at which conduction of current begins in a pn junction. 3. The voltage at which channel formation occurs in a metal oxide semiconductor field-effect transistor. 4. The voltage at which a solid-state lamp begins to emit light.

13998 optoelectronics Effect Electronic

1. The branch of electronics that deals with solid-state and other electronic devices for generating, modulating, transmitting, and sensing electromagnetic radiation in the ultraviolet, visible-light, and infrared portions of the spectrum. 2.

13393 high Q Effect Electronic

A characteristic wherein a component has a high ratio of reactance to effective resistance, so that its Q factor is high.

13318 bistable circuit Effect Electronic

A circuit with two stable states such that the transition between the states cannot be accomplished by self-triggering.

13458 synchroscope Effect Electronic

A cathode-ray oscilloscope designed to show a short-duration pulse by using a fast sweep that is synchronized with the pulse signal to be observed.

14157 pig Effect Electronic

1. An ion source based on the same principle as the Philips ionization gage. 2. See Philips ionization gage.

13327 complementary symmetry Effect Electronic

A circuit using both pnp and npn transistors in asymmetrical arrangement that permits push-pull operation without an input transformer or other form of phase inverter.

14025 compression Effect Electronic

1. Reduction of the effective gain of a device at one level of signal with respect to the gain at a lower level of signal, so 117 compression coupling that weak signal components will not be lost in background and strong signals will not overload the system. 2. See compression ratio.

1333 diode transistor logic Effect Electronic

A circuit that uses diodes, transistors, and resistors to provide logic functions. Abbreviated DTL.

1389 screen Effect Electronic

1. The surface on which a television, radar, x-ray, or cathode-ray oscilloscope image is made visible for viewing; it may be a fluorescent screen with a phosphor layer that converts the energy of an electron beam to visible light, or a translucent or opaque screen on which the optical image is projected. Also known as viewing screen. 2. See screen grid.

1374 bipolar junction transistor Effect Electronic

A bipolar transistor that is composed entirely of one type of semiconductor, silicon. Abbreviated BJT.

1350 silicon capacitor Effect Electronic

A capacitor in which a pure silicon-crystal slab serves as the dielectric; when the crystal is grown to have a p zone, a depletion zone, and an n zone, the capacitance varies with the externally applied bias voltage, as in a varactor.

3883 conductive interference Law Electronic

Interference to electronic equipment that orginates in power lines supplying t h e equipment, and is conducted to the equipment and coupled through the power supply transformer.

3168 electrode characteristic Law Electronic

Relation between the electrode voltage and the current to an electrode, all other electrode voltages being maintained constant.

3207 electrode resistance Law Electronic

Reciprocal of the electrode conductance; this is the effective parallel resistance and is not the real component of the electrode impedance.

3208 electrode impedance Law Electronic

Reciprocal of the electrode admittance.

3223 average noise figure Law Electronic

Ratio in a transducer of total output noise power to the portion thereof attributable to thermal noise in the input termination, the total noise being summed over frequencies from zero to infinity, and the noise temperature of the input termination being standard (290 K).

326 electrode conductance Law Electronic

Quotient of the inphase component of the electrode alternating current by the electrode alternating voltage, all other electrode voltage being maintained constant; this is a variational and not a total conductance. Also known as grid conductance.

3262 rectification factor Law Electronic

Quotient of the change in average current of an electrode by the change in amplitude of the alternating sinusoidal voltage applied to the same electrode, the direct voltages of this and other electrodes being maintained constant.

24 Suhl effect Law Electronic

When a strong transverse magnetic field is applied to an n-type semiconducting filament, holes injected intothe filament are deflected to the surface, where they may recombine rapidly with electrons or be withdrawn by a probe.

11264 Child's law Law Electronic

A law stating that the current in a thermionic diode varies directly with the three-halves power of anode voltage and inversely with the square of the distance between the electrodes, provided the operating conditions are such that the current is limited only by the space charge. Also known as Child-Langmuir equation; Child-Langmuir-Schottky equation; Langmuir-Child equation.

10059 piezoelectric transducer Prime Effect Electronic

A piezoelectric crystal used as a transducer, either to convert mechanical or acoustical signals to electric signals, as in a microphone, or vice versa, as in ultrasonic metal inspection.

Engineering

13620 viscometry Effect Engineering

A branch of rheology; the study of the behavior of fluids under conditions of internal shear; the technology of measuring viscosities of fluids.

8032 vortex thermometer Effect Engineering

A thermometer, used in aircraft, which automatically corrects for adiabatic and frictional temperature rises by imparting a rotary motion to the air passing the thermal sensing element.

8029 slush molding Effect Engineering

A thermoplastic casting in which a liquid resin is poured into a hot, hollow mold where a viscous skin forms; excess slush is drained off, the mold is cooled, and the molded product is stripped out.

6667 sterilizer Effect Engineering

An apparatus for sterilizing by dry heat, steam, or water.

6688 eolian anemometer Effect Engineering

An anemometer which works on the principle that the pitch of the eolian tones made by air moving past an obstacle is a function of the speed of the air.

632 magnetooptic recording Effect Engineering

An erasable data storage technology in which data are stored on a rotating disk in a thin magnetic layer that may be switched between two magnetization states by the combination of a magnetic field and a pulse of light from a diode laser.

766 normal-plate anemometer Effect Engineering

A type of pressure-plate anemometer in which the plate, restrained by a stiff spring, is held perpendicular to the wind; the wind-activated motion of the plate is measured electrically; the natural frequency of this system can be made high enough so that resonance magnification does not occur.

6744 vibration galvanometer Effect Engineering

An alternatingcurrent galvanometer in which the natural oscillation frequency of the moving element is equal to the frequency of the current being measured. vibration isolation

6658 pasteurizer Effect Engineering

An apparatus used for pasteurization of fluids.

6746 telescopic alidade Effect Engineering

An alidade used with a plane table, consisting of a telescope mounted on a straightedge ruler, fitted with a level bubble, scale, and vernier to measure angles, and calibrated to measure distances.

6803 sonobuoy Effect Engineering

An acoustic receiver and radio transmitter mounted in a buoy that can be dropped from an aircraft by parachute to pick up underwater sounds of a submarine and transmit them to the aircraft; to track a submarine, several buoys are dropped in a pattern that includes the known or suspected location of the submarine, with each buoy transmitting an identifiable signal; an electronic computer then determines the location of the submarine by comparison of the received signals and triangulation of the resulting time-delay data. Also known as radio sonobuoy.

8025 ultrasonic thickness gage Effect Engineering

A thickness gage in which the time of travel of an ultrasonic beam through a sheet of material is used as a measure of the thickness of the material.

8024 x-ray thickness gage Effect Engineering

A thickness gage used for measuring and indicating the thickness of moving cold-rolled sheet steel during the rolling process without making contact with the sheet; an x-ray beam directed through the sheet is absorbed in proportion to the thickness of the material and its atomic number.

8022 reed Effect Engineering

A thin bar of metal, wood, or cane that is clamped at one end and set into transverse elastic vibration, usually by wind pressure; used to generate sound in musical instruments, and as a frequency standard, as in a vibratingreed frequency meter.

7973 tubeless tire Effect Engineering

A tire that does not require an inner tube to hold air.

6733 polarized-vane ammeter Effect Engineering

An ammeter of only moderate accuracy in which the current to be measured passes through a small coil, distorting the field of a circular permanent magnet, and an iron vane aligns itself with the axis of the distorted field, the deflection being roughly proportional to the current.

8147 differential scatter Effect Engineering

A technique for the remote sensing of atmospheric particles in which the ackscattering from laser beams at a number of infrared wavelengths is measured and correlated with scattering signatures that are uniquely related to particle composition. Abbreviated DISC.

8180 electrolytic tank Effect Engineering

A tank in which voltages are applied to an enlarged scale model of an electron-tube system or a reduced scale model of an aerodynamic system immersed in a poorly conducting liquid, and equipotential lines between electrodes are traced; used as an aid to electron-tube design or in computing ideal fluid flow; the latter application is based on the fact that the velocity potential in ideal flow and the stream function in planar flow satisfy the same equation, Laplace's equation, as an electrostatic potential. Also known as electric tank; potential flow analyzer.

6488 induction furnace Effect Engineering

An electric furnace in which heat is produced in a metal charge by electromagnetic induction.

8157 laser ranging Effect Engineering

A technique for determining the distance to a target by precise measurement of the time required for a laser pulse to travel from a transmitter to a reflector on the target and return to a detector.

8148 nondestructive testing Effect Engineering

A technique for revealing flaws and defects in a material or device without damaging or destroying the test sample; includes use of x-rays, ultrasonics, radiography, and magnetic flux.

6517 diving bell Effect Engineering

An early diving apparatus constructed in the shape of a box or cylinder without a bottom and connected to a compressed-air hose.

8116 resistor bulb Effect Engineering

A temperature-measurement device inside of which is a resistance winding; changes in temperature cause corresponding changes in resistance, varying the current in the winding.

6554 post drill Effect Engineering

An auger or drill supported by a post.

8117 spiral thermometer Effect Engineering

A temperaturemeasurement device consisting of a bimetal spiral that winds tighter or opens with changes in temperature.

6582 radio telescope Effect Engineering

An astronomical instrument used to measure the amount of radio energy coming from various directions in the sky, consisting of a highly directional antenna and associated electronic equipment.

8130 sorption pumping Effect Engineering

A technique used to reduce the pressure of gas in an atmosphere; the gas is adsorbed on a granular sorbent material such as a molecular sieve in a metal container; when this sorbent-filled container is immersed in liquid nitrogen, the gas is sorbed.

6589 flame arrester Effect Engineering

An assembly of screens, perforated plates, or metal-gauze packing attached to the breather vent on a flammableproduct storage tank.

6613 thermopile Effect Engineering

An array of thermocouples connected either in series to give higher voltage output or in parallel to give higher current output, used for measuring temperature or radiant energy or for converting radiant energy into electric power.

6622	spray pond	Effect	Engineering

An arrangement for cooling large quantities of water in open reservoirs or ponds; nozzles spray a portion of the water into the air for the evaporative cooling effect.

13729	rake blade	Effect	Engineering

A blade on a bulldozer in the form of spaced tines that point down.

6539	unitized body	Effect	Engineering

An automotive body that has the body and frame in one unit; side members are designed on the principle of a bridge truss to gain stiffness, and sheet metal of the body is stressed so that it carries some of the load.

743	pressure relief	Effect	Engineering

A valve or other mechanical device (such as a rupture disk) that eliminates system overpressure by allowing the controlled or emergency escape of liquid or gas from a pressured system.

7035	plenum	Effect	Engineering

Acondition in which air pressure within an enclosed space is greater than that in the outside atmosphere.

7658	polarizing pyrometer	Effect	Engineering

A type of pyrometer, such as the Wanner optical pyrometer, in which monochromatic light from the source under investigation and light from a lamp with filament maintained at a constant but unknown temperature are both polarized and their intensities compared.

7460	vacuum evaporator	Effect	Engineering

A vacuum device used to evaporate metals and spectrographic carbon to coat (replicate) a specimen for electron spectroscopic analysis or for electron microscopy.

265	spring-load	Effect	Engineering

To load or exert a force on an object by means of tension from a spring or by compression.

7166	sawhorse	Effect	Engineering

A wooden rack used to support wood that is being sawed.

792	paravane	Effect	Engineering

A torpedo-shaped device with sawlike teeth along its forward end, towed with a wire rope underwater from either side of the bow of a ship to cut the cables of anchored mines. Also known as otter.

7457 molecular drag pump Effect Engineering

A vacuum pump in which pumping is accomplished by imparting a high momentum to the gas molecules by impingement of a body rotating at very high speeds, as much as 16,000 revolutions per minute; such pumps achieve a vacuum as high as 10"6 torr.

6994 Rogowski coil Effect Engineering

Adevice for measuring alternating current without making contact with the current-carrying conductor, which consists of an air-core coil placed around the conductor in a toroidal fashion so that the alternating magnetic field produced by the current induces a voltage in the coil.

7422 pressure-regulating valve Effect Engineering

A valve that releases or holds process-system pressure (that is, opens or closes) either by preset spring tension or by actuation by a valve controller to assume any desired position between full open and full closed.

7398 rotameter Effect Engineering

A variable-area, constanthead, rate-of-flow volume meter in which the fluid flows upward through a tapered tube, lifting a shaped weight to a position where upward fluid force just balances its weight.

7339 micro heat pipe Effect Engineering

A very small heat pipe that has a diameter between about 100 micrometers and 2 millimeters (0.004 and 0.08 inch) and a triangular cross section or other cross section with sharp corners, and that uses the sharp corner regions instead of a wick to return the working fluid from the condenser to the evaporator; it has potential applications in the electronics (cooling circuit chips), medical, space, and aircraft industries.

7323 micromechanical display Effect Engineering

A video display based on an array of mirrors on a silicon chip that can be deflected by electrostatic forces. Abbreviated MMD.

13857 temper Effect Engineering

1. To moisten and mix clay, plaster, or mortar to the proper consistency for use. 2. See anneal.

7243 mechanical scale Effect Engineering

A weighing device that incorporates a number of levers with precisely located fulcrums to permit heavy objects to be balanced with counterweights or counterpoises.

13866 net Effect Engineering

1. Threads or cords tied together at regular intervals to form a mesh. 2. A series of surveying or leveling stations that have

been interconnected in such a manner that closed loops or circuits have been formed, or that are arranged so as to provide a check on the consistency of the measured values. Also known as network.

6932	suspension cable	Effect	Engineering

A freely hanging cable; may carry mainly its own weight or a uniformly distributed load.

7239	plumb bob	Effect	Engineering

A weight suspended on a string to indicate the direction of the vertical. plumb bond

6818	water brake	Effect	Engineering

An absorption dynamometer for measuring power output of an engine shaft; the mechanical energy is converted to heat in a centrifugal pump, with a free casing where turning moment is measured.

6819	water-flow pyrheliometer	Effect	Engineering

An absolute pyrheliometer, in which the radiation-sensing element is a blackened, water calorimeter; it consists of a cylinder, blackened on the interior, and surrounded by a special chamber through which water flows at a constant rate; the temperatures of the incoming and outgoing water, which are monitored continuously by thermometers, are used to compute the intensity of the radiation.

6902	mechanical hygrometer	Effect	Engineering

Ahygrometer in which an organic material, most commonly a bundle of human hair, which expands and contracts with changes in the moisture in the surrounding air or gas is held under slight tension 348 mechanical units by a spring, and a mechanical linkage actuates a pointer.

13773	normal barometer	Effect	Engineering

A barometer of such accuracy that it can be used for the determination of pressure standards; an instrument such as a large-bore mercury barometer is usually used.

13788	radiosonde	Effect	Engineering

A balloon-borne instrument for the simultaneous measurement and transmission of meteorological data; the instrument consists of transducers for the measurement of pressure, temperature, and humidity, a modulator for the conversion of the output of the transducers to a quantity which controls a property of the radio-frequency signal, a selector switch which determines the sequence in which the parameters are to be transmitted, and a transmitter which generates the radio-frequency carrier.

8246	piping	Effect	Engineering

A system of pipes provided to carry a fluid. Also known as pipework. piston (ENG

7684 Ledoux bell meter Effect Engineering

A type of manometer used to measure the difference in pressure between two points generated by any one of several types of flow measurement devices such as a pitot tube; it is equipped with a shaped plug which makes the reading of the meter directly proportional to the flow rate.

6996 respirator Effect Engineering

Adevice for maintaining artificial respiration to protect the respiratory tract against irritating and poisonous gases, fumes, smoke, and dusts, with or without equipment supplying oxygen or air; some types have a fitting which covers the nose and mouth.

7668 Wanner optical pyrometer Effect Engineering

A type of polarizing pyrometer in which beams from the source under investigation and a comparison lamp are polarized at right angles and then passed through a Nicol prism and a red filter; the source temperature is determined from the angle through which the Nicol prism must be rotated in order to equalize the intensities of the resulting patches of light.

6943 vortex amplifier Effect Engineering

A fluidic device in which the supply flow is introduced at the circumference of a shallow cylindrical chamber; the vortex field developed can substantially reduce orthrottle flow; used in fluidic diodes, throttles, pressure amplifiers, and a rate

278 sharpen Effect Engineering

To give a thin keen edge or a sharp acute point to.

7663 liquid-sealed meter Effect Engineering

A type of positivedisplacement meter for gas flows consisting of a cylindrical chamber that is more than half filled with water and divided into four rotating compartments formed by trailing vanes; gas entering through the center shaft into one compartment after another forces rotation that allows the gas then to exhaust out the top as it is displaced by the water. Also known as drum meter.

6985 thermoacoustic-Stirling engine Effect Engineering

Adevice in which the thermodynamic cycle of a Stirling engine is accomplished in a traveling-wave acoustic network, and acoustic power is produced from heat.

7913 cooling tower Effect Engineering

A towerlike device in which atmospheric air circulates and cools warm water, generally by direct contact (evaporation). coolometer

7687 Lenard spiral Effect Engineering

A type of magnetometer consisting of a spiral of bismuth wire and a Wheatstone bridge to measure changes in the resistance of the wire produced by magnetic fields and as a result of the transverse magnetoresistance of bismuth.

9969 reaction injection molding Effect Engineering

A plastics fabrication process in which two streams of highly reactive, low-molecular-weight, low-viscosity resin systems are combined to form a solid material.

9779 stroboscopic disk Effect Engineering

A printed disk having a number of concentric rings each containing a different number of dark and light segments; when the disk is placed on a phonograph turntable or rotating shaft and illuminated at a known frequency by a flashing discharge tube, speed can be determined by noting which pattern appears to stand still or to rotate slowly.

10303 purse seine Effect Engineering

A net that can be dropped by two boats to encircle a school of fish, then pulled together at the bottom and raised, thereby catching the fish.

10302 gill net Effect Engineering

A net that entangles the gill covers of fish.

1030 seine net Effect Engineering

A net used to catch fish by encirclement, usually by closure of the two ends and the bottom.

1028 ultrasonic testing Effect Engineering

A nondestructive test method that employs high-frequency mechanical vibration energy to detect and locate structural discontinuities or differences and to measure thickness of a variety of materials.

10233 gasket Effect Engineering

A packing made of deformable material, usually in the form of a sheet or ring, used to make a pressure-tight joint between stationary parts. Also known as static seal. gas law

10084 bistable unit Effect Engineering

A physical element that can be made to assume either of two stable states; a binary cell is an example.

10006 sump Effect Engineering

A pit or tank which receives and temporarily stores drainage at the lowest point of a circulating or drainage system. Also known as sump pit.

10418 deep-draw mold Effect Engineering

A mold for plastic material that is long in relation to the thickness of the mold wall.

9972 pinch-tube process Effect Engineering

A plastics blowmolding process in which the extruder drops a tube between mold halves, and the tube is pinched off when the mold closes.

10447 flash steam Effect Engineering

A mixture of steam and water that occurs when hot water under pressure moves to a region of lower pressure, such as in a flash boiler.

9963 sprayed metal mold Effect Engineering

A plastics mold made by spraying molten metal onto a master spring gravimeter form until a shell of predetermined thickness is achieved; the shell is then removed and backed up with plaster, cement, or casting resin; used primarily in plastic sheet forming.

9962 semipositive mold Effect Engineering

A plastics mold that allows a small amount of excess material to escape when it is closed.

996 loose-detail mold Effect Engineering

A plastics mold with parts that come out with the molded piece. loose fit

9960 air-assist forming Effect Engineering

A plastics thermoforming method in which air pressure is used to partially preform a sheet before it enters the mold.

9959 pressure forming Effect Engineering

A plastics thermoforming process using pressure to push the plastic sheet to be formed against the mold surface, as opposed to using vacuum to suck the sheet flat against the mold.

9958 slip forming Effect Engineering

A plastics-sheet forming technique in which some of the sheet is allowed to slip through the mechanically operated clamping rings during stretch-forming operations.

9852 kick wheel Effect Engineering

A potter's wheel worked by a foot pedal.

13476 water jacket Effect Engineering

A casing for circulation of cooling water.

9973 screw plasticating injection molding Effect Engineering

A plastic-molding technique in which plastic is converted from pellets to a viscous (plasticated) melt by an extruder screw that is an integral part of the molding machine.

10568 slot dozing Effect Engineering

A method of moving large quantities of material with a bulldozer using the same path for each trip so that the spillage from the sides of t h e blade builds up along each side; afterward all material pushed into the slot is retained in front of the

10593 drape forming Effect Engineering

A method of forming thermoplastic sheet in which the sheet is clamped into a movable frame, heated, and draped over high points of a male mold; vacuum is then applied to complete the forming operation.

10586 plasma-source ion implantation Effect Engineering

A method of ion implantation in which the workpiece is placed in a plasma containing the appropriate ion species and is repetitively pulse-biased to a high negative potential so that positive plasma ions are accelerated to the surface and implant in the bulk material. Abbreviated PSII.

10584 stitch bonding Effect Engineering

A method of making wire connections between two or more points on an integrated circuit by using impulse welding or heat and pressure while feeding the connecting wire through a hole in the center of the welding electrode.

10582 magnetic source imaging Effect Engineering

A method of mapping electric currents within an object, particularly currents associated with biological activity, by using an array of SQUID magnetometers to detect the resulting magnetic fields surrounding the object. Abbreviated MSI.

10579 magnetovision Effect Engineering

A method of measuring and displaying magnetic field distributions in which scanning results from a thin-film Permalloy magnetoresistive sensor are processed numerically and presented in the form of a color map on a video display unit.

10577 thermography Effect Engineering

A method of measuring surface temperature by using luminescent materials: the two main types are contact thermography and projection thermography.

10576 contact thermography Effect Engineering

A method of measuring surface temperature in which a thin layer of luminescent material is spread on the surface of an object and is excited by ultraviolet radiation in a darkened room; the brightness of the coating indicates the surface temperature.

10575 infrared thermography Effect Engineering

A method of measuring surface temperatures by observing the infrared emission from the surface.

10307 photonephelometer Effect Engineering

A nephelometer that uses a photocell or phototube to measure the amount of light transmitted by a suspension of particles.

10570 bag molding Effect Engineering

A method of molding plastic or plywood-plastic combinations into curved shapes, in which fluid pressure acting through a flexible cover, or bag, presses the material to be molded against a rigid die.

9768 Zyglo method Effect Engineering

A procedure for visualizing incipient cracks caused by fatigue failure, in which the part is immersed in a special activated penetrating oil and viewed under black light.

10567 pulsed video thermography Effect Engineering

A method of nondestructive testing in which a source of heat is applied to an area of a specimen for a very short time duration, and an infrared detection system reveals anomalously hot or cold regions that then appear close to defects.

10565 intrusion grouting Effect Engineering

A method of placing concrete by intruding the mortar component in position and then converting it into concrete as it is introduced into voids.

10553 stuffing Effect Engineering

A method of sealing the mechanical joint between two metal surfaces; packing (stuffing) material is inserted within the seal area container (the stuffing or packing box), and compressed to a liquid-proof seal by a threaded packing ring follower. Also known as packing.

10548 two-step grooving system Effect Engineering

A method of spooling a drum in which the wire rope, controlled by grooves, moves parallel to the drum flanges for one-half the circumference and then crosses over to start the next wrap. Also known as counterbalance system.

10547 hot-air sterilization Effect Engineering

A method of sterilization using dry heat for glassware and other heatresistant materials which need to be dry after treatment; temperatures of 160-165℃ are generated for at least 2 hours.

1053 electromagnetic logging Effect Engineering

A method of well logging in which a transmitting coil sets up an alternating electromagnetic field, and a receiver coil, placed in the drill hole above the transmitter coil, measures the secondary electromagnetic field induced by the resulting eddy currents within the formation. Also known as electromagnetic well logging.

10528 rope boring Effect Engineering

A method similar to rod drilling except that rigid rods are replaced by a steel rope to which the boring tools are attached and allowed to fall by their own weight.

10520 Rossman drive Effect Engineering

A method used to provide speed control of alternating-current motors; an induction motor stator is mounted on trunnion bearings and driven with an auxiliary motor, to provide the desired change in slip between the stator and rotor.

124 frequency-modulation Doppler Effect Engineering

Type of radar involving frequency modulation of both carrier and modulation on radial sweep.

144 Smithell's burner Effect Engineering

Two concentric tubes that can be added to a bunsen burner to separate the inner and outer flame cones.

9795 Dines anemometer Effect Engineering

A pressure-tube anemometer in which the pressure head on a weather vane is kept facing into the wind, and the suction head, near the bearing which supports the vane, develops a suction independent of wind direction; the pressure difference between the heads is proportional to the square of the wind speed and is measured by a float manometer with a linear wind scale.

9374 potter's wheel Effect Engineering

A revolving horizontal disk that turns when a treadle is operated; used to shape clay by hand.

9366 spreader beam Effect Engineering

A rigid beam hanging from a crane hook and fitted with a number of ropes at different points along its length; employed for such purposes as lifting reinforced concrete piles or large sheets of glass.

9142 demister blanket Effect Engineering

A section of knitted wire mesh that is placed below the vapor outlet of a vaporizer or an evaporator to separate entrained liquid droplets from the stream of vapor.

9135 Van Dorn sampler Effect Engineering

A sediment sampler that consists of a Plexiglas cylinder closed at both ends by rubber force cups; in the armed position the cups are pulled outside the cylinder and restrained by a releasing mechanism, and after the sample is taken, a length of surgical rubber tubing connecting the cups is sufficiently prestressed to permit the force cups to retain the sample in the cylinder.

9133 Schweydar mechanical detector Effect Engineering

A seismic detector that senses and records refracted waves; a lead sphere is suspended by a flat spring, the sphere's motion is magnified by an aluminum cone that moves a bow around a spindle carrying a mirror, and this motion is then photographically recorded.

9125 universal chuck Effect Engineering

A self-centering chuck whose jaws move in unison when a scroll plate is rotated.

9123 aqualung Effect Engineering

A self-contained underwater breathing apparatus (scuba) of the demand or open-circuit type developed by J.Y.

9423 prepreg Effect Engineering

A reinforced-plastics term for the reinforcing material that contains or is combined with the full complement of resin before the molding operation.

9066 torsion-string galvanometer Effect Engineering

A sensitive galvanometer in which the moving system is suspended by two parallel fibers that tend to twist around each other.

9508 vectopluviometer Effect Engineering

A rain gage or array of rain gages designed to measure the inclination and direction of falling rain; vectopluviometers may be constructed in the fashion of a wind vane so that the receiver always faces the wind, or they may consist of four or more receivers arranged to point in cardinal directions.

6172 microtome Effect Engineering

An instrument for cutting thin sections of tissues or other materials for microscopical examination.

9028 surface micromachining Effect Engineering

A set of processes based upon deposition, patterning, and selective etching of thin films to form a freestanding microsensor on the surface of a silicon wafer.

6487 resistance furnace Effect Engineering

An electric furnace in which the heat is developed by the passage of current through a suitable internal resistance that may be the charge itself, a resistor embedded in the charge, or a resistor surrounding the charge. Also known as electric resistance furnace.

8887 slip casting Effect Engineering

A process in the manufacture of shaped refractories, cermets, and other materials in which the slip is poured into porous plaster molds.

8799 vernier Effect Engineering

A short, auxiliary scale which slides along the main instrument scale to permit accurate fractional reading of the least main division of the main scale.

870 specific-gravity bottle Effect Engineering

A small bottle or flask used to measure the specific gravities of liquids; the bottle is weighed when it is filled with the liquid whose specific gravity is to be determined, when filled with a reference liquid, and when empty. Also known as density bottle; relative-density bottle.

8642 wheelbarrow Effect Engineering

A small, hand-pushed vehicle with a single wheel and axle between the front ends of two shafts that support a boxlike body and serve as handles at the rear. Also known as barrow.

13527 supercalendering Effect Engineering

A calendering process that uses both steam and high pressure to give calendered material, for example, paper, a highdensity finish.

9122 recirculator Effect Engineering

A self-contained underwater breathing apparatus that recirculates an oxygen supply (mix-gas or pure) to the diver until the oxygen is depleted.

9625 conduction pump Effect Engineering

A pump in which liquid metal or some other conductive liquid is moved through a pipe by sending a current across the liquid and applying a magnetic field at right angles to current flow.

9749 dielectric curing Effect Engineering

A process for curing a thermosetting resin by subjecting it to a highfrequency electric charge.

9747 Fourcault process Effect Engineering

A process for forming sheet glass in which the molten glass is drawn vertically upward.

9740 ion-beam mixing Effect Engineering

A process in which bombardment of a solid with a beam of energetic ions causes the intermixing of atoms of two separate phases originally present in the near-surface region.

9726 ion implantation Effect Engineering

A process of introducing impurities into the near-surface regions of solids by directing a beam of ions at the solid.

9725 extrusion coating Effect Engineering

A process of placing resin on a substrate by extruding a thin film of molten resin and pressing it onto or into the substrates, or both, without the use of adhesives. exudation See sweating.

9724 full-cell process Effect Engineering

A process of preservative treatment of wood that uses a pressure vessel and first draws a vacuum on the charge of wood and then introduces the preservative without breaking the vacuum. Also known as Bethell process.

971 solvent molding Effect Engineering

A process to form thermoplastic articles by dipping a mold into a solution or dispersion of the resin and drawing off (evaporating) the solvent to leave a plastic film adhering to the mold.

9707 flotation Effect Engineering

A process used to separate particulate solids by causing one group of particles to float; utilizes differences in surface chemical properties of the particles, some of which are entirely wetted by water, others are not; the process is primarily applied to treatment of minerals but can be applied to chemical and biological materials; in mining engineering it is referred to as froth flotation.

9400 stockpile Effect Engineering

A reserve stock of material, equipment, raw material, or other supplies.

9675 deep underwater muon and neutrino Effect Engineering

A proposed device for detecting and determining the direction of extraterrestrial neutrinos passing through a volume of approximately 1 cubic kilometer of ocean water, using an array of several thousand Cerenkov counters suspended in the water to sense the showers of charged particles generated by neutrinos. Abbreviated DUMAND.

8414 bimetallic strip Effect Engineering

A strip formed of two dissimilar metals welded together; different temperature coefficients of expansion of the metals cause the strip to bend or curl when the temperature changes.

9599 Michaelson actinograph Effect Engineering

A pyrheliometer of the bimetallic type used to measure the intensity of direct solar radiation; the radiation is measured in terms of the angular deflection of a blackened bimetallic strip which is exposed to the direct solar beams.

9598 narrow-band pyrometer Effect Engineering

A pyrometer in which light from a source passes through a color filter, which passes only a limited band of wavelengths, before falling on a photoelectric detector.

9583 raft Effect Engineering

A quantity of timber or lumber secured together by means of ropes, chains, or rods and used for transportation by

9564 ionosonde Effect Engineering

A radar system for determining the vertical height at which the ionosphere reflects signals back to earth at various frequencies; a pulsed vertical beam is swept periodically through a frequency range from 0.5 to 20 megahertz, and the variation of echo return time with frequency is photographically recorded.

9560 radar triangulation Effect Engineering

A radar system of locating targets, usually aircraft, in which two or more separate radars are employed to measure range only; the target is located by automatic trigonometric solution of the triangle composed of a pair of radars and the target in which all three sides are known.

9557 Doppler radar Effect Engineering

A radar that makes use of the Doppler shift of an echo due to relative motion of target and radar to differentiate between fixed and moving targets and measure target velocities.

9552 chromoradiometer Effect Engineering

A radiation meter that uses a substance whose color changes with x-ray dosage.

9546 Golay cell Effect Engineering

A radiometer in which radiation absorbed in a gas chamber heats the gas, causing it to expand and deflect a diaphragm in accordance with the amount of radiation.

9678 dry permeability Effect Engineering

A property of dried bonded sand to permit passage of gases while molten material is poured into a mold.

3253 monopulse radar Effect Engineering

Radar in which directional information is obtained with high precision by using a receiving antenna system having two or more partially overlapping lobes in the radiation patterns.

3363 cryopreservation Effect Engineering

Preservation of food, biologicals, and other materials at extremely low temperatures.

3362 Cartesian diver manostat Effect Engineering

Preset, on-offcontrol manometer arrangement by which a specified low pressure (high vacuum) is maintained via the rise or submergence of a marginally buoyant float within a liquid mercury reservoir.

3356 diaphragm gage Effect Engineering

Pressure- or vacuumsensing instrument in which pressures act against opposite sides of an enclosed diaphragm that consequently moves in relation tothe difference between the two pressures, actuating a mechanical indicator or electric-electronic signal.

335 kiss-roll coating Effect Engineering

Procedure for coating a substrate web in which the coating roll carries a metered film of coating material; part of the film transfers to the web, part remains on the roll.

3314 capillary drying Effect Engineering

Progressive removal of moisture from a porous solid mass by surface evaporation followed by capillary movement of more moisture to the drying surface from the moist inner region, until the surface and core stabilize at the same moisture concentration.

3313 stitching Effect Engineering

Progressive welding of thermoplastic materials (resins) by successive applications of two small, mechanically operated, radiofrequency- heated electrodes; the mechanism is similar to that of a normal sewing machine.

14204 blowpipe Effect Engineering

1. Along, straight tube, used in glass blowing, on which molten glass is gathered and worked. 2. A small, tapered, and frequently curved tube that leads a jet, usually of air, into a flame to concentrate and direct it; used in flame tests in analytical chemistry and in brazing and soldering of fine work. 3. See blowtorch.

2935 Doppler sonar Effect Engineering

Sonar based on Doppler shift measurement technique. Abbreviated DS. Doppler tracking

327 inert-gas blanketing Effect Engineering

Purging the air from a unit of a heat exchanger by using an inert gas as the unit is being shut down.

3408 quench-tank extrusion Effect Engineering

Plastic-film or metal extrusion that is cooled in a quenching medium.

3190 damping Effect Engineering

Reducing or eliminating reverberation in a room by placing sound-absorbing materials on the walls and ceiling. Also known as soundproofing.

3188	pulping	Effect	Engineering

Reducing wood to pulp. pulp molding

312	pitometer	Effect	Engineering

Reversed pitot-tube-type flowmeasurement device with one pressure opening facing upstream and the other facing downstream.

3083	radiogoniometry	Effect	Engineering

Science of locating a radio transmitter by means of taking bearings on the radio waves emitted by such a transmitter.

14232	sonar	Effect	Engineering

1. A system that uses underwater sound, at sonic or ultrasonic frequencies, to detect and locate objects in the sea, or for communication; the commonest type is echo-ranging sonar; other versions are passive sonar, scanning sonar, and searchlight sonar. Derived from sound navigation and ranging. 2. See sonar set.

14253	peg	Effect	Engineering

1. A small pointed or tapered piece, often cylindrical, used to pin down or fasten parts. 2. A projection used to hang or support objects.

3005	gravity separation	Effect	Engineering

Separation of immiscible phases (gas-solid, liquid-solid, liquid-liquid, solid-solid) by allowing the denser phase to settle out under the influence of gravity; used in ore dressing and various industrial chemical processes.

6183	vibrometer	Effect	Engineering

An instrument designed to measure the amplitude of a vibration. Also known as vibration meter.

3289	jet propulsion	Effect	Engineering

Propulsion by means of a jet of fluid.

3498	electrohydraulic	Effect	Engineering

Operated or effected by a combination of electric and hydraulic mechanisms.

3692	injection molding	Effect	Engineering

Molding metal, plastic, or nonplastic ceramic shapes by injecting a measured quantity of the molten material into dies.

369	jet molding	Effect	Engineering

Molding method in which most of the heat is applied to the material to be molded as it passes through a nozzle or jet, rather than in a conventional heating cylinder.

3650 airtight Effect Engineering

Not permitting the passage of air. Also known as airproof.

3643 diamond coring Effect Engineering

Obtaining core samples of rock by using a diamond drill.

3637 gimbal freedom Effect Engineering

Of a gyro, the maximum angular displacement about the output axis of a gimbal.

3596 force compensation Effect Engineering

On an analytical balance, the weight force of a load that is held in equilibrium by a force of equal size which acts in the opposite direction.

14177 micrometer Effect Engineering

1. An instrument attached to a telescope or microscope for measuring small distances or angles. 2. A caliper for making precise measurements; a spindle is moved by a screw thread so that it touches the object to be measured; the dimension can then be read on a scale. Also known as micrometer caliper.

3554 die chaser Effect Engineering

One of the cutting parts of a composite die or a die used to cut threads.

3405 injection blow molding Effect Engineering

Plastics molding process in which a hollow-plastic tube is formed by injection molding.

3499 hydropneumatic Effect Engineering

Operated by both water and air power.

3406 continuous tube process Effect Engineering

Plastics blowmolding process that uses a continuous extrusion of plastic tubing as feed to a series of blow molds as they clamp in sequence.

3475 ramming Effect Engineering

Packing a powder metal or sand into a compact mass.

14197 spark arrester Effect Engineering

1. An apparatus that prevents sparks from escaping from a chimney.

3465 radiopasteurization Effect Engineering

Pasteurization by surface treatment with low-energy irradiation. radio position finding

3460 screen pipe Effect Engineering

Perforated pipe with a straining device in the form of closely wound wire coils wrapped around it to admit well fluids while excluding sand.

3427 macroscopic anisotropy Effect Engineering

Phenomenon in electrical downhole logging wherein electric current flows more easily along sedimentary strata beds than perpendicular to them.

3422 cooling process Effect Engineering

Physical operation in which heat is removed from process fluids or solids; may be by evaporation of liquids, expansion of gases, radiation or heat exchange to a cooler fluid stream, and so on.

342 scouring Effect Engineering

Physical or chemical attack on process equipment surfaces, as in a furnace or fluid catalytic cracker.

2900 reference tone Effect Engineering

Stable tone of known frequency continuously recorded on one track of multitrack signal recordings and intermittently recorded on signal track recordings by the collection equipment operators for subsequent use by the data analysts as a frequency reference.

3513 ropeway Effect Engineering

One or a pair of steel cables between several supporting towers which serve as tracks for transporting materials in mountainous areas or at sea.

14434 lockset Effect Engineering

1. A complete lock including the lock mechanism, keys, plates, and other parts.

1470 acoustic hologram Effect Engineering

The phase interference pattern, formed by acoustic beams, that is used in acoustical holography; when light is made to interact with this pattern, it forms an image of an object placed in one of the beams.

14412 gland Effect Engineering

1. A device for preventing leakage at a machine joint, as where a shaft emerges from a vessel containing a pressurized fluid. 2. A movable part used in a stuffing box to compress the packing.

14417 magnetic balance Effect Engineering

1. A device for determining the repulsion or attraction between magnetic poles, in which one magnet is suspended and the forces needed to cancel the effects of bringing a pole of another magnet close to one end are measured. 2. Any device

for measuring the small forces involved in determining paramagnetic or diamagnetic susceptibility.

14419 skid Effect Engineering

1. A device attached to a chain and placed under a wheel to prevent its turning when descending a steep hill. 2. A timber, bar, rail, or log placed under a heavy object when it is being moved over bare ground. 3. A wood or metal platform support on wheels, legs, or runners used for handling and moving material.

14426 bucket Effect Engineering

1. A cup on the rim of a Pelton wheel against which water impinges. 2. A reversed curve at the toe of a spillway to deflect the water horizontally and reduce erosiveness.

619 thermoelectric cooling Effect Engineering

Cooling of a chamber based on the Peltier effect; an electric current is sent through a thermocouple whose cold junction is thermally coupled to the cooled chamber, while the hot junction dissipates heat to the surroundings. Also known as thermoelectric refrigeration.

108 abrasive jet cleaning Effect Engineering

The removal of dirt from a solid by a gas or liquid jet carrying abrasives to ablate the surface.

14254 pen Effect Engineering

1. A small place for confinement, storage, or protection. 2. A device for writing with ink.

14433 lifting dog Effect Engineering

1. A component part of the overshot assembly that grasps and lifts the inner tube or a wire-line core barrel. 2. A clawlike hook for grasping cylindrical objects, such as drill rods or casing, while raising and lowering them.

14409 go-devil Effect Engineering

1. A device inserted in a pipe or hole for purposes such as cleaning or for detonating an explosive. 2. A sled for moving logs or cultivating. 3. A large rake for gathering hay.

994 virtual leak Effect Engineering

The semblance of the vacuum system leak caused by a gradual desorptive release of gas at a rate which cannot be accurately predicted.

988 vacuum filtration Effect Engineering

The separation of solids from liquids by passing the mixture through a vacuum filter.

14435 grizzly Effect Engineering

1. A coarse screen used for rough sizing and separation of ore, gravel, or soil. 2. A grating to protect chutes, manways, and winzes, in mines, or to prevent debris from entering a water inlet.

874 bionics Effect Engineering

The study of systems, particularly electronic systems, which function after the manner of living systems.

14446 air lock Effect Engineering

1. A chamber capable of being hermetically sealed that provides for passage between two places of different pressure, such as between an altitude chamber and the outside 15 air-lock strip atmosphere, or between the outside atmosphere and the work area in a tunnel or shaft being excavated through soil subjected to water pressure higher than atmospheric Also known as lock. 2. An air bubble in a pipeline which impedes liquid flow. 3. A depression on the surface of a molded plastic part that results from air trapped between the surface of the mold and the plastic.

658 friction force microscopy Effect Engineering

The use of an atomic force microscope to measure the frictional forces on a surface.

659 electrostatic force microscopy Effect Engineering

The use of an atomic force microscope to measure electrostatic forces from electric charges on a surface.

14467 drawbar Effect Engineering

1. A bar used to connect a tender to a steam locomotive. 2. A beam across the rear of a tractor for coupling machines or other loads. 3. A clay block submerged in a glass-making furnace to define the point at which sheet glass is drawn.

14430 bullet Effect Engineering

1. A conical-nosed cylindrical weight, attached to a wire rope or line, either notched or seated to engage and attach itself to the upper end of a wire line core barrel or other retrievable or retractable device that has been placed in a borehole. Also known as bug; godevil; overshot. 2. A scraper with self-adjusting spring blades, inserted in a pipeline and carried forward by the fluid pressure, clearing away accumulations or debris from the walls of a pipe.

14340 flame spraying Effect Engineering

1. A method of applying a plastic coating onto a surface in which finely powdered fragments of the plastic, together with suitable fluxes, are projected through a cone of flame. 2. Deposition of a conductor on a board in molten form, generally through a metal mask or stencil, by means of a spray gun that feeds wire into a gas flame and drives the molten particles against the work.

2848 sandblasting Effect Engineering

Surface treatment in which steel grit, sand, or other abrasive material is blown against an object to produce a roughened surface or to remove dirt, rust, and scale.

2818 gravity segregation Effect Engineering

Tendency of immiscible liquids or multicomponent granular mixtures to separate into distinct layers in accordance with their respective densities.

2705 shot boring Effect Engineering

The act or process of producing a borehole with a shot drill.

14255 vent Effect Engineering

1. A small passage made with a needle through stemming, for admitting a squib to enable the charge to be lighted. 2. A hole, extending up through the bearing at the top of the core-barrel inner tube, which allows the water and air in the upper part of the inner tube to escape into the borehole. 3. A small hole in the upper end of a core-barrel inner tube that allows water and air in the inner tube to escape into the annular space between the inner and outer barrels. 4. An opening provided for the discharge of pressure or the release of pressure from tanks, vessels, reactors, processing equipment, and so on. 5. A pipe for providing airflow to or from a drainage system or for circulating air within the system to protect trap seals from siphonage and back pressure.

2566 bioengineering Effect Engineering

The application of engineering knowledge to the fields of medicine and biology.

2562 neurotechnology Effect Engineering

The application of microfabricated devices to achieve direct contact with the electrically active cells of the nervous system (neurons).

14307 preform Effect Engineering

1. A preshaped fibrous reinforcement. 2. A compact mass of premixed plastic material that has been prepared for convenient handling and control of uniformity during the mold loading process.

2489 micromechatronics Effect Engineering

The branch of engineering concerned with micro-electro-mechanical systems.

1441 tumbler Effect Engineering

1. A device in a lock cylinder that must be moved to a particular position, as by a key, before the bolt can be thrown. 2. A device or mechanism in which objects are tumbled.

2206 electrothermal energy conversion Effect Engineering

The direct conversion of electric energy into heat energy, as in an electric heater.

563 pneumatic Effect Engineering

Pertaining to or operated by air or other gas.

2163 slant drilling Effect Engineering

The drilling of a borehole or well at an angle to t h e vertical.

2063 spinning Effect Engineering

The extrusion of a spinning solution (such as molten plastic) through a spinneret.

14347 bellows Effect Engineering

1. A mechanism that expands and contracts, or has a rising and falling top, to suck in air through a valve and blow it out through a tube. 2. Any of several types of enclosures which have accordionlike walls, allowing one to vary the volume. 3. See aneroid capsule.

1999 fly rock Effect Engineering

The fragments of rock thrown and scattered during quarry or tunnel blasting. flywheel

14374 bell Effect Engineering

1. A hollow metallic cylinder closed at one end and flared at the other; it is used as a fixed-pitch musical instrument or signaling device and is set vibrating by a clapper or tongue which strikes the lip. 2. See bell tap.

1882 surface ignition Effect Engineering

The initiation of a flame in the combustion chamber of an automobile engine by any hot surface other than the spark discharge.

14408 vapor-recovery unit Effect Engineering

1. A device or system to catch vaporized materials (usually fuels or solvents) as they are vented. 2. In petroleum refining, a process unit to which gases and vaporized gasoline from various processing operations are charged, separated, and recovered for further use.

3713 sandwich heating Effect Engineering

Method for heating both sides of a thermoplastic sheet simultaneously prior to forming or shaping.

2270 precoating Effect Engineering

The depositing of an inert material, such as filter aid, onto the filter medium prior to the filtration of suspended solids from a solid-liquid slurry.

6005 normal-incidence pyrheliometer Effect Engineering

An instrument that measures the energy in the solar beam; it usually measures the radiation that strikes a target at the end of a tube equipped 373 normal inspection with a shutter and baffles to collimate the beam.

6142 convectron Effect Engineering

An instrument for indicating deviation from the vertical which is based on the principle that the convection from a heated wire depends strongly on its inclination; it consists of a Y-shaped tube, each of whose arms contains a wire forming part of a bridge circuit.

6136 inkometer Effect Engineering

An instrument for measuring adhesion of liquids by rotating drums in contact with the liquid.

6125 nutating-disk meter Effect Engineering

An instrument for measuring flow of a liquid in which liquid passing through a chamber causes a disk to nutate, or roll back and forth, and the total number of rolls is mechanically counted.

6123 vortex precession flowmeter Effect Engineering

An instrument for measuring gas flows from the rate of precession of vortices generated by a fixed set of radial vanes placed in the flow. Also known as swirl flowmeter.

6122 free-piston gage Effect Engineering

An instrument for measuring high fluid pressures in which the pressure is applied to the face of a small piston that can move in a cylinder and the force needed to keep the piston stationary is determined. Also known as piston gage.

6112 acoustic radiometer Effect Engineering

An instrument for measuring sound intensity by determining the unidirectional steady-state pressure caused by the reflection or absorption of a sound wave at a boundary.

6108 water meter Effect Engineering

An instrument for measuring the amount of water passing a specified point in a piping system.

3694 thread plug Effect Engineering

Mold part which shapes an internal thread onto a molded article; must be unscrewed from the finished piece.

6013 vibrating-reed magnetometer Effect Engineering

An instrument that measures magnetic fields by noting their effect on the vibration of reeds excited by an alternating magnetic field.

6146 hygrometer Effect Engineering

An instrument for giving a direct indication of the amount of moisture in the air or other gas, the indication usually being in terms of relative humidity as a percentage which the moisture present bears to the maximum amount of moisture that could be present at the location temperature without condensation taking place.

5998 mass flowmeter Effect Engineering

An instrument that measures the mass of fluid that flows through a pipe, duct, or open channel in a unit time.

5993 pitot tube Effect Engineering

An instrument that measures the stagnation pressure of a flowing fluid, consisting of an open tube pointing into the fluid and connected to a pressure-indicating device. Also known as impact tube.

597 positron camera Effect Engineering

An instrument that uses photomultiplier tubes in combination with scintillation counters to detect oppositely directed gamma-ray pairs resulting from the annihilation with electrons of positrons emitted by short-lived radioisotopes used as tracers in the human body.

5949 x-ray diffractometer Effect Engineering

An instrument used in x-ray analysis to measure the intensities of the diffracted beams at different angles.

5937 vaporimeter Effect Engineering

An instrument used to measure a substance's vapor pressure, especially that of an alcoholic liquid, in order to determine its alcohol content.

5910 ultrasonic leak detector Effect Engineering

An instrument which detects ultrasonic energy resulting from the transition from laminar to turbulent flow of a gas passing through an orifice.

5909 mercury barometer Effect Engineering

An instrument which determines atmospheric pressure by measuring the height of a column of mercury which the atmosphere will support; the mercury is in a glass tube closed at one end and placed, open end down, in a well of mercury. Also known as Torricellian barometer.

5899 spring balance Effect Engineering

An instrument which measures force by determining the extension of a helical spring.

6014 photoelectric pyrometer Effect Engineering

An instrument that measures high temperatures by using a photoelectric arrangement to measure the radiant energy given off by the heated object.

618 viscometer Effect Engineering

An instrument designed to measure the viscosity of a fluid.

14470 rail Effect Engineering

1. A bar extending between posts or other supports as a barrier or guard. 2. A steel bar resting on the crossties to provide track for railroad cars and other vehicles with flanged wheels.

3 buckling Effect Engineering

Wrinkling or warping of fibers in a composite material.

629 dust explosion Effect Engineering

An explosion following the ignition of flammable dust suspended in the air.

6246 solar furnace Effect Engineering

An image furnace in which high temperatures are produced by focusing solar radiation.

6229 hot stamp Effect Engineering

An impression on a forging made in a heated condition.

6207 low-frequency induction furnace Effect Engineering

An induction furnace in which current flow at the commercial power-line frequency is induced in the charge to be heated.

6206 high-frequency furnace Effect Engineering

An induction furnace in which the heat is generated within the charge, within the walls of the containing crucible, or within both, by currents induced by 270 high-vacuum insulation high-frequency magnetic flux produced by a surrounding coil. Also known as coreless-type induction furnace; high-frequency heater.

6185 x-ray telescope Effect Engineering

An instrument designed to detect x-rays emanating from a source outside the earth's atmosphere and to resolve the x-rays into an image; they are carried to high altitudes by balloons, rockets, or space vehicles; although several types of x-ray detector, involving gas counters, scintillation counters, and collimators, have been used, only one, making use of the phenomenon of total external reflection of x-rays from a surface at grazing incidence, is strictly an x-ray telescope.

6144 compass Effect Engineering

An instrument for indicating a horizontal reference direction relative to the earth.

6182 radio atmometer Effect Engineering

An instrument designed to measure the effect of sunlight upon evaporation from plant foliage; consists of a porous- clay atmometer whose surface has been blackened so that it absorbs radiant energy.

6145	atom probe	Effect	Engineering

An instrument for identifying a single atom or molecule on a metal surface; it consists of a field ion microscope with a probe hole in its screen opening into a mass spectrometer; atoms that are removed from the specimen by pulsed field evaporation fly through the probe hole and are detected in the mass spectrometer.

6690	sonic anemometer	Effect	Engineering

An anemometer which measures wind speed by means of the properties of wind-borne sound waves; it operates on the principle that the propagation velocity of a sound wave in a moving medium is equal to the velocity of sound with respect to the medium plus the velocity of the medium.

616	stadimeter	Effect	Engineering

An instrument for determining the distance to an object, but its height must be known; the angle subtended by the object's bottom and top as measured at the observer's position is proportional to the object's height; the instrument is graduated directly in distance.

6159	Ewing's hysteresis tester	Effect	Engineering

An instrument for determining the hysteresis loss of a specimen of magnetic material by measuring the deflection of a horseshoe magnet when the specimen is rapidly rotated between the poles of the magnet and the magnet is allowed to rotate about an axis that is aligned with the axis of rotation of the specimen.

6158	Curle balance	Effect	Engineering

An instrument for determining the susceptibility of weakly magnetic materials, in which the deflection produced by a strong permanent magnet on a suspended tube containing the specimen is measured.

6154	Doppler ultrasonic flowmeter	Effect	Engineering

An instrument for determining the velocity of fluid flow from the Doppler shift of high-frequency sound waves reflected from particles or discontinuities in the flowing fluid.

6153	volumenometer	Effect	Engineering

An instrument for determining the volume of a body by measuring the pressure in a closed air space when the specimen is present and when it is absent.

6150	venturi meter	Effect	Engineering

An instrument for efficiently measuring fluid flow rate in a piping system; a nozzle section increases velocity and is followed by an expanding section for recovery of kinetic energy.

5694 minimum thermometer Effect Engineering

A thermometer that automatically registers the lowest temperature attained during an interval of time.

10596 vapor-phase axial deposition Effect Engineering

A method of fabricating graded-index optical fibers in which fine glass particles of silicon dioxide and germanium dioxide are synthesized and deposited on a rotating seed rod, and the synthesized porous preform is then pulled up and passes through a hot zone, undergoing dehydration and sintering, to become a porous preform. Abbreviated VAD.

4252 radiation oven Effect Engineering

Heating chamber relying on tungsten-filament infrared lamps with reflectors to create temperatures up to 600°F (315°C); used to dry sheet and granular material and to bake surface coatings.

5879 torsion balance Effect Engineering

An instrument, consisting essentially of a straight vertical torsion wire whose upper end is fixed while a horizontal beam is suspended from the lower end; used to measure minute gravitational, electrostatic, or magnetic forces.

4667 friction-tube viscometer Effect Engineering

Device to determine liquid viscosity by measurement of pressure drop through a friction tube with the liquid in viscous flow; gives direct solution to Poiseuille's equation.

4655 photoelectric fluorometer Effect Engineering

Device using a photoelectric cell to measure fluorescence in a chemical sample that has been excited (one or more electrons have been raised to higher energy level) by ultraviolet or visible light; used for analysis of chemical mixtures.

4646 molding shrinkage Effect Engineering

Difference in dimensions between the molding and the mold cavity, measured at normal room temperature.

460 blasthole drilling Effect Engineering

Drilling to produce a series of holes for placement of blasting charges. blasting

4472 prefilter Effect Engineering

Filter used to remove gross solid contaminants before the liquid stream enters a separator-filter.

4399 frequency-modulated radar Effect Engineering

Form of radar in which the radiated wave is frequency modulated, and the returning echo beats with the wave being radiated, thus enabling range to be measured.

4357 induction burner Effect Engineering

Fuel-air burner into which the fuel is fed under pressure to entrain needed air into the combustion nozzle area. induction charging

473 vacuum evaporation Effect Engineering

Deposition of thin films of metal or other materials on a substrate, usually through openings in a mask, by evaporation from a boiling source in a hard vacuum.

4253 resistor oven Effect Engineering

Heating chamber relying on an electrical-resistance element to create temperatures of up to 800℉ (430℃); used for drying and baking.

4756 sawing Effect Engineering

Cutting with a saw.

4239 microwave early warning Effect Engineering

High-power, long-range radar with a number of indicators, giving high resolution, and with a large traffichandling capacity; used for early warning of missiles.

4238 press polish Effect Engineering

High-sheen finish on plastic sheet stock produced by contact with a smooth metal under heat and pressure.

3979 premix Effect Engineering

In plastics molding, materials in which the resin, reinforcement, extenders, fillers, and so on have been premixed before molding.

3865 hot-gas welding Effect Engineering

Joining of thermoplastic materials by softening first with a jet of hot air, then joining at the softened points.

3852 infiltration Effect Engineering

Leakage of outdoor air into a building by natural forces, for example, by seepage through cracks or other openings.

14143 seal Effect Engineering

1. Any device or system that creates a nonleaking union between two mechanical or process-system elements; for example, gaskets for pipe connection seals, mechanical seals for rotating members such as pump shafts, and liquid seals to prevent gas entry to or loss from a gas-liquid processing sequence. 2. A tight, perfect closure or joint.

3746 bubble test Effect Engineering

Measurement of the largest opening in the mesh of a filter screen; determined by the pressure needed to force air or gas through the screen while it is submerged in a liquid.

13900 screening Effect Engineering

1. The separation of a mixture of grains of various sizes into two or more sizerange portions by means of a porous or wovenmesh screening media. 2. The removal of solid particles from a liquid-solid mixture by means of a screen. 3. The material that has passed through a screen.

4259 vitrification Effect Engineering

Heat treatment of a material such as a ceramic to produce a glazed surface.

5315 gravity corer Effect Engineering

Any type of corer that achieves bottom penetration solely as a result of gravitational force acting upon its mass.

3709 chill-roll extrusion Effect Engineering

Method of extruding plastic film in which the film is cooled while being drawn around two or more highly polished chill rolls, inside of which there is cooling water.

568 sonoscan Effect Engineering

A type of acoustic microscope in which an unfocused acoustic beam passes through the object and produces deformations in a liquid-solid interface that are sensed by a laser beam reflected from the surface.

5677 Danjon prismatic astrolabe Effect Engineering

A type of astrolabe in which a Wollaston prism just inside the focus of the telescope converts converging beams of light into parallel beams, permitting a great increase in accuracy daraf

5597 motion picture projector Effect Engineering

An optical and mechanical device capable of flashing pictures taken by a motion picture camera on a viewing screen at the same frequency the action was photographed, thus producing an image that appears to move.

5486 blast cleaning Effect Engineering

Any cleaning process in which an abrasive is directed at high velocity toward the surface being cleaned, for example, sand blasting.

5456 telescope Effect Engineering

Any device that collects radiation, which may be in the form of electromagnetic or particle radiation, from a limited direction in space.

5410 cock Effect Engineering

Any mechanism which starts, stops, or regulates the flow of liquid, such as a valve, faucet, or tap.

5377 relief hole Effect Engineering

Any of the holes fired afterthe 455 relief valve cut holes and before the lifter holes in breaking ground for tunneling or shaft sinking.

4713 aviation method Effect Engineering

Determination of knocklimiting power, under lean-mixture conditions, of fuels used in spark-ignition aircraft engines.

5317 snorkel Effect Engineering

Any tube which supplies air for an underwater operation, whether it be for material or personnel.

5848 mirror interferometer Effect Engineering

An interferometer used in radio astronomy, in which the sea surface acts as a mirror to reflect radio waves up to a single antenna, where the reflected waves interfere with the waves arriving directly from the source.

531 gravity conveyor Effect Engineering

Any unpowered conveyor such as a gravity chute or a roller conveyor, which uses the force of gravity to move materials over a downward path.

5282 suction line Effect Engineering

A pipe ortubing feeding into the inlet of a fluid impelling device (for example, pump, compressor, or blower), consequently under suction.

5122 vibrating-reed tachometer Effect Engineering

Atachometer consisting of a group of reeds of different lengths, each having a specific natural frequency of vibration; observation of the vibrating reed when in contact with a moving mechanical device indicates the frequency of vibration for the device.

13979 micromechanics Effect Engineering

1. The design and fabrication of micromechanisms. 2. See composite micromechanics.

5033 Langmuir diffusion pump Effect Engineering

Atypeof diffusion pump in which the mercury vapor emerges from a nozzle, giving it motion in a direction away from the high-vacuum side of the pump. lantern

4895 sonic cleaning Effect Engineering

Cleaning of contaminated materials by the action of intense sound in the liquid in which the material is immersed.

4873 surface combustion Effect Engineering

Combustion brought about near the surface of a heated refractory material by forcing a mixture of air and combustible gases through it or through a hole in it, or having the gas impinge directly upon it; used in muffles, crucibles, and certain types of boiler furnaces.

4787 reeding Effect Engineering

Corrugating or serrating, as in coining or embossing.

5344 electrothermal process Effect Engineering

Any process which uses an electric current to generate heat, utilizing resistance, arcs, or induction; used to achieve temperatures higher than can be obtained by combustion methods.

11628 nuclear gyroscope Effect Engineering

A gyroscope in which the conventional spinning mass is replaced by the spin of atomic nuclei and electrons; one version uses optically pumped mercury isotopes, and another uses nuclear magnetic resonance techniques.

80 remote manipulation Effect Engineering

Use of mechanical equipment controlled from a distance to handle materials, such as radioactive materials. Also known as teleoperation.

11624 nuclear magnetic resonance Effect Engineering

A gyroscope that obtains information from the dynamic angular motion of atomic nuclei. nuclear magnetometer

12654 sediment trap Effect Engineering

A device for measuring the accumulation rate of sediment on the floor of a body of water.

12220 manometer Effect Engineering

A double-leg liquid-column gage used to measure the difference between two fluid pressures.

11978 nuclear magnetic resonance flowmeter Effect Engineering

A flowmeter in which nuclei of the flowing fluid are resonated by a radio-frequency field superimposed on an intense permanent magnetic field, and a detector downstream measures the amount of decay of the resonance, thereby sensing fluid velocity.

12200 telescopic derrick Effect Engineering

A drill derrick divided into two or more sections, with the uppermost sections nesting successively into the lower sections.

11627 electrically suspended gyro Effect Engineering

A gyroscope in which the main rotating element is suspended by an electromagnetic or an electrostatic field.

12757 ground magnetic survey Effect Engineering

A determination of the magnetic field at the surface of the earth by means of ground-based instruments. groundman

12378 strain gage Effect Engineering

A device which uses the change of electrical resistance of a wire under strain to measure pressure.

12896 magneto anemometer Effect Engineering

A cup anemometer with its shaft mechanically coupled to a magnet; both the frequency and amplitude of the voltage generated are proportional to the wind speed, and may be indicated or recorded by suitable electrical instruments.

10762 nutator Effect Engineering

A mechanical or electrical device used to move a radar beam in a circular, conical, spiral, or other manner periodically to obtain greater air surveillance than could be obtained with a stationary beam.

89 spectrometerion machining Effect Engineering

Use of a high-velocity ion beam to remove material from a surface. Also known as ion beam thinning, ion milling.

10922 Kapitza balance Effect Engineering

A magnetic balance for measuring susceptibilities of materials in large magnetic fields that are applied for brief periods. Kapitza expander

12425 vacuum breaker Effect Engineering

A device used to relieve a vacuum formed in a water supply line to prevent backflow. Also known as backflow preventer. vacuum cleaner

12429 flamethrower Effect Engineering

A device used to project ignited fuel from a nozzle so as to cause casualties to personnel or to destroy material such as weeds or insects.

11686 gravity chute Effect Engineering

A gravity conveyor in the form of an inclined plane, trough, or framework that depends on sliding friction to control the rate of descent.

10752 pressure pillow Effect Engineering

A mechanical-hydraulic snow gage consisting of a circular rubber or metal pillow filled with a solution of antifreeze and water, and containing either a pressure transducer or a riser pipe to record increase in pressure of the snow.

7 rotating viscometer vacuum gage Effect Engineering

Vacuum (reduced-pressure) measurement device in which the torque on a spinning armature is proportional to the viscosity (and the pressure) of the rarefied gas being measured; sensitive for absolute pressures of 1 millimeter of mercury (133.32 pascals), down to a few tens of micrometers.

10875 telltale Effect Engineering

A marker on the outside of a tank that indicates on an exterior scale the amount of fluid inside the tank.

11210 limelight Effect Engineering

A light source once used in spotlights; it consisted of a block of lime heated to incandescence by means of an oxyhydrogen flame torch.

11087 capillary viscometer Effect Engineering

A long, narrow tube that is used to measure the laminar flow of fluids.

12714 breaking pin device Effect Engineering

A device designed to relieve pressure resulting from inlet static pressure by the fracture of a loaded part of a pin.

52 granular-bed separator Effect Engineering

Vessel or chamber in which a bed of granular material is used to remove dust from a dust-laden gas as it passes through the bed.

11098 rotary kiln Effect Engineering

A long cylindrical kiln lined with refractory, inclined at a slight angle, and rotated at a slow speed.

11560 thermoacoustic engine Effect Engineering

A heat engine that harnesses the combination of the pressure oscillations of a sound wave with the accompanying adiabatic temperature oscillations.

11203 no-go gage Effect Engineering

A limit gage designed not to fit a part being tested; usually employed with a go gage to set the acceptable maximum and minimum dimension limits of the part.

12658 vibrating wire transducer Effect Engineering

A device for measuring ocean depth, consisting of a very fine tungsten wire stretched in a magnetic field so that it vibrates at a frequency that depends on the tension in the wire, and thereby on pressure and depth.

11245 pressure dye test Effect Engineering

A leak detection method in which a pressure vessel is filled with liquid dye and is pressurized under water to make possible leakage paths visible.

13219 Six's thermometer Effect Engineering

A combination maximum thermometer and minimum thermometer; the tube is shaped in the form of a U with a bulb 503 six-tenths factor at either end; one bulb is filled with creosote which expands or contracts with temperature variation, forcing before it a short column of mercury having iron indexes at either end; the indexes remain at the extreme positions reached by the mercury column, thus indicating the maximum and minimum temperatures; the indexes can be reset with the aid of a magnet.

1336 transfer chute Effect Engineering

A chute used at a transfer point in a conveyor system; the chute is designed with a curved base or some other feature so that the load be discharged in a centralized stream and in the same direction as the receiving conveyor.

11587 wire stripper Effect Engineering

A hand-operated tool or special machine designed to cut and remove the insulation for a predetermined distance from the end of an insulated wire, without damaging the solid or stranded wire inside.

11492 getter-ion pump Effect Engineering

A high-vacuum pump that employs chemically active metal layers which are continuously or intermittently deposited on the wall of the pump, and which chemisorb active gases while inert gases are "cleaned up" by ionizing them in an electric discharge and drawing the positive ions to the wall, where the neutralized ions are buried by fresh deposits of metal. Also known as sputter-ion pump.

11727 tape Effect Engineering

A graduated steel ribbon used, instead of a chain, in surveying.

13230 photoelectric colorimeter Effect Engineering

A colorimeter that uses a phototube or photocell, a set of color filters, an amplifier, and an indicating meter for quantitative determination of color.

617 electroscope Effect Engineering

An instrument for detecting an electric charge by means of the mechanical forces exerted between electrically charged bodies.

10896 U-tube manometer Effect Engineering

A manometer consisting of a U-shaped glass tube partly filled with a liquid of known specific gravity; when the legs of the manometer are connected to separate sources of pressure, the liquid rises in one leg and drops in the other; the difference between the levels is proportional to the difference in pressures and inversely proportional to the liquid's specific gravity. Also known as liquid-column gage.

10918 vibrating needle Effect Engineering

A magnetic needle used in compass adjustment to find the relative intensity of the horizontal components of the earth's magnetic field and the magnetic field at the compass location.

11225 photoelectric liquid-level indicator Effect Engineering

A level indicator in which rising liquid interrupts the light beam of a photoelectric control system; used in a tank or process vessel.

11805 far-infrared maser Effect Engineering

A gas maser that generates a beam having a wavelength well above 100 micrometers, and ranging up to the present lower wavelength limit of about 500 micrometers for microwave oscillators.

10613 radio echo observation Effect Engineering

A method of determining the distance of objects in the atmosphere or outer space, in which a radar pulse is directed at the object and the time that elapses from transmission of the pulse to reception of a reflected pulse is measured.

10615 autoclave molding Effect Engineering

A method of curing reinforced plastics that uses an autoclave with 50-100 pounds per square inch (345-690 kilopascals) steam pressure to set the resin.

12612 Penning trap Effect Engineering

A device for trapping electrons and isolating single electrons, consisting of a large, homogeneous magnetic field plus a superimposed weak parabolic electric potential Penning-trap mass spectrometer created by a positive charge +Q on a ring electrode and two negative charges -Q/2 each on two cap electrodes.

10702 pressure vessel Effect Engineering

A metal container, generally cylindrical or spheroid, capable of withstanding bursting pressures.

78 acoustic radar Effect Engineering

Use of sound waves with radar techniques for remote probing of the lower atmosphere, up to heights of about 5000 feet (1500 meters), for measuring wind speed and direction, humidity, temperature inversions, and turbulence.

12556 self-timer Effect Engineering

A device that delays the tripping of a camera shutter so that the photographer can be included in the photograph.

12192 telescopic tripod Effect Engineering

A drill or surveyor's tripod each leg of which is a series of two or more closely fitted nesting tubes, which can be locked rigidly together in an extended position to form a long leg or nested one within the other for easy transport.

76 neuromorphic engineering Effect Engineering

Use of the functional principles of biological nervous systems to inspire the design and fabrication of artificial nervous systems, such as vision chips and roving robots.

12105 cartridge filter Effect Engineering

A filter for the clarification of process liquids containing small amounts of solids; turgid liquid flows between thin metal disks, assembled in a vertical stack, to openings in a central shaft supporting the disks, and solids are trapped between

10663 moving-iron meter Effect Engineering

A meter that depends on current in one or more fixed coils acting on one or more pieces of soft iron, at least one of which is movable.

11810 torsion galvanometer Effect Engineering

A galvanometer in which the force between the fixed and moving systems is measured by the angle through which the supporting head of the moving system must be rotated to bring the moving system back to its zero position.

12615 scrubber Effect Engineering

A device for the removal, or washing out, of entrained liquid droplets or dust, or for the removal of an undesired gas component from process gas streams. Also known as washer; wet collector.

79 radio prospecting Effect Engineering

Use of radio and electric equipment to locate mineral or oil deposits. radio shielding

12106 vacuum filter Effect Engineering

A filter device into which a liquid-solid slurry is fed to the high-pressure side of a filter medium, with liquid pulled through to the low-pressure side of the medium and a cake of solids forming on the outside of the medium.

75 gamma-ray tracking Effect Engineering

Use of three tracking stations, located at the three corners of a triangle centered on a missile about to be launched, to obtain accurate azimuthal tracking of a cobalt-60 gamma source in the tail.

10783	micromechanism	Effect	Engineering

A mechanical component with submillimeter dimensions and corresponding tolerances of the order of 1 micrometer or less.

12574	lazy jack	Effect	Engineering

A device that accommodates changes in length of a pipeline or similar structure through the motion of two linked bell cranks.

10632	press bonding	Effect	Engineering

A method of bonding structures or materials through the application of pressure by a platen press or other tool. pressed loading

10749	spray	Effect	Engineering

A mechanically produced dispersion of liquid into a gas stream; as drops are large, the spray is unstable and the liquid will fall free of the gas stream when velocity decreases.

10602	auger drilling	Effect	Engineering

A method of drilling in which penetration is accomplished by the cutting or gouging action of chisel-type cutting edges forced into the substance by rotation of the auger bit. Also known as auger boring.

6394	Wiese formula	Law	Engineering

An empirical relationship for motor fuel antiknock values above 100 in relation to performance numbers; basis for the American Society forTesting and Materials scale, in which octane numbers above 100 are related to increments of tetraethyllead added to isooctane.

587	plasma processing	Law	Engineering

Methods and technologies that utilize a plasma to treat and manufacture materials, generally through etching, deposition, or chemical alteration at a surface inside or at the boundary of the plasma.

10566	analytical photogrammetry	Law	Engineering

A method of photogrammetry in which solutions are obtained by mathematical methods.

3264	calorific value	Law	Engineering

Quantity of heat liberated on the complete combustion of a unit weight or unit volume of fuel.

2273	Blears effect	Law	Engineering

The dependence of the signal from an ionization gage on the geometry of the system being measured when an organic vapor is present in the vacuum; the effect can falsify measurement results by up to an order of magnitude.

207 footage Law Engineering

The extent or length of a material expressed in feet.

13624 geophysical engineering Law Engineering

A branch of engineering that applies scientific methods for locating mineral deposits.

3239 analytical radial triangulation Law Engineering

Radial triangulation performed by computational routines.

4538 aerospace engineering Law Engineering

Engineering pertaining to the design and construction of aircraft and space vehicles and of power units, and to the special problems of flight in both the earth's atmosphere and space, as in the flight of air vehicles and in the launching, guidance, and control of missiles, earth satellites, and space vehicles and probes.

13795 aerodynamic balance Law Engineering

A balance used for the measurement of the forces exerted on the surfaces of instruments exposed to flowing air; frequently used in tests made on models in wind tunnels.

8052 Simon's theory Law Engineering

A theory of drilling which includes the effects of drilling by percussion and by vibration with a rotary (oil well) bit, cable tool, and pneumatic hammer; the rate of penetration of a chisel-shaped bit into brittle rock may be defined as follows: R = NAf v /TTD, where R equals the rate of advance of bit, N equals the number of wings of bit, fv equals the number of impacts per unit time, D equals the diameter of the bit, and A equals the cross-sectional area of the crater at the periphery of the drill hole.

11000 magnetic separator Prime Effect Engineering

A machine for separating magnetic from less magnetic or nonmagnetic materials by using strong magnetic fields; used for example, in tramp iron removal, or concentration and purification.

4257 thermoelectric heating Prime Effect Engineering

Heating based on the Peltier effect, involving a device which is in principle the same as that used in thermoelectric cooling except that the current is reversed.

4255 infrared heating Prime Effect Engineering

Heating by means of infrared radiation.

4886 metal spraying Prime Effect Engineering

Coating a surface with droplets of molten metal or alloy by using a compressed gas stream.

1329 sonic flaw detection Prime Effect Engineering

The process of locating imperfections in solid materials by observing internal reflections or a variation in transmission through the materials as a function of sound-path location.

10600 freeze drying Prime Effect Engineering

A method of drying materials, such as certain foods, that would be destroyed by the loss of volatile ingredients or by drying temperatures above the freezing point; the material is frozen under high vacuum so that ice or other frozen solvent will quickly sublime and a porous solid remain.

3413 cavitation Prime Effect Engineering

Pitting of a solid surface such as metal or concrete.

14059 evaporative cooling Prime Effect Engineering

1. Lowering the temperature of a large mass of liquid by utilizing the latent heat of vaporization of a portion of the liquid. 2. Cooling air by evaporating water into it. 3. See vaporization cooling.

2075 irradiation Prime Effect Engineering

The exposure of a material, object, or patient to x-rays, gamma rays, ultraviolet rays, or other ionizing radiation.

13085 venturi tube Prime Effect Engineering

A constriction that is placed in a pipe and causes a drop in pressure as fluid flows through it, consisting essentially of a short straight pipe section or throat between two tapered sections; it can be used to measure fluid flow rate (a venturi meter), or to draw fuel into the main flow stream, as in a carburetor.

14346 sieve Prime Effect Engineering

1. A meshed or perforated device or sheet through which dry loose material is refined, liquid is strained, and soft solids are comminuted.

1423 radar Prime Effect Engineering

1. A system using beamed and reflected radio-frequency energy for detecting and locating objects, measuring distance or altitude, navigating, homing, bombing, and other purposes; in detecting and ranging, the time interval between transmission of the energy and reception of the reflected energy establishes the range of an object in the beam's path. Derived from radio detection and ranging. 2. See radar set.

5472 transducer Prime Effect Engineering

Any device or element which converts an input signal into an output signal of a different form; examples include the microphone, phonograph pickup, loudspeaker, barometer, photoelectric cell, automobile horn, doorbell, and underwater sound transducer.

3370 radio-frequency preheating Prime Effect Engineering

Preheating of plastics-molding materials by radio frequencies of 10-100 megahertz per second to facilitate the molding operation or to reduce the moldingcycle time. Abbreviated rf preheating.

196 terahertz technology Prime Effect Engineering

The generation, detection, and application (such as in communications and imaging) of electromagnetic radiation roughly in the frequency range from 0.05 to 20 terahertz, corresponding to wavelengths from 6 millimeters down to 15 micrometers.

14010 nanotechnology Prime Effect Engineering

1. Systems for transforming matter, energy, and information that are based on nanometer-scale components with precisely defined molecular features. 2. Techniques that produce or measure features less than 100 nanometers in size.

10925 water-jet cutting Prime Effect Engineering

A machining method that uses a jet of pressurized water containing abrasive powder for cutting steel and other dense materials.

3675 gravity feed Prime Effect Engineering

Movement of materials from one location to another using the force of gravity. gravity meter

14410 x-ray microscope Prime Effect Engineering

1. A device in which an ultra-fine-focus x-ray tube or electron gun produces an electron beam focused to an extremely small image on a transmission-type x-ray target that serves as a vacuum seal; the magnification is by projection; specimens being examined can thus be in air, as also can the photographic film that records the magnified image.

10360 gravity bed Prime Effect Engineering

A moving body of solids in which particles (granules, pellets, beads, or briquets) flow downward by gravity through a vessel, while process fluid flows upward; the moving- bed technique is used in blast and shaft furnaces, petroleum catalytic cracking, pellet dryers, and coolers.

8145 magnetic resonance imaging Prime Effect Engineering

A technique in which an object placed in a spatially varying magnetic field is subjected to a pulse of radio-frequency radiation, and the resulting nuclear magnetic resonance spectra are combined to give cross-sectional images. Abbreviated MRI.

13623 mechatronics Prime Effect Engineering

A branch of engineering that incorporates the ideas of mechanical and electronic engineering into a whole, and, in particular, covers those areas of engineering concerned with the increasing integration of mechanical, electronic, and software engineering into a production process.

1075 vacuum drying Prime Effect Engineering

The removal of liquid from a solid material in a vacuum system; used to lower temperatures needed for evaporation to avoid heat damage to sensitive material.

13077 mechanical comparator Prime Effect Engineering

A contact comparator in which movement is amplified usually by a rack, pinion, and pointer or by a parallelogram arrangement.

7234 friction welding Prime Effect Engineering

A welding process for metals and thermoplastic materials in which two members are joined by rubbing the mating faces together under high pressure.

5615 solar collector Prime Effect Engineering

An installation designed to gather and accumulate energy in the form of solar radiation.

10526 ultrasonic cleaning Prime Effect Engineering

A method used to clean debris and swarf from surfaces by immersion in a solvent in which ultrasonic vibrations are

10642 ultrasonic sealing Prime Effect Engineering

A method for sealing plastic film by using localized heat developed by vibratory mechanical pressure at ultrasonic frequencies.

4260 convection cooling Prime Effect Engineering

Heat transfer by natural, upward flow of hot air from the device being cooled.

11622 gyroscope Prime Effect Engineering

A gyroscope that senses, measures, and transmits angular displacement data.

8592 sonic depth finder Prime Effect Engineering

A sonar-type instrument used to measure ocean depth and to locate underwater objects; a sound pulse is transmitted vertically downward by a piezoelectric or magnetostriction transducer mounted on the hull of the ship; the time required for the pulse to return after reflection is measured electronically. Also known as echo sounder.

3436 self-cleaning Prime Effect Engineering

Pertaining to any device that is designed to clean itself without disassembly, for example, a filter in which accumulated filter cake or sludge is removed by an internal scraper or by a blowdown or backwash action.

14108 shrinkage Prime Effect Engineering

1. Contraction of a molded material, such as metal or resin, upon cooling. 2. Contraction of a plastics casting upon polymerizing. shrink fit

5509 variable-resistance accelerometer Prime Effect Engineering

Any accelerometer which operates on the principle that electrical resistance of any conductor is a function of its dimensions; when the dimensions of the conductor are varied mechanically, as constant current flows through it, the voltage across it varies as a function of this mechanical excitation; examples include the strain-gage accelerometer, and an accelerometer making use of a slide-wire potentiometer.

14339 wedging Prime Effect Engineering

1. A method used in quarrying to obtain large, regular blocks of building stones; a row of holes is drilled, either by hand or by pneumatic drills, close to each other so that a longitudinal crevice is formed into which a gently sloping steel wedge is driven, and the block of stone can be detached without shattering.

7697 vacuum freeze dryer Prime Effect Engineering

A type of indirect batch dryer used to dry materials that would be destroyed by the loss of volatile ingredients or by drying temperatures above the freezing point.

6139 stroboscope Prime Effect Engineering

An instrument for making moving bodies visible intermittently, either by illuminating the object with brilliant flashes of light or by imposing an intermittent shutter between the viewer and the object; a high-speed vibration can be made visible by adjusting the strobe frequency close to the vibration frequency.

788 piezoresistive sensor Prime Effect Engineering

A transducer which converts variations in mechanical stress into an electrical output; it consists of an element of piezoresistive material that is connected to a Wheatstone bridge circuit and is placed on a highly stressed part of a suitable mechanical structure, usually attached to a cantilever or other beam configuration.

3914 induction heating Prime Effect Engineering

Increasing the temperature in a material by induced electric current. Also known as eddy-current heating.

3006 electrostatic separation Prime Effect Engineering

Separation of finely pulverized materials by placing them in electrostatic separators. Also known as hightension

3404 vacuum forming | Prime Effect | Engineering

Plastic-sheet forming in which the sheet is clamped to a stationary frame, then heated and drawn down into a mold by vacuum.

11967 self-sealing | Prime Effect | Engineering

A fluid container, such as a fuel tank or a tire, lined with a substance that allows it to close immediately over any small puncture or rupture.

62 vaporization cooling | Prime Effect | Engineering

Cooling by volatilization of a nonflammable liquid having a low boiling point and high dielectric strength; the liquid is flowed or sprayed on hot electronic equipment in an enclosure where it vaporizes, carrying the heat to the enclosure walls, radiators, or heat exchanger. Also known as evaporative cooling.

1249 thermoacoustic refrigerator | Prime Effect | Engineering

A device that uses acoustic power to pump heat from a region of low temperature to a region of ambient temperature.

Engineering Acoustics

1162 absolute efficiency | Effect | Engineering Acoustics

The ratio of the power output of an electroacoustic transducer, under specified conditions, to the power output of an ideal electroacoustic transducer.

2276 acoustic jamming | Effect | Engineering Acoustics

The deliberate radiation or reradiation of mechanical or electroacoustic signals with the objectives of obliterating or obscuring signals which the enemy is attempting to receive and of deterring enemy weapons systems.

2343 electroacoustics | Effect | Engineering Acoustics

The conversion of acoustic energy and waves into electric energy and waves, or vice versa.

Industrial Engineering

509 containerization | Effect | Industrial Engineering

The practice of placing cargo in large containers such astrucktrailers to facilitate loading on and off ships and railroad flat cars.

1386 Pareto's law Law Industrial Engineering

The principle that in most activities a small fraction (around 20%) of the total activity accounts for a large fraction (around 80%) of the result. Also known as rule of 80-20.

396 cooling correction Law Industrial Engineering

In statistical quality control, the limits of acceptability placed on control charts; parts outside the limits are defective.

952 lambda dispatch Law Industrial Engineering

The solution of the problem of finding the most economical use of generators to supply a given quantity of electric power, using the method of Lagrange multipliers, which are symbolized A..

Mechanical

790 acoustic fatigue Effect Mechanical

The tendency of a material, such as a metal, to lose strength after acoustic stress.

1607 revolution Effect Mechanical

The motion of a body around a closed orbit.

544 set forward Effect Mechanical

Relative forward movement of component parts which occurs in a projectile, missile, or bomb in flight when impact occurs; the effect is due to inertia and is opposite in direction to setback.

52 strain energy Effect Mechanical

The potential energy stored in a body by virtue of an elastic deformation, equal to the work that must be done to produce this deformation.

3097 spin Effect Mechanical

Rotation of a body about its axis.

2290 structural deflections Effect Mechanical

The deformations or movements of a structure and its flexural members from their original positions.

3458 plastic deformation Effect Mechanical

Permanent change in shape or size of a solid body without fracture resulting from the application of sustained stress beyond the elastic limit.

4733 torsional hysteresis Effect Mechanical

Dependence of the torques in a twisted wire or rod not only on the present torsion of the object but on its previous history of torsion.

1433 center of buoyancy Important Law Mechanical

The point through which acts the resultant force exerted on a body by a static fluid in which it is submerged or floating; located at the centroid of displaced volume. center of force

1826 Newton's law of gravitation Important Law Mechanical

The law that every two particles of matter in the universe attract each other with a force that acts along 370 noise the line joining them, and has a magnitude proportional to the product of their masses and inversely proportional to the square of the distance between them. Also known as law of gravitation.

2015 gravitational force Important Law Mechanical

The force on a particle due to its gravitational attraction to other particles.

2793 force Important Law Mechanical

That influence on a body which causes it to accelerate; quantitatively it is a vector, equal to the body's time rate of change of momentum.

183 Newton's first law Important Law Mechanical

The law that a particle not subjected to external forces remains at rest or moves with constant speed in a straight line. Also known as first law of motion; Galileo's law of inertia.

1814 Newton's third law Important Law Mechanical

The law that, if two particles interact, the force exerted by the first particle on the second particle (called the action force) is equal in magnitude and opposite in direction to the force exerted by the second particle on the first particle (called the reaction force).

2105 kinetic energy Important Law Mechanical

The energy which a body possesses because of its motion; in classical mechanics, equal to one-half of the body's mass times the square of its speed.

1823 Newton's second law Important Law Mechanical

The law that the acceleration of a particle is directly proportional tothe resultant external force acting on the particle and is inversely proportional to the mass of the particle. Also known as second law of motion.

2742 inertia Important Law Mechanical

That property of matter which manifests itself as a resistance to any change in the momentum of a body.

1596 leverage Important Law Mechanical

The multiplication of force or motion achieved by a lever lever shears

1816 Hooke's law Important Law Mechanical

The law that the stress of a solid is directly proportional to the strain applied to it.

833 Newtonian mechanics Important Law Mechanical

The system of mechanics based upon Newton's laws of motion in which mass and energy are considered as separate, conservative, mechanical properties, in contrast to their treatment in relativistic mechanics.

542 product of inertia Important Law Mechanical

Relative to two rectangular axes, the sum of the products formed by multiplying the mass (or, sometimes, the area) of each element of a figure by the product of the coordinates corresponding to those axes.

12046 center of gravity Important Law Mechanical

A fixed point in a material body through which the resultant force of gravitational attraction acts.

70 gyroscopic precession Important Law Mechanical

The turning of the axis of spin of a gyroscope as a result of an external torque acting on the gyroscope; the axis always turns toward the direction of the torque.

1675 tensile strength Important Law Mechanical

The maximum stress a material subjected to a stretching load can withstand without tearing. Also known as hot strength.

1191 sand hill analogy Law Mechanical

A formal identity between the differential equation and boundary conditions for a stress function for torsion of a perfectly plastic prismatic bar, and those for the height of t h e surface of a granular material, such as dry sand, which has a constant angle of rest.

11910 membrane analogy Law Mechanical

A formal identity between the differential equation and boundary conditions for a stress function for torsion of an elastic prismatic bar, and those for the deflection of a uniformly stretched membrane with the same boundary as the cross section of the bar, subjected to a uniform pressure.

11899 Barlow's equation Law Mechanical

A formula, $t = DP/2S$, used in computing the strength of cylinders subject to internal pressures, where t is the thickness of t h e cylinder in inches, D the outside diameter in inches, P t h e pressure in pounds per square inch, and Sthe allowable tensile strength in pounds per square inch.

11937 axial load Law Mechanical

A force with its resultant passing through the centroid of a particular section and being perpendicular to the plane of the section.

1187 basic truss Law Mechanical

A framework of bars arranged so that for any given loading of the bars the forces on the bars are uniquely determined by the laws of statics.

136 two-body problem Law Mechanical

The problem of predicting the motions of two objects obeying Newton's laws of motion and exerting forces on each other according to some specified law such as Newton's law of gravitation, given their masses and their positions and velocities at some initial time.

2767 ballistics of penetration Law Mechanical

That part of terminal ballistics which treats of the motion of a projectile as it forces its way into targets of solid or semisolid substances, such as earth, concrete, or steel.

11923 electrostriction Law Mechanical

A form of elastic deformation of a dielectric induced by an electric field, associated with those components of strain 195 electrostriction transducer which are independent of reversal of field direction, in contrast to the piezoelectric effect. Also known as electrostrictive strain.

11936 impact Law Mechanical

A forceful collision between two bodies which is sufficient to cause an appreciable change in the momentum of the system on which it acts. Also known as impulsive force.

11949 elastic force Law Mechanical

A force arising from the deformation of a solid body which depends only on the body's instantaneous deformation and not on its previous history, and which is conservative.

11938 central force Law Mechanical

A force whose line of action is always directed toward a fixed point; the force may attract or repel.

11939 variable force Law Mechanical

A force whose direction or magnitude or both change with time.

11940 repulsion Law Mechanical

A force which tends to increase the distance between two bodies having like electric charges, or the force between atoms or molecules at very short distances which keeps them apart. Also known as repulsive force.

1194 rolling friction Law Mechanical

A force which opposes the motion of any body which is rolling over the surface of another.

11943 apparent force Law Mechanical

A force introduced in a relative coordinate system in order that Newton's laws be satisfied in the system; examples are the Coriolis force and the centrifugal force incorporated in gravity.

11945 external force Law Mechanical

A force exerted on a system or on some of its components by an agency outside the system.

11946 internal force Law Mechanical

A force exerted by one part of a system on another.

11950 repeated load Law Mechanical

A force applied repeatedly, causing variation in the magnitude and sometimes in the sense, of the internal forces. 456 reset rate repeater

1195 inelastic stress Law Mechanical

A force acting on a 291 inequality of Clausius solid which produces a deformation such that the original shape and size of the solid are not restored after removal of the force.

2874 fluid stress Law Mechanical

Stress associated with plastic deformation in a solid material.

5797 material particle Law Mechanical

An object which has rest-mass and an observable position in space, but has no geometrical extension, being confined to a single point. Also known as particle.

4852 crushing strain Law Mechanical

Compression which causes the failure of a material.

2869 load stress Law Mechanical

Stress that results from a pressure or gravitational load.

1606 Poinsot motion Law Mechanical

The motion of a rigid body with a point fixed in space and with zero torque or moment acting on the body about the fixed point.

2870 cooling stress Law Mechanical

Stress resulting from uneven contraction during cooling of metals and ceramics due to uneven temperature distribution.

287 thermal shock Law Mechanical

Stress produced in a body or in a material as a result of undergoing 561 thermal soakback a sudden change in

2872 tensile stress Law Mechanical

Stress developed by a material bearing a tensile load.

2873 stress intensity Law Mechanical

Stress at a point in a structure due to pressure resulting from combined tension (positive) stresses and compression (negative) stresses.

5670 nonintegrablesystem Law Mechanical

Adynamicalsystem whose motion is governed by an equation that is not an integrable differential equation.

2868 membrane stress Law Mechanical

Stress which is equivalent to the average stress across the cross section involved and normal to the reference plane.

13965 funicular polygon Law Mechanical

1. The figure formed by a light string hung between two points from which weights are suspended at various points. 2. A force diagram for such a string, in which the forces (weights and tensions) acting on points of the string from which weights are suspended are represented by a series of adjacent triangles.

13960 static friction Law Mechanical

1. The force that resists the initiation of sliding motion of one body over the other with which it is in contact. 2. The force required to move one of the bodies when they are at rest. Also known as limiting friction; starting friction.

2875 melt strength Law Mechanical

Strength of a molten plastic.

5577 forced oscillation Law Mechanical

An oscillation produced in a simple oscillator or equivalent mechanical system by an external periodic driving force. Also known as forced vibration.

5513 static load Law Mechanical

Anonvarying load; the basal pressure exerted by the weight of a mass at rest, such as the load imposed on a drill bit by the weight of the drill-stem equipment or the pressure exerted on the rocks around an underground opening by the weight of the superimposed rocks. Also known as dead load.

5504 deformation Law Mechanical

Any alteration of shape or dimensions of a body caused by stresses, thermal expansion or contraction, chemical or metallurgical transformations, or shrinkage and expansions due to moisture change.

5500 Schuler pendulum Law Mechanical

Any apparatus which swings, because of gravity, with a natural period of 84.4 minutes, that is, with the same period as a hypothetical simple pendulum whose length is the earth's radius; the pendulum arm remains vertical despite any motion of its pivot, and the apparatus is therefore useful in navigation.

2876 flexural strength Law Mechanical

Strength of a material in blending, that is, resistance to fracture.

1134 setback force Law Mechanical

The rearward force of inertia which is created bythe forward acceleration of a projectile or missile during its launching phase; the forces are directly proportional to the acceleration and mass of the parts being accelerated.

1136 rotational resistance Law Mechanical

The real part of rotational impedance; it is responsible for dissipation of energy. Also known as mechanical rotational resistance.

5423 factor of stress concentration Law Mechanical

Any irregularity producing localized stress in a structural member subject to load. Also known as fatigue-strength reduction factor.

1396 thrust Law Mechanical

1. The force exerted in any direction by a fluid jet or by a powered screw.

5830 bending stress Law Mechanical

An internal tensile or compressive longitudinal stress developed in a beam in response to curvature induced by an external load.

5868 holonomic constraints Law Mechanical

An integrable set of differential equations which describe the restrictions on the motion of a system; a function relating several variables, in the form f(x 1,. . .,xn) = 0, in optimization or physical problems.

5867 action Law Mechanical

An integral associated with the trajectory of a system in configuration space, equal to the sum of the integrals of the generalized momenta of the system over their canonically conjugate coordinates. Also known as phase integral.

2794 elastic recovery Law Mechanical

That fraction of a given deformation of a solid which behaves elastically elastic scattering

2795 ballistic wind Law Mechanical

That constant wind which would produce the same effect upon the trajectory of a projectile as the actual wind encountered in flight.

13938 shear strength Law Mechanical

1. The maximum shear stress which a material can withstand without rupture. 2. The ability of a material to withstand shear stress.

2797 dynamics Law Mechanical

That branch of mechanics which deals with the motion of a system of material particles under the influence of forces, especially those which originate outside the system under consideration.

280 entry ballistics Law Mechanical

That branch of ballistics which pertains to the entry of a missile, spacecraft, or other object from outer space into and through an atmosphere.

12912 Griffith's criterion Law Mechanical

A criterion for the fracture of a brittle material under biaxial stress, based on the theory that the strength of such a material is limited by small cracks.

447 angle of fall Law Mechanical

The vertical angle at the level point, between the line of fall and the base of the trajectory.

1126 torsional compliance Law Mechanical

The reciprocal of the torsional rigidity.

442 bullet drop Law Mechanical

The vertical drop of a bullet. bull gear

5874 deflecting torque Law Mechanical

An instrument's moment, resulting from the quantity measured, that acts to cause the pointer's deflection.

13090 energy integral Law Mechanical

A constant of integration resulting from integration of Newton's second law of motion in the case of a conservative force; equal to the sum of the kinetic energy of the particle and the potential energy of the force acting on it.

13947 tangential velocity Law Mechanical

1. The instantaneous linear velocity of a body moving in a circular path; its direction is tangential to the circular path at the point in question. 2. The component of the velocity of a body that is perpendicular to a line from an observer or reference point to the body.

11846 Hamiltonian function Law Mechanical

A function of the generalized coordinates and momenta of a system, equal in value to the sum over the coordinates of the product of the generalized momentum corresponding to the coordinate, and the coordinate's time derivative, minus the Lagrangian of the system; it is numerically equal to the total energy if the Lagrangian does not depend on time explicitly; the equations of motion of the system are determined by the functional dependence of the Hamiltonian on the generalized coordinates and momenta.

2827 radial stress Law Mechanical

Tangential stress at the periphery of an opening.

13955 weight Law Mechanical

1. The gravitational force with 613 weight barometer which the earth attracts a body. 2. By extension, the gravitational force with which a star, planet, or satellite attracts a nearby body weight barometer

436 self-induced vibration Law Mechanical

The vibration of a mechanical system resulting from conversion, within the system, of nonoscillatory excitation to oscillatory excitation. Also known as selfexcited vibration.

283 gravitational systems of units Law Mechanical

Systems in which length, force, and time are regarded as fundamental, and the unit of force is the gravitational force on a standard body at a specified location on the earth's surface.

2855 inelastic buckling Law Mechanical

Sudden increase of deflection or twist in a column when compressive stress reaches the elastic limit but before elastic buckling develops.

2865 bonding strength Law Mechanical

Structural effectiveness of adhesives, welds, solders, glues, or of the chemical bond formed between the metallic and ceramic components of a cermet, when subjected to stress loading, for example, shear, tension, or compression.

445 normal axis Law Mechanical

The vertical axis of an aircraft or missile.

939 distance Law Mechanical

The spatial separation of two points, measured by the length of a hypothetical line joining them.

6727 yardage Law Mechanical

An amount expressed in yards. yard crane See crane truck.

6583 equivalent viscous damping Law Mechanical

An assumed value of viscous damping used in analyzing a vibratory motion, such that the dissipation of energy per cycle at resonance is the same for the assumed or the actual damping force.

13126 stress concentration Law Mechanical

A condition in which a stress distribution has high localized stresses; usually induced by an abrupt change in the shape of a member; in the vicinity of notches, holes, changes in diameter of a shaft, and so forth, maximum stress is several times greater than where there is no geometrical discontinuity.

2586 precession Law Mechanical

The angular velocity of the axis of spin of a spinning rigid body, which arises as a result of external torques acting on the body. precessional torque

14279 static moment Law Mechanical

1. A scalar quantity (such as area or mass) multiplied by the perpendicular distance from a point connected with the quantity (such as the centroid of the area or the center of mass) to a reference axis. 2. The magnitude of some vector (such as force, momentum, or a directed line segment) multiplied by the length of a perpendicular dropped from the line of action of the vector to a reference point.

6564 ballistic wave Law Mechanical

An audible disturbance caused by compression of air ahead of a missile in flight.

257 analytic mechanics Law Mechanical

The application of differential and integral calculus to classical (nonquantum) mechanics.

2590 roll acceleration Law Mechanical

The angular acceleration of an aircraft or missile about its longitudinal or X axis.

938 bomb ballistics Law Mechanical

The special branch of ballistics concerned with bombs dropped from aircraft.

1366 Boussinesq's problem Law Mechanical

The problem of determining the stresses and strains in an infinite elastic body, initially occupying all the space on one side of an infinite plane, and indented by a rigid punch having the form of a surface of revolution with axis of revolution perpendicular to the plane. Also known as Cerruti's problem.

926 radius of gyration Law Mechanical

The square root of the ratio of the moment of inertia of a body about a given axis to its mass.

683 baromil Law Mechanical

The unit of length used in graduating a mercury barometer in the centimetergram-

13888 fiber stress Law Mechanical

1. The tensile or compressive stress on the fibers of a fiber metal or other fibrous material, especially when fiber orientation is parallel with the neutral axis. 2. Local stress through a small area (a point or line) on a section where the stress is not uniform, as in a beam under bending load.

452 impact velocity Law Mechanical

The velocity of a projectile or missile at the instant of impact. Also known as striking velocity.

11724 moment diagram Law Mechanical

A graph of the bending moment at a section of a beam versus the distance of the section along the beam.

334 rate of change of acceleration Law Mechanical

Time rate of change of acceleration; this rate is a factor in the design of some items of ammunition that undergo large accelerations.

2700 contraction Law Mechanical

The action or process of becoming smaller or pressed together, as a gas on cooling.

1176 Krigar-Menzel law Law Mechanical

A generalization of the second Young-Helmholtz law which states that when a string is bowed at a point which is at a distance of p/q times the string's length from one of the ends, where p and q are relative primes, then the string moves back and forth with two constant velocities, one of which is q - 1 times as large as the other.

453 relative velocity Law Mechanical

The velocity of a body with respect to a second body; that is, its velocity in a reference frame where the second body is fixed.

13895 proof stress Law Mechanical

1. The stress that causes a specified amount of permanent deformation in a material. 2. Aspecified stress to be applied 428 proportioning probe to a member or structure in order to assess its ability to support service loads.

11760 canonically conjugate variables Law Mechanical

A generalized coordinate and its conjugate momentum.

2589 yaw acceleration Law Mechanical

The angular acceleration of an aircraft or missile about its normal or Z axis.

454 detonating rate Law Mechanical

The velocity at which the explosion wave passes through a cylindrical charge.

11719 influence line Law Mechanical

A graph of the shear, stress, bending moment, or other effect of a movable load on a structural member versus the position of the load.

264 gravitational potential Law Mechanical

The amount of work which must be done against gravitational forces to move a particle of unit mass to a specified position from a reference position, usually a point at infinity.

2638 extensibility Law Mechanical

The amount to which a material can be stretched or distorted without breaking.

6522 axis of torsion Law Mechanical

An axis parallel to the generators of a cylinder undergoing torsion, located so that the displacement of any point on the axis lies along the axis. Also known as axis of twist.

2624 free-flight angle Law Mechanical

The angle between the horizontal and a line in the direction of motion of a flying body, especially a rocket, at the beginning of free flight.

2595 angle of torsion Law Mechanical

The angle through which a part of an object such as a shaft or wire is rotated from its normal position when a torque is applied. Also known as angle of twist.

259 pitch acceleration Law Mechanical

The angular acceleration of an aircraft or missile about its lateral, or Y, axis.

11759 palpable coordinate Law Mechanical

A generalized coordinate that appears explicitly in the Lagrangian of a system.

2518 instantaneous axis Law Mechanical

The axis about which a rigid body is carrying out a pure rotation at a given instant in time.

46 transverse vibration Law Mechanical

Vibration of a rod in which elements of the rod move at right angles to the axis of the rod.

6917 cyclic coordinate Law Mechanical

Ageneralized coordinate on which the Lagrangian of a system does not depend explicitly. Also known as ignorable coordinate.

6927 Rayleigh's dissipation function Law Mechanical

Afunction which enters into the equations of motion of a system undergoing small oscillations and represents frictional forces which are proportional to velocities; given by a positive definite quadratic form in the time derivatives of the coordinates.

11684 Kater's reversible pendulum Law Mechanical

A gravity pendulum designed to measure the acceleration of gravity and consisting of a body with two knifeedge supports on opposite sides of the center of mass.

6933 shearfracture Law Mechanical

Afracture resulting from shear stress.

6899 compressed air Law Mechanical

Air whose density is increased by subjecting it to a pressure greater than atmospheric pressure.

6940 concentrated load Law Mechanical

Aforce that is negligible because of a small contact area; a beam supported on a girder represents a concentrated load on the girder.

903 flow stress Law Mechanical

The stress along one axis at a given value of strain that is required to produce plastic deformation.

2517 permanent axis Law Mechanical

The axis of the greatest moment of inertia of a rigid body, about which it can rotate in equilibrium.

457 elements Law Mechanical

The various features of a trajectory such as the angle of departure, maximum ordinate, angle of fall, and so on.

13885 velocity Law Mechanical

1. The time rate of change of position of a body; it is a vector quantity having direction as well as magnitude. Also known as linear velocity. 2. The speed at which the detonating wave passes through a column of explosives, expressed in meters or feet per second.

2508 chaotic behavior Law Mechanical

The behavior of a system whose final state depends so sensitively on the system's precise initial state that the behavior is in effect unpredictable and cannot be distinguished from a random process, even though it is strictly determinate in a mathematical sense.

2506 fixing moment Law Mechanical

The bending moment at the end support of a beam necessary to fix it and prevent rotation. Also known as fixed end moment.

1375 conservation of angular momentum Law Mechanical

The principle that, when a physical system is subject only to internal forces that bodies in the system exert on each other, the total angular momentum of the system remains constant, provided that both spin and orbital angular momentum are taken into account.

6939 friction Law Mechanical

Aforce which opposes the relative motion of two bodies whenever such motion exists or whenever there exist other forces which tend to produce such motion.

2529 pitch attitude Law Mechanical

The attitude of an aircraft, rocket, or other flying vehicle, referred to the relationship between the longitudinal body axis and a chosen reference line or plane as seen from the side.

11703 Mohr's circle Law Mechanical

A graphical construction making it possible to determine the stresses in a cross section if the principal stresses are

253 Tresca criterion Law Mechanical

The assumption that plastic deformation of a material begins when the difference between the maximum and minimum principal stresses equals twice the yield stress in shear.

2530 von Mises yield criterion Law Mechanical

The assumption that plastic deformation of a material begins when the sum of the squares of the principal components of the deviatoric stress reaches a certain critical value.

1170 Bow's notation Law Mechanical

A graphical method of representing coplanar forces and stresses, using alphabetical letters, in the solution of stresses or in determining the resultant of a system of concurrent forces.

6808 Siacci method Law Mechanical

An accurate and useful method for calculation of trajectories of highvelocity missiles with low quadrant angles of departure; basic assumptions are that the atmospheric density anywhere on the trajectory is approximately constant, and the angle of departure is less than about 15°.

456 closing line Law Mechanical

The vector required to complete a polygon consisting of a set of vectors whose sum is zero (such as the forces acting on a body in equilibrium).

6823 elastic buckling Law Mechanical

An abrupt increase in the lateral deflection of a column at a critical load while the stresses acting on the column are wholly elastic.

1362 three-body problem Law Mechanical

The problem of predicting the motions of three objects obeying Newton's laws of motion and attracting each other according to Newton's law of gravitation.

6866 shear strain Law Mechanical

Also known as shear. 1. A deformation of a solid body in which a plane in the body is displaced parallel to itself relative to parallel planes in the body; quantitatively, it is the displacement of any plane relative to a second plane, divided by the perpendicular distance between planes. 2. The force causing such deformation.

6867 rotation Law Mechanical

Also known as rotational motion. 1. Motion of a rigid body in which either one point is fixed, or all the points on a straight line are fixed. 2. Angular displacement of a rigid body. 3. The motion of a particle about a fixed point.

6869 perch Law Mechanical

Also known as pole; rod. 1. A unit of length, equal to 5.5 yards, or 16.5 feet, or 5.0292 meters. 2. A unit of area, equal to 30.25 square yards, or 272.25 square feet, or 25.29285264 square meters.

904 bulk strength Law Mechanical

The strength per unit volume of a solid.

6873 Coriolis effect Law Mechanical

Also known as Coriolis deflection. 1. The deflection relative to the earth's surface of any object moving above the earth, caused by the Coriolis force; an object moving horizontally is deflected to the right in the Northern Hemisphere, to the left in the Southern. 2. The effect of the Coriolis force in any rotating system.

689 bending moment Law Mechanical

Algebraic sum of all moments located between a cross section and one end of a structural member; a bending moment that bends the beam convex downward is positive, and one that bends it convex upward is negative.

11695 velocity analysis Law Mechanical

A graphical technique for the determination of the velocities of the parts of a mechanical device, especially those of a plane mechanism with rigid component links.

272 pounds per square inch absolute Law Mechanical

The absolute, thermodynamic pressure, measured by the number of pounds-force exerted on an area of 1 square inch. Abbreviated lbf in.~2abs; psia. pounds per square inch differential

380 differential effects Law Mechanical

Theeffects uponthe elements of the trajectory due to variations from standard conditions.

390 initial yaw Law Mechanical

The yaw of a projectile the instant it leaves the muzzle of a gun.

385 orbital angular momentum Law Mechanical

Theangular momentum associated with the motion of a particle about an origin, equal to the cross product 383 orbital moment of the position vector with the linear momentum.

2735 breaking strength Law Mechanical

The ability of a material to resist breaking or rupture from a tension force.

1032 mechanomotive force Law Mechanical

The root-meansquare value of a periodically varying force. mechanooptical vibrometer

2737 hydrostatic strength Law Mechanical

The ability of a body to withstand hydrostatic stress.

626 Hookean solid Law Mechanical

An ideal solid which obeys Hooke's law exactly for all values of stress, however large.

2739 ballistic temperature Law Mechanical

That temperature (in °F) which, when regarded as a surface temperature and used in conjunction with the lapse rate of the standard artillery atmosphere, would produce the same effect on a projectile as the actual temperature distribution encountered by the projectile in flight.

6263 Kelvin body Law Mechanical

An ideal body whose shearing (tangential) stress is the sum of a term proportional to its deformation and a term proportional to the rate of change of its deformation with time. Also known as Voigt body.

2720 acceleration of free fall Law Mechanical

The acceleration imparted to bodies by the attractive force of the earth; has an international standard value of 980.665 cm/s2 but varies with latitude and elevation. Also known as acceleration of free fall; apparent gravity.

1022 Lanchester's rule Law Mechanical

The rule that a torque applied to a rotating body along an axis large-systems control theory perpendicular to the rotation axis will produce precession in a direction such that, if the body is viewed along a line of sight coincident with the torque axis, then a point on the body's circumference, which initially crosses the line of sight, will appear to describe an ellipse whose sense is that of the torque.

6277 stress crack Law Mechanical

An external or internal crack in a solid body (metal or plastic) caused by tensile, compressive, or shear forces. stress difference

6279 body force Law Mechanical

An external force, such as gravity, which acts on all parts of a body.

13905 yaw Law Mechanical

1. The rotational or oscillatory movement of a ship, aircraft, rocket, or the like about a vertical axis. Also known as yawing. 2. The amount of this movement, that is, the angle of yaw. 3. To rotate or oscillate about a vertical axis.

38 local structural discontinuity Law Mechanical

Theeffect of intensified stress on a small portion of a structure.

1047 recovery Law Mechanical

The return of a body to its original dimensions after it has been stressed, possibly over a considerable period of time.

11843 compressadensity function Law Mechanical

A function used in the acoustic levitation technique to determine either the density or the adiabatic compressibility of a submicroliter droplet suspended in another liquid, if the other property is known.

13184 state of stress Law Mechanical

A complete description, including the six components of stress, of a homogeneously stressed volume.

2760 elastic center Law Mechanical

That point of a beam in the plane of the section lying midway between the flexural center and the center of twist in that section.

2759 center of mass Law Mechanical

That point of a material body or system of bodies which moves as though the system's total mass existed at the point and all external forces were applied at the point. Also known as center of inertia; centroid.

13917 elasticity Law Mechanical

1. The property whereby a solid material changes its shape and size under action of opposing forces, but recovers its original configuration when the forces are removed.

1038 fulcrum Law Mechanical

The rigid point of support about which a lever pivots.

13112 cone of friction Law Mechanical

A cone in which the resultant force exerted by one flat horizontal surface on another must be located when both surfaces are at rest, as determined by the coefficient of static friction.

2878 rotational strain Law Mechanical

Strain in which the orientation of the axes of strain is changed.

13914 jerk Law Mechanical

1. The rate of change of acceleration; it is the third derivative of position with

2743 brittleness Law Mechanical

That property of a material manifested by fracture without appreciable prior plastic deformation.

13912 factor of safety Law Mechanical

1. The ratio between the breaking load on a member, appliance, or hoisting rope and the safe permissible load on it. Also known as safety factor. 2. See factor of stress intensity.

6243 axis of symmetry Law Mechanical

An imaginary line about which a geometrical figure is symmetric.

2740 offset yield strength Law Mechanical

That stress at which the strain surpasses by a specific amount (called the offset) an extension of the initial proportional portion of the stress-strain curve; usually expressed in pounds per square inch.

625 rigid body Law Mechanical

An idealized extended solid whose size and shape are definitely fixed and remain unaltered when forces are applied. rigid-body dynamics

2750 descending branch Law Mechanical

That portion of a trajectory which is between the summit and the point where the trajectory terminates, either by impact or air burst, and along which the projectile falls, with altitude constantly decreasing.

12945 spin-decelerating moment Law Mechanical

A couple about the axis of the projectile, which diminishes spin.

6280 surface force Law Mechanical

An external force which acts only on the surface of a body; an example is the force exerted by another object with which the body is in contact.

345 Morera's stress functions Law Mechanical

Three functions of position,^, 4,2, and^3, in terms of which the elements of the stress tensor a of a body may be expressed, if the body is in equilibrium and is not subjected to body forces; the elements of the stress tensor are given by CT11 = - 252*|*1/ dx2dx3, <J23 = d2\\f2/dx1dx2 + d2\\f3/dx1dx3, and cyclic permutations of these equations.

634 hydrostatic balance Law Mechanical

An equal-arm balance in which an object is weighed first in air and then in a beaker of water to determine its specific

2685 spring modulus Law Mechanical

The additional force necessary to deflect a spring an additional unit distance; if a certain spring has a modulus of 100 newtons per centimeter, a 100-newton weight will compress it 1 centimeter, a 200-newton weight 2 centimeters, and so

2684 frictional grip Law Mechanical

The adhesion between the wheels of a locomotive and the rails of the railroad track.

346 Maxwell's stress functions Law Mechanical

Three functions of position, 4>1, 4>2, and 4>3, in terms of which the elements of the stress tensor a of a body may be expressed, if t h e body is in equilibrium and is not subjected to body forces; the elements of the stress tensor are given by CT11 =624>2/,3x3 2 + 524>3/3x 2 2 , °"23= ~~ d2$1/dx2dx3, and cyclic permutations of these equations.

2674 stress range Law Mechanical

The algebraic difference between the maximum and minimum stress in one fatigue test cycle.

347 Euler angles Law Mechanical

Three angular parameters that specify the orientation of a body with respect to reference axes.

6374 supported end Law Mechanical

An end of a structure, such as a beam, whose position is fixed but whose orientation may vary; for example, an end supported on a knife-edge.

6375 fixed end Law Mechanical

An end of a structure, such as a beam, that is clamped in place so that both its position and orientation are fixed.

344 Newton's laws of motion Law Mechanical

Three fundamental principles (called Newton's first, second, and third laws) which form the basis of classical, or Newtonian, mechanics, and have proved valid for all mechanical problems not involving speeds comparable with the speed of light and not involving atomic or subatomic particles.

13125 weightlessness Law Mechanical

A condition in which no acceleration, whether of gravity or other force, can be detected by an observer within the system in question. Also known as zero gravity.

45 Newtonian velocity Law Mechanical

The velocity of an object in a Newtonian reference frame, S, which can be determined from the velocity of the object in any other such frame, S', by taking the vector sum of the velocity of the object in S' and the velocity of the frame S'relative

6405 inertia ellipsoid Law Mechanical

An ellipsoid used in describing the motion of a rigid body; it is fixed in the body, and the distance from its center to its surface in any direction is inversely proportional to the square root of the moment of inertia about the corresponding axis. Also known as Poinsot ellipsoid.

449 settling velocity Law Mechanical

The velocity reached by a particle as it falls through a fluid, dependent on its size and shape, and the difference between its specific gravity and that of the settling medium; used to sort particles by grain size.

64 equivalent twisting moment Law Mechanical

Atwisting moment which, if acting alone, would produce in a circular shaft a shear stress of the same magnitude as the shear stress produced by a given twisting moment and a given bending moment acting simultaneously.

6293 Melde's experiment Law Mechanical

An experiment to study transverse vibrations in a long, horizontal thread when one end of the thread is attached to a prong of a vibrating tuning fork, while the other passes over a pulley and has weights suspended from it to control the tension in the thread.

2699 warpage Law Mechanical

The action, process, or result of twisting or turning out of shape.

448 quadrant angle of fall Law Mechanical

The vertical acute angle at the level point, between the horizontal and the line of fall of a projectile.

372 flexure theory Law Mechanical

Theory of the deformation of a prismatic beam having a length at least 10 times its depth and consisting of a material obeying Hooke's law, in response to stresses within the elastic limit.

37 elastic theory Law Mechanical

Theory of the relations between the forces acting on a body and the resulting changes in dimensions.

6338 pile formula Law Mechanical

An equation for the forces acting on a pile at equilibrium: P = pA + tS + Sn sin 4>, where P is the load, A is the area of the pile point, p is the force per unit area on the point, S is the embedded surface of the pile, t is the force per unit area parallel to S, n is the force per unit area normal to S, and 4> is the taper angle of the pile.

369 equivalent nitrogen pressure Law Mechanical

Thepressurethat would be indicated by a device if the gas inside it were replaced by nitrogen of equivalent 201 equivalent noise pressure molecular density.

13103 shear plane Law Mechanical

A confined zone along which fracture occurs in metal cutting.

1012 exterior ballistics Law Mechanical

The science concerned with behavior of a projectile after leaving the muzzle of the firing weapon.

101 fluid mechanics Law Mechanical

The science concerned with fluids, either at rest or in motion, and dealing with pressures, velocities, and accelerations in the fluid, including fluid deformation and compression or expansion.

358 work-kinetic energy theorem Law Mechanical

The theorem that the change in the kinetic energy of a particle during a displacement is equal to the work done by the resultant force on the particle during this displacement.

356 friction torque Law Mechanical

Thetorque which is produced by frictional forces and opposes rotational motion, such as that associated with journal or sleeve bearings in machines.

269 angle of impact Law Mechanical

The acute angle between the tangent to the trajectory at the point of impact of a projectile and the plane tangent to the surface of the ground or target at the point of impact.

1010 interior ballistics Law Mechanical

The science concerned with the combustion of powder, development of pressure, and movement of a projectile in the bore of a gun.

638 directional gyro Law Mechanical

Atwo-degrees-of-freedom gyro with a provision for maintaining its spin axis approximately horizontal.

12725 simple pendulum Law Mechanical

A device consisting of a small, massive body suspended by an inextensible object of negligible mass from a fixed horizontal axis about which the body and suspension are free to rotate.

1273 torsional pendulum Law Mechanical

A device consisting of a disk or other body of large moment of inertia mounted on one end of a torsionally flexible elastic rod whose other end is held fixed; if the disk is twisted and released, it will undergo simple harmonic motion, provided the torque in the rod is proportional to the angle of twist.

1226 axial modulus Law Mechanical

The ratio of a simple tension stress applied to a material to the resulting strain parallel to the tension when the sides of the sample are restricted so that there is no lateral deformation. Also known as modulus of simple longitudinal extension.

14085 unit strain Law Mechanical

1. For tensile strain, the elongation per unit length. 2. For compressive strain, the shortening per unit length. 3. For shear strain, the change in angle between two lines originally perpendicular to each other.

4326 Lagrange bracket Law Mechanical

Given two functions of coordinates and momenta in a system, their Lagrange bracket is an expression measuring how coordinates and momenta change jointly with respect to the two functions.

414 fracture wear Law Mechanical

The wear on individual abrasive grains on the surface of a grinding wheel caused by fracture.

14203 momentum Law Mechanical

1. Also known as linear momentum; vector momentum. 2. For a single nonrelativistic particle, the product of the mass and the velocity of a particle. 3. For a single relativistic particle, mv/(1 - v2/c2)1/2, where m is the rest-mass, v the velocity, and c the speed of 361 momentum conservation light. 4. For a system of particles, the vector sum of the momenta (as in the first or second definition) of the particles.

13086 moving constraint Law Mechanical

A constraint that changes with time, as in the case of a system on a moving platform.

4282 orthotropic Law Mechanical

Having elastic properties such as those of timber, that is, with considerable variations of strength in two or more directions perpendicular to one another.

14086 torque Law Mechanical

1. For a single force, the cross product of a vector from some reference point to the point of application of the force with the force itself. Also known as moment of force; rotation moment. 2. For several forces, the vector sum of the torques (first definition) associated with each of the forces.

1235 deceleration Law Mechanical

The rate of decrease of speed of a motion.

1285 plasticity Law Mechanical

The property of a solid body whereby it undergoes a permanent change in shape or size when subjected to a stress exceeding a particular value, called the yield value.

1247	centripetal force	Law	Mechanical

The radial force required to keep a particle or object moving in a circular path, which can be shown to be directed toward the center of the circle.

14054	circular motion	Law	Mechanical

1. Motion of a particle in a circular path. 2. Motion of a rigid body in which all its particles move in circles about a common axis, fixed with respect to the body, with a common angular velocity.

1250	moisture content	Law	Mechanical

The quantity of water in a mass of soil, sewage, sludge, or screenings; expressed in percentage by weight of water in the mass.

4364	Coulomb friction	Law	Mechanical

Friction occurring between dry surfaces.

13233	inelastic collision	Law	Mechanical

A collision in which the total kinetic energy of the colliding particles is not the same after the collision as before it.

48	steady-state vibration	Law	Mechanical

Vibration in which the velocity of each particle in the system is a continuous periodic quantity.

336	back pressure	Law	Mechanical

Pressure due to a force that is operating in a direction opposite to that being considered, such as that of a fluid flow.

3395	center of oscillation	Law	Mechanical

Point in a physical pendulum, on the line through the point of suspension and the center of mass, which moves as if all the mass of the pendulum were concentrated there.

13234	elastic collision	Law	Mechanical

A collision in which the sum of the kinetic energies of translation of the participating systems is the same after the collision as before.

4213	Maxwell's theorem	Law	Mechanical

If a load applied at one point A of an elastic structure results in a given deflection at another point B, then the same load applied at B will result in the same deflection at A.

4212 center of percussion Law Mechanical

If a rigid body, free to move in a plane, is struck a blow at a point O, and the line of force is perpendicular to the line from O to the center of mass, then the initial motion of the body is a rotation about the center of percussion relative to O; it can be shown to coincide with the center of oscillation relative to O.

421 conjugate momentum Law Mechanical

If qj(j = 1,2,) are generalized coordinates of a classical dynamical system, and L is its Lagrangian, the momentum conjugate to qj ispj = dL /dqj . Also known as canonical momentum; generalized momentum.

4205 neutral axis Law Mechanical

In a beam bent downward, the line of zero stress below which all fibers are in tension and above which they are in compression. neutral fiber

3407 plasticoviscosity Law Mechanical

Plasticity in which the rate of deformation of a body subjected to stresses greater than the yield stress is a linear function of the stress.

4125 mean normal stress Law Mechanical

In a system stressed multiaxially, the algebraic mean of the three principal stresses.

47 normal mode of vibration Law Mechanical

Vibration of a coupled system in which the value of one of the normal coordinates oscillates and the values of all the other coordinates remain stationary.

1248 centripetal acceleration Law Mechanical

The radial component of the acceleration of a particle or object moving around a circle, which can be shown to be directed toward the center of the circle. Also known as radial acceleration.

1224 stiffness Law Mechanical

The ratio of a steady force acting on a deformable elastic medium to the resulting displacement.

3096 roll Law Mechanical

Rotational or oscillatory movement of an aircraft or similar body about a longitudinal axis through the body; it is called roll for any degree of such rotation.

12302 Strouhal number Law Mechanical

A dimensionless number used in studying the vibrations of a body past which a fluid is flowing; it is equal to a characteristic dimension of the body times the frequency of vibrations divided by the fluid velocity relative to the body; for a taut wire perpendicular to the fluid flow, with the characteristic dimension taken as the diameter of the wire, it has a value between 0.185 and 0.2 Symbolized Sr. Also known as reduced frequency.

3305 compression strength Law Mechanical

Property of a material to resist rupture under compression.

1194 fatigue ratio Law Mechanical

The ratio of the fatigue limit or fatigue strength to the static tensile strength. Also known as endurance ratio.

1195 elastic ratio Law Mechanical

The ratio of the elastic limit to the ultimate strength of a solid.

4438 apparent weight Law Mechanical

For a body immersed in a fluid (such as air), the resultant of the gravitational force and the buoyant force of the fluid acting on the body; equal in magnitude to the true weight minus the weight of the displaced fluid.

4436 Lagrangian density Law Mechanical

For a dynamical system of fields or continuous media, a function of the fields, of their time and space derivatives, and the coordinates and time, whose integral over space is the Lagrangian.

1199 bulk modulus of elasticity Law Mechanical

The ratio of the compressive or tensile force applied to a substance per unit surface area to the change in volume of t h e substance per unit volume. Also known as bulk modulus; compression modulus; hydrostatic modulus; modulus of compression; modulus of volume elasticity.

407 tare Law Mechanical

The weight of an empty vehicle or container; subtracted from gross weight to ascertain net weight.

120 bulk strain Law Mechanical

The ratio of the change in the volume of a body that occurs when the body is placed under pressure, to the original volume of the body.

4428 Kennedy and Pancu circle Law Mechanical

For a harmonic oscillator subject to hysteretic damping and subjected to a sinusoidally varying force, a plot of the in-phaseand quadrature components of the displacement of the oscillator as the frequency of the applied vibration

3307 rotational stability Law Mechanical

Property of a body for which a small angular displacement sets up a restoring torque that tends to return the body to its original position.

436 stiction Law Mechanical

Friction that tends to prevent relative motion between two movable parts at their null position.

1217 stress ratio Law Mechanical

The ratio of minimum to maximum stress in fatigue testing, considering tensile stresses as positive and compressive stresses as negative.

4362 phonon friction Law Mechanical

Friction that arises when atoms close to a surface are set into motion by the sliding action of atoms in an opposing surface, and the mechanical energy needed to slide one surface over the other is thereby converted to the energy of atomic lattice vibrations (phonons) and is eventually transformed into heat.

4414 axial moment of inertia Law Mechanical

For any object rotating about an axis, the sum of its component masses times the square of the distance to the axis.

41 towed load Law Mechanical

The weight of a carriage, trailer, or other equipment towed by a prime mover.

4412 Poisson bracket Law Mechanical

For any two dynamical variables, X and Y, the sum, over all degrees of freedom of the system, of (dX/dq)(dY/dp) - (dX/dp)(dY/dq), where q is a generalized coordinate and p is the corresponding generalized momentum.

1225 Young's modulus Law Mechanical

The ratio of a simple tension stress applied to a material to the resulting strain parallel to the tension. Also known as modulus of elasticity y parameter

4405 buckling stress Law Mechanical

Force exerted by the crippling load.

4402 resonance vibration Law Mechanical

Forced vibration in which the frequency of the disturbing force is very close to the natural frequency of the system, so that the amplitude of vibration is very large.

440 cold stress Law Mechanical

Forces tending to deform steel, cement, and other materials, resulting from low temperatures.

4400 coplanar forces Law Mechanical

Forces that act in a single plane; thus the forces are parallel to the plane and their points of application are in the plane.

12307 Deborah number Law Mechanical

A dimensionless number used in rheology, equal to the relaxation time for some process divided by the time it is observed. Symbolized D.

4384 Kolosov-Muskhelishvili formulas Law Mechanical

Formulas which express plane strain and plane stress in terms of two holomorphic functions of the complex variable z = x + iy, where x and y are plane coordinates.

4366 boundary friction Law Mechanical

Friction between surfaces that are neither completely dry nor completely separated by a lubricant.

4365 stick-slip friction Law Mechanical

Friction between two surfaces that are alternately at rest and in motion with respect to each other.

14094 equation of motion Law Mechanical

1. Equation which specifies the coordinates of particles as functions of time. 2. A differential equation, or one of several such equations, from which the coordinates of particles as functions of time can be obtained if the initial positions and velocities of the particles are known.

4425 polhode Law Mechanical

For a rotating rigid body not subject to external torque, the closed curve traced out on the inertia ellipsoid by the intersection with this ellipsoid of an axis parallel to the angular velocity vector and through the center.

3483 elastic vibration Law Mechanical

Oscillatory motion of a solid body which is sustained by elastic forces and the inertia of the body.

4079 limit velocity Law Mechanical

In armor and projectile testing, the lowest possible velocity at which any one of the complete penetrations is obtained; since the limit velocity is difficult to obtain, a more easily obtainable value, designated as the ballistic limit, is usually

3727 melt fracture Law Mechanical

Melt flow instability through a die during plastics molding, leading to helicular, rippled surface irregularities on the finished product.

13235 plastic collision Law Mechanical

A collision in which one or both of the colliding bodies suffers plastic deformation and mechanical energy is dissipated.

3464 standard trajectory Law Mechanical

Path through the air that it is calculated a projectile will follow under given conditions of weather, position, and material, including the particular fuse, projectile, and propelling charge that are used; firing tables are based on standard

3686 curvilinear motion Law Mechanical

Motion along a curved path.

3685 radial motion Law Mechanical

Motion in which a body moves along a line connecting it with an observer or reference point; for example, the motion of stars which move toward or away from the earth without a change in apparent position.

3684 rolling Law Mechanical

Motion of a body across a surface combined with rotational motion of the body so that the point on the body in contact with the surface is instantaneously at rest. rolling contact

3683 flat spin Law Mechanical

Motion of a projectile with a slow spin and a very large angle of yaw, happening most frequently in fin-stabilized projectiles with some spin-producing moment, when the period of revolution of the projectile coincides with the period of its oscillation; sometimes observed in bombs and in unstable spinning projectiles.

3678 ballistic entry Law Mechanical

Movement of a ballistic body from without to within a planetary atmosphere. ballistic instrument

3668 low velocity Law Mechanical

Muzzle velocity of an artillery projectile of 2499 feet (762 meters) per second or less.

3663 Newton's equations of motion Law Mechanical

Newton's laws of motion expressed in the form of mathematical equations.

3652 inelastic Law Mechanical

Not capable of sustaining a deformation without permanent change in size or shape.

3730 bridge vibration Law Mechanical

Mechanical vibration of a bridge superstructure due to natural and human-produced excitations.

3636 topple axis Law Mechanical

Of a gyroscope, t h e horizontal axis, perpendicular to the horizontal spin axis, around which topple occurs. Also known as tumble axis.

3732 thermal stress Law Mechanical

Mechanical stress induced in a body when some or all of its parts are not free to expand or contract in response to changes in temperature.

3632 angle of orientation Law Mechanical

Of a projectile in flight, the angle between the plane determined by the axis of the projectile and the tangent to the trajectory (direction of motion), and the vertical plane including the tangent to the trajectory.

22 air resistance Law Mechanical

Wind drag giving rise to forces and wear on buildings and other structures.

1279 isochronism Law Mechanical

The property of having a uniform rate of operation or periodicity, for example, of a pendulum or watch balance.

3612 equipollent Law Mechanical

Of two systems of forces, having the same vector sum and the same total torque about an arbitrary point.

3589 volumetric strain Law Mechanical

One measure of deformation; the change of volume per unit of volume.

3505 nanogram Law Mechanical

One-billionth (10~9) of a gram. Abbreviated ng.

3568 Newtonian reference frame Law Mechanical

One of a set of reference frames with constant relative velocity and within which Newton's laws hold; the frames have a common time, and coordinates are related by the Galilean transformation rule.

424 specific volume Law Mechanical

The volume of a substance per unit mass; it is the reciprocal of the density. Abbreviated sp vol.

3566 Euler-Rodrigues parameter Law Mechanical

One of four numbers which may be used to specify the orientation of a rigid body; they are components of a quaternion.

1284 compressibility Law Mechanical

The property of a substance capable of being reduced in volume by application of pressure; quantitively, the reciprocal of the bulk modulus.

3542 overtone Law Mechanical

One of the normal modes of vibration of a vibrating system whose frequency is greater than that of the fundamental mode.

3539 dynamical variable Law Mechanical

One of the quantities used to describe a system in classical mechanics, such as the coordinates of a particle, the components of its velocity, the momentum, or functions of these quantities.

3533 principal axis of strain Law Mechanical

One of the three axes of a body that were mutually perpendicular before deformation. Also known as strain axis.

3479 spin compensation Law Mechanical

Overcoming or reducing the effect of projectile rotation in decreasing the penetrating capacity of the jet in shaped-charge ammunition.

1263 flexibility Law Mechanical

The quality or state of being able to be flexed or bent repeatedly.

4490 fibrous fracture Law Mechanical

Failure of a material resulting from a ductile crack; broken surfaces are dull and silky. Also known as ductile fracture. fiducial temperature

4060 damping coefficient Law Mechanical

In damped harmonic motion, the ratio of the frictional resistive force to the speed. Also known as damping coefficient; damping constant; mechanical resistance.

4054 negative g Law Mechanical

In designating the direction of acceleration on a body, the opposite of positive g; for example, the effect of flying an outside loop in the upright seated position.

4044 reciprocal strain ellipsoid Law Mechanical

In elastic theory, an ellipsoid of certain shape and orientation which under homogeneous strain is transformed into a set of orthogonal diameters of the sphere.

4033 topple Law Mechanical

In gyroscopes for marine or aeronautical use, the condition of a sudden upset gyroscope or a gyroscope platform evidenced by a sudden and rapid precession of the spin axis due to large torque disturbances such as the spin axis striking the mechanical stops. Also known as tumble.

4022 initial free space Law Mechanical

In interior ballistics, the portion of the effective chamber capacity not displaced by propellant.

402 initial shot start pressure Law Mechanical

In interior ballistics, the pressure required to start the motion of the projectile from its initial loaded position; in fixed ammunition, it includes pressure required to separate projectile and cartridge case and to start engraving the rotating band.

399 isostatics Law Mechanical

In photoelasticity studies of stress analyses, those curves, the tangents to which represent the progressive change in principal- plane directions. Also known as stress trajectories.

12353 bending-moment diagram Law Mechanical

A diagram showing the bending moment at every point along the length of a beam plotted as an ordinate.

3957 side direction Law Mechanical

In stress analysis, t h e direction perpendicular to the plane of symmetry of an object.

3949 Kirkwood-Brinkely's theory Law Mechanical

In terminal ballistics, a theory formulating the scaling laws from which the effect of blast at high altitudes may be inferred, based upon observed results at ground level.

3935 Delaunay orbit element Law Mechanical

In the n-body 150 De Nora cell problem, certain functions of variable elements of an ellipse with a fixed focus along which one of the bodies travels; these functions have rates of change satisfying simple equations.

3729 classical mechanics Law Mechanical

Mechanics based on Newton's laws of motion.

1262 rigidity Law Mechanical

The quality or state of resisting change in form.

4068 causality Law Mechanical

In classical mechanics, the principle that the specification of the dynamical variables of a system at a given time, and of the external forces acting on the system, completely determines the values of dynamical variables at later times. Also known as determinism.

390 gravitational instability Law Mechanical

Instability of a dynamic system in which gravity is the restoring force.

3900 melt instability Law Mechanical

Instability of t h e plastic melt flow through a die.

14107 internal friction Law Mechanical

1. Conversion of mechanical strain energy to heat within a material subjected to fluctuating stress. 2. In a powder, the friction that is developed by the particles sliding over each other; it is greater than the friction of the mass of solid that comprises the individual particles.

12356 shear diagram Law Mechanical

A diagram in which the shear at every point along a beam is plotted as an ordinate.

3428 elastic hysteresis Law Mechanical

Phenomenon exhibited by some solids in which the deformation of the solid depends not only on the stress applied to the solid but also on the previous history of this stress; analogous to magnetic hysteresis, with magnetic field strength and magnetic induction replaced by stress and strain respectively.

3819 bearing pressure Law Mechanical

Load on a bearing surface divided by its area. Also known as bearing stress.

3818 bearing capacity Law Mechanical

Load per unit area which can be safely supported by the ground. bearing circle

3814 line of thrust Law Mechanical

Locus of the points through which the resultant forces pass in an arch or retaining wall.

1420 Coriolis acceleration Law Mechanical

1. An acceleration which, when added to the acceleration of an object relative to a rotating coordinate system and to its centripetal acceleration, gives the acceleration of the object relative to a fixed coordinate system. 2. A vector which is equal in magnitude and opposite in direction to that of the first definition.

14144 virtual displacement Law Mechanical

1. Any change in the positions of the particles forming a mechanical system. 2. An infinitesimal change in the positions of the particles forming a mechanical system, which is consistent with the geometrical constraints on the system.

3783 antifriction Law Mechanical

Making friction smaller in magnitude.

3457 permanent set Law Mechanical

Permanent plastic deformation of a structure or a test piece after removal of the applied load. Also known as set.

3737 friction loss Law Mechanical

Mechanical energy lost because of mechanical friction between moving parts of a machine.

3932 helical angle Law Mechanical

In the study of torsion, the angular displacement of a longitudinal element, originally straight on the surface of an untwisted bar, which becomes helical after twisting. helical conveyor

4947 creep buckling Law Mechanical

Buckling that may occur when a compressive load is maintained on a member over a long period, leading to creep which eventually reduces the member's bending stiffness.

5026 revolution per second Law Mechanical

Aunit of angular velocity equal to the uniform angular velocity of a body which rotates through an angle of 360° (27T radians), so that every point in the body returns to its original position, in 1 second. Abbreviated rps.

5024 cubicfoot per minute Law Mechanical

Aunit of volume flow rate, equal to a uniform flow of 1 cubic foot in 1 minute; equal to 1/60 cusec. Abbreviated cfm.

5012 standard gravity Law Mechanical

Avalue of the acceleration of gravity equal to 9.80665 meters per second per second.

1348 propulsion Law Mechanical

The process of causing a body to move by exerting a force against it. propulsion system

12887 release adiabat Law Mechanical

A curve or locus of points which defines the succession of states through which a mass that has been shocked to a high-pressure state passes while monotonically returning to zero pressure.

5006 free vector Law Mechanical

Avectorwhose direction in space is prescribed but whose point of application and line of application are not prescribed.

499 conical pendulum Law Mechanical

Aweight suspended from a cord or light rod and made to rotate in a horizontal circle about a vertical axis with a constant angular velocity.

3095 sliding friction Law Mechanical

Rubbing of bodies in sliding contact.

12975 rotating coordinate system Law Mechanical

A coordinate system whose axes as seen in an inertial coordinate system are rotating.

4974 combined stresses Law Mechanical

Bending or twisting stresses in a structural member combined with direct tension or compression.

13876 kilogram Law Mechanical

1. The unit of mass in t h e meter- kilogram-second system, equal to the mass of the international prototype kilogram stored at Sevres, France. Abbreviated kg. 2. See kilogram force.

3120 elastic deformation Law Mechanical

Reversible alteration of the form or dimensions of a solid body under stress or strain.

4479 Chladni's figures Law Mechanical

Figures produced by sprinkling sand or similar material on a horizontal plate and then vibrating the plate while holding it rigid at its center or along its periphery; indicate t h e nodal lines of vibration.

495 frangible Law Mechanical

Breakable, fragile, or brittle.

13975 Lagrangian Law Mechanical

1. The difference between the kinetic energy and the potential energy of a system of particles, expressed as a function of generalized coordinates and velocities from which Lagrange's equations can be derived.

3124 elastic flow Law Mechanical

Return of a material to its original shape following deformation.

4935 elastic potential energy Law Mechanical

Capacity that a body has to do work by virtue of its deformation.

1398 flexure Law Mechanical

1. The deformation of any beam subjected to a load. 2. Any deformation of an elastic body in which the points originally lying on any straight line are displaced to form a plane curve.

4915 strain Law Mechanical

Change in length of an object in some direction per unit undistorted length in some direction, not necessarily the same; the nine possible strains form a second-rank tensor.

4914 angular speed Law Mechanical

Change of direction per unit time, as of a target on a radar screen, without regard to the direction of the rotation axis; in other words, the magnitude of the angular velocity vector. Also known as angular rate.

490 uniform circular motion Law Mechanical

Circular motion in which the angular velocity remains constant. uniform click track

14212 meter-kilogram Law Mechanical

1. A unit of energy or work in a meter-kilogram-second gravitational system, equal to the work done by a kilogramforce when the point at which the force is applied is displaced 1 meter in the direction of the force; equal to 9.80665 joules. Abbreviated m-kgf.

1421 foot-poundal Law Mechanical

1. A unit of energy or work in the English absolute system, equal to the work done by a force of magnitude 1 poundal when the point at which the force is applied is displaced 1 foot in the direction of the force; equal to approximately 0.04214011 joule. Abbreviated ft-pdl. 2. A unit of torque in the English absolute system, equal to the torque produced by a force of magnitude 1 poundal acting at a perpendicular distance of 1 foot from the axis of rotation.

3133 trigger pull trigger pull Law Mechanical

Resistance offered by the trigger of a rifle or other weapon; force which must be exerted to pull the trigger trigonometric leveling

12883 deformation curve Law Mechanical

A curve showing the relationship between the stress or load on a structure, structural member, or a specimen and the strain or deformation that results. Also known as stress-strain curve.

4869 deadbeat Law Mechanical

Coming to rest without vibration or oscillation, as when the pointer of a meter moves to a new position without

4862 ballistic table Law Mechanical

Compilation of ballistic data from which trajectory elements such as angle of fall, range to summit, time of flight, and ordinate at anytime, can be obtained.

4953 ballistics Law Mechanical

Branch of applied mechanics which deals with the motion and behavior characteristics of missiles, that is, projectiles, bombs, rockets, guided missiles, and so forth, and of accompanying phenomena.

5278 equatorial plane Law Mechanical

Aplane perpendicular to the axis of rotation of a rotating body and equidistant from the intersections of this axis with the body's surface, provided that the body is symmetric about the axis of rotation and is symmetric under reflection through this plane.

5403 kinematically admissible motion Law Mechanical

Any motion of a mechanical system which is geometrically compatible with the constraints.

5402 periodic motion Law Mechanical

Any motion that repeats itself identically at regular intervals.

12149 constant of motion Law Mechanical

A dynamical variable of a system which remains constant in time.

1148 Poisson ratio Law Mechanical

The ratio of the transverse contracting strain to the elongation strain when a rod is stretched by forces which are applied at its ends and which are parallel to the rod's axis.

2892 moment Law Mechanical

Static moment of some quantity, except in the term "moment of inertia." momental ellipsoid

2894 elastoplasticity Law Mechanical

State of a substance subjected to a stress greater than its elastic limit but not so great as to cause it to rupture, in which it exhibits both elastic and plastic properties. elastoresistance

5353 stiffness constant Law Mechanical

Any one of the coefficients of the relations in the generalized Hooke's law used to express stress components as linear functions of the strain components.

12150 integrable system Law Mechanical

A dynamical system whose motion is governed by an integrable differential equation.

1149 torsional modulus Law Mechanical

The ratio of the torsional rigidity of a bar to its length. Also known as modulus of torsion.

1150 torsional rigidity Law Mechanical

The ratio of the torque applied about the centroidal axis of a bar at one end of the bar to the resulting torsional angle, when the other end is held fixed.

2915 remaining velocity Law Mechanical

Speed of a projectile at any point along its path of fire.

2938 radial wave equation Law Mechanical

Solutions to wave equations with spherical symmetry can be found by separation of variables; the ordinary differential equation for the radial part of the wave function is called the radial wave equation.

5054 flat trajectory Law Mechanical

Atrajectory which is relatively flat, that is, described by a projectile of relatively high velocity.

5298 pure shear Law Mechanical

Aparticular example of irrotational strain or flattening in which a body is elongated in one direction and shortened at right angles to it as a consequence of differential displacements on two sets of intersecting planes.

5055 skip trajectory Law Mechanical

Atrajectory made up of ballistic phases alternating with skipping phases; one of the basic trajectories for the unpowered portion of the flight of a reentry vehicle or spacecraft reentering earth's atmosphere.

5249 base pressure Law Mechanical

Apressure used as a reference base, for example, atmospheric pressure.

518 pivot Law Mechanical

Ashort, pointed shaft formingthe center and fulcrum on which something turns, balances, or oscillates.

5177 equal-arm balance Law Mechanical

Asimple balance in which the distances from the point of support of the balance-arm beam to the two pans at the end of the beam are equal.

5176 equilibrant Law Mechanical

Asingle force which cancels the vector sum of a given system of forces acting on a rigid body and whose torque cancels the sum of the torques of the system.

5146 heterogeneous strain Law Mechanical

Astrain in which the components of the displacement of a point in the body cannot be expressed as linear functions of the original coordinates.

513 nonholonomic system Law Mechanical

Asystem of particles which is subjected to constraints of such a nature that the system cannot be described by independent coordinates; examples are a rolling hoop, or an ice skate which must point along its path.

5126 circular velocity Law Mechanical

At any specific distance from the primary, the orbital velocity required to maintain a constant-radius orbit. circulating fluid

1154 flexural rigidity Law Mechanical

The ratio of the sideward force applied to one end of a beam to the resulting displacement of this end, when the other end is clamped.

5089 parallel axis theorem Law Mechanical

Atheorem which states that the moment of inertia of a body about any given axis is the moment of inertia about a parallel axis through the center of mass, plus the moment of inertia that the body would have about the given axis if all the mass of the body were located at the center of mass. Also known as Steiner's theorem.

5088 perpendicular axis theorem Law Mechanical

Atheorem which states that the sum of the moments of inertia of a plane lamina about any two perpendicular axes in the plane of the lamina is equal to the moment of inertia about an axis through their intersection perpendicular to the lamina.

5087 least-work theory Law Mechanical

Atheory of statically indeterminate structures based on the fact that when a stress is applied to such a structure the individual parts of it are deflected so that the energy stored in the elastic members is minimized.

2988 coaxial Law Mechanical

Sharing the same axes.

4838 equilibrium Law Mechanical

Condition in which a particle, or all the constituent particles of a body, are at rest or in unaccelerated motion in an inertial reference frame. Also known as static equilibrium.

1153 plate modulus Law Mechanical

The ratio of the stress component Txx in an isotropic, elastic body obeying a generalized Hooke's law to the corresponding strain component Sxx, when the strain components Syy and Szz are 0; the sum of the Poisson ratio and twice the rigidity modulus.

1187 coefficient of friction Law Mechanical

The ratio of the frictional force between two bodies in contact, parallel to the surface of contact, to the force, normal to the surface of contact, with which the bodies press against each other. Also known as friction coefficient.

3185 embrittlement Law Mechanical

Reduction or loss of ductility or toughness in a metal or plastic with little change in other mechanical properties. emergency brake

396 elastic strain energy Law Mechanical

The work done in deforming a solid within its elastic limit.

14023 relaxation Law Mechanical

1. Relief of stress in a strained material due to creep. 2. The lessening of elastic resistance in an elastic medium under an applied stress resulting in permanent deformation.

4633 canting Law Mechanical

Displacing the free end of a beam which is fixed at one end by subjecting it to a sideways force which is just short of that required to cause fracture.

4632 plastic Law Mechanical

Displaying, or associated with, plasticity.

4630 range deviation Law Mechanical

Distance by which a projectile strikes beyond, or short of, the target; the distance as measured along the gun-target line or along a line parallel to the gun-target line.

4628 point-blank range Law Mechanical

Distance to a target that is so short that the trajectory of a bullet or projectile is practically a straight, rather than a curved, line.

4579 plane of maximum shear stress Law Mechanical

Either of two planes that lie on opposite sides of and at angels of 45° to the maximum principal stress axis and that are parallel to the intermediate principal stress axis.

4577 time of flight Law Mechanical

Elapsed time in seconds from the instant a projectile or other missile leaves a gun or launcher until the instant it strikes or bursts.

14024 Roche lobes Law Mechanical

1. Regions of space surrounding two massive bodies revolving around each other under their mutual gravitational attraction, such that the gravitational attraction of each body dominates the lobe surrounding it.

55 plane of departure Law Mechanical

Vertical plane containing the path of a projectile as it leaves the muzzle of the gun.

14037 centrobaric Law Mechanical

1. Pertaining to the center of gravity, or to some method of locating it. 2. Possessing a center of gravity.

56 plane of fire Law Mechanical

Vertical plane containing the gun and the target, or containing a line of site.

1186 coefficient of rolling friction Law Mechanical

The ratio of the frictional force, parallel to the surface of contact, opposing the motion of a body rolling over another, to the force, normal to the surface of contact, with which the bodies press against coefficient of sliding friction

4647 maximum ordinate Law Mechanical

Difference in altitude between the origin and highest point of the trajectory of a projectile.

4532 Saint Venant's compatibility equations Law Mechanical

Equations for the components eij of the strain tensor that follow from their integrability, namely, (eij)kl + (ekl)ij - (eik)jl - (ejl)ik = 0, where i, j, k, and l can take on any of the values x, y, and z, and subscripts outside the parentheses indicate partial differentiation.

453 Lagrange's equations Law Mechanical

Equations of motion of a mechanical system for which a classical (non-quantum-mechanical) description is suitable, and which relate the kinetic energy of the system to the generalized coordinates, the generalized forces, and the time. Also known as Lagrangian equations of motion.

1295 centrifugal moment Law Mechanical

The product of the magnitude of centrifugal force acting on a body and the distance to the center of rotation. centrifugal pump

403 specific weight Law Mechanical

The weight per unit volume of a substance.

3300 firmoviscosity Law Mechanical

Property of a substance in which the stress is equal to the sum of a term proportional to the substance's deformation, and a term proportional to its rate of deformation.

3302 underspin Law Mechanical

Property of a projectile having insufficient rate of spin to give proper stabilization. underwater sound projector

4509 shimmy Law Mechanical

Excessive vibration of the front wheels of a wheeled vehicle causing a jerking motion of the steering wheel.

119 force constant Law Mechanical

The ratio of the force to the deformation of a system whose deformation is proportional to the applied force.

3304 viscoelasticity Law Mechanical

Property of a material which is viscous but which also exhibits certain elastic properties such as the ability to store energy of deformation, and in which the application of a stress gives rise to a strain that approaches its equilibrium value slowly.

1193 stiffness coefficient Law Mechanical

The ratio of the force acting on a linear mechanical system, such as a spring, to its displacement from equilibrium.

450 Euler equation Law Mechanical

Expression for the energy removed from a gas stream by a rotating blade system (as a gas turbine), independent of the blade system (as a radial- or axial-flow system).

4500 length Law Mechanical

Extension in space.

4493 elastic failure Law Mechanical

Failure of a body to recover its original size and shape after a stress is removed.

1185 coefficient of kinetic friction Law Mechanical

The ratio of the frictional force, parallel to the surface of contact, that opposes the motion of a body which is sliding or rolling over another, to the force, normal to the surface of contact, with which the bodies press against each other.

4740 wind deflection Law Mechanical

Deflection caused by the influence of wind on the course of a projectile in flight.

2879 creep recovery Law Mechanical

Strain developed in a period of time after release of load in a creep test.

4834 ballistic conditions Law Mechanical

Conditions which affect the motion of a projectile in the bore and through the atmosphere, including muzzle velocity, weight of projectile, size and shape of projectile, rotation of the earth, density of the air, temperature or elasticity of the air, and the wind.

13986 angular momentum Law Mechanical

1. The cross product of a vector from a specified reference point to a particle, with the particle's linear momentum.

14210 mil Law Mechanical

1. A unit of length, equal to 0.001 inch, or to 2.54 X 10~5 meter. Also known as milli-inch; thou. 2. See milliliter.

1399 normal acceleration Law Mechanical

1. The component of the linear acceleration of an aircraft or missile along its normal, or Z, axis. 2. The usual or typical acceleration.

1172 section modulus Law Mechanical

The ratio of the moment of inertia of the cross section of a beam undergoing flexure to the greatest distance of an element of the beam from the neutral axis. sector

4775 thermal stress cracking Law Mechanical

Crazing or cracking of materials (plastics or metals) by overexposure to elevated temperatures and sudden temperature changes or large temperature differentials.

4773 cold flow Law Mechanical

Creep in polymer plastics.

4772 dynamic creep Law Mechanical

Creep resulting from fluctuations in a load or temperature.

3225 slope of fall Law Mechanical

Ratio between t h e drop of a projectile and its horizontal movement; tangent of the angle of fall.

4762 pressure-travel curve Law Mechanical

Curve showing pressure plotted against the travel of t h e projectile within the bore of the weapon.

14209 metric centner Law Mechanical

1. A unit of mass equal to 50 kilograms. 2. A unit of mass equal to 100 kilograms. Also known as quintal.

395 virtual work Law Mechanical

The work done on a system during any displacement which is consistent with the constraints on the system.

475 hysteresis damping Law Mechanical

Damping of a vibration due to energy lost through mechanical hysteresis.

12859 formed cutter Law Mechanical

A cutting tool shaped to make surfaces with irregular geometry. Also known as form cutter.

4739 Hookean deformation Law Mechanical

Deformation of a substance which is proportional to the force applied to it.

4736 sq See square. square Law Mechanical

Denotes a unit of area; if x is a unit of length, a square x is the area of a square whose sides have a length of 1x; for example, a square meter, or a meter squared, is the area of 524 stability matrix a square whose sides have a length of 1 meter.

4734 cubic Law Mechanical

Denoting a unit of volume, so that if x is a unit of length, a cubic x is the volume of a cube whose sides have length 1x; for example, a cubic meter, or a meter cubed, is the volume of a cube whose sides have a length of 1 meter. Abbreviated cu.

1173 factor of stress intensity Law Mechanical

The ratio of the maximum stress to which a structural member can be subjected, to the maximum stress to which it is likely to be subjected. Also known as factor of safety.

118 modulus of elasticity Law Mechanical

The ratio of the increment of some specified form of stress to the increment of some specified form of strain, such as Young's modulus, the bulk modulus, or the shear modulus. Also known as coefficient of elasticity; elasticity modulus; elastic modulus.

14006 mean stress Law Mechanical

1. The algebraic mean of 347 mean temperature difference the maximum and minimum values of a periodically varying stress. 2. See octahedral normal stress.

4693 anelasticity Law Mechanical

Deviation from a proportional relationship between stress and strain.

12786 plane strain Law Mechanical

A deformation of a body in which the displacements of all points in the body are parallel to a given plane, and the values of these displacements do not depend on the distance perpendicular to the plane.

14208 ounce Law Mechanical

1. A unit of mass in avoirdupois measure equal to 1/16 pound or to approximately 0.0283495 kilogram. Abbreviated oz. 2. A unit of mass in either troy or apothecaries' measure equal to 480 grains or exactly 0.0311034768 kilogram. Also known

as apothecaries' ounce or troy ounce (abbreviations are oz ap and oz t in the United States, and oz apoth and oz tr in the United Kingdom).

14008 ballistic efficiency Law Mechanical

1. The ability of a projectile to overcome the resistance of the air; depends chiefly on the weight, diameter, and shape of the projectile. 2. The external efficiency of a rocket or other jet engine of a missile.

3266 incompressibility Law Mechanical

Quality of a substance which maintains its original volume under increased pressure.

14019 autorotation Law Mechanical

1. Rotation about any axis of a body that is symmetrical and exposed to a uniform airstream and maintained only by aerodynamic moments. 2. Rotation of a stalled symmetrical airfoil parallel to the direction of the wind.

3277 traction Law Mechanical

Pulling friction of a moving body on the surface on which it moves.

4752 hysteretic damping Law Mechanical

Damping of a vibrating system in which the retarding force is proportional to the velocity and inversely proportional to the frequency of the vibration. This page intentionally left blank.

1027 primary stress Law Mechanical

A normal or shear stress component in a solid material which results from an imposed loading and which is under a condition of equilibrium and is not self-limiting.

2016 gravity vector Law Mechanical

The force of gravity per unit mass at a given point. Symbolized g. gravity wall

2017 arc force Law Mechanical

The force of a plasma arc through a nozzle or opening.

2019 tear strength Law Mechanical

The force needed to initiate or to continue tearing a sheet or fabric.

2020 gun reaction Law Mechanical

The force exerted on the gun mount by the rearward movement of the gun resulting from the forward motion of the projectile and hot gases. Also known as recoil.

202 static reaction Law Mechanical

The force exerted on a body by other bodies which are keeping it in equilibrium.

2022 driving resistance Law Mechanical

The force exerted by soil on a pile being driven into it.

2023 normal reaction Law Mechanical

The force exerted by a surface on an object in contact with it which prevents the object from passing through the surface; the force is perpendicular to the surface, and is the only force that the surface exerts on the object in the absence of frictional forces.

2024 stress Law Mechanical

The force acting across a unit area in a solid material resisting the separation, compacting, or sliding that tends to be induced by external forces.

10230 closed pair Law Mechanical

A pair of bodies that are subject to constraints which prevent any relative motion between them.

2036 combined flexure Law Mechanical

The flexure of a beam under a combination of transverse and longitudinal loads.

2057 gravitational field Law Mechanical

The field in a region in space in which a test particle would experience a gravitational force; quantitatively, the gravitational force per unit mass on the particle at a particular point.

2058 inertial force Law Mechanical

The fictitious force acting on a body as a result of using a noninertial frame of reference; examples are the centrifugal and Coriolis forces that appear in rotating coordinate systems. Also known as effective force.

11186 Poinsot's central axis Law Mechanical

A line through a rigid body which is parallel to the vector sum F of a system of forces acting on the body, and which is located so that the system of forces is equivalent to the force F applied anywhere along the line, plus a couple whose torque is equal to the component of the total torque T exerted by the system in the direction F Poinsot's method

8753 stress function Law Mechanical

A single function, such as the Airy stress function, or one of two or more functions, such as Maxwell's or Morera's stress functions, that uniquely define the stresses in an elastic body as a function of position.

8950 resilience Law Mechanical

1. Ability of a strained body, by virtue of high yield strength and low elastic modulus, to recover its size and form following deformation. 2. The work done in deforming a body to some predetermined limit, such as its elastic limit or breaking point, divided by the body's volume.

1674 elastic limit Law Mechanical

The maximum stress a solid can sustain without undergoing permanent deformation.

1408 spherical stress Law Mechanical

The portion of the total stress that corresponds to an isotropic hydrostatic pressure; its stress tensor is the unit tensor multiplied by one-third the trace of the total stress tensor.

2088 angular travel error Law Mechanical

The error which is introduced into a predicted angle obtained by multiplying an instantaneous angular velocity by a time of flight.

1123 angular length Law Mechanical

A length expressed in the unit of the length per radian or degree of a specified wave.

1673 modulus of rupture in bending Law Mechanical

The maximum stress per unit area that a specimen can withstand without breaking when it is bent, as calculated from the breaking load under the assumption that the specimen is elastic until rupture takes place.

1672 modulus of rupture in torsion Law Mechanical

The maximum stress per unit area that a specimen can withstand without breaking when its ends are twisted, as calculated from the breaking load under the assumption that the specimen is elastic until rupture takes place.

1407 deviatonic stress Law Mechanical

The portion of the total stress that differs from an isostatic hydrostatic pressure; it is equal to the difference between the total stress and the spherical stress.

1406 ascending branch Law Mechanical

The portion of the trajectory between the origin and the summit on which a projectile climbs and its altitude constantly increases.

1400 inch of mercury Law Mechanical

The pressure exerted by a 1-inch-high (2.54-centimeter) column of mercury that has a density of 13.5951 grams per cubic centimeter when the acceleration of gravity has the standard value of 9.80665 m/s2 or approximately 32.17398 ft/s2 equal to 3386.388640341 pascals; used as a unit in the measurement of atmospheric pressure.

861 elastic body Law Mechanical

A solid body for which the additional deformation produced by an increment of stress completely disappears when the increment is removed. Also known as elastic solid.

2106 gravitational potential energy Law Mechanical

The energy that a system of particles has by virtue of their positions, equal to the work that must be done against gravitational forces to assemble 252 grease trap the particles from some reference configuration, such as mutually infinite separation. Also known as gravitational energy.

1397 barye Law Mechanical

The pressure unit of the centimeter- gram-second system of physical units; equal to 1 dyne per square centimeter (0.001 millibar).

10269 Voigt notation Law Mechanical

A notation employed in the theory of elasticity in which elastic constants and elastic moduli are labeled by replacing the pairs of letters xx, yy, zz, yz, zx, and xy by the number 1, 2, 3, 4, 5, and 6 respectively.

11198 axis Law Mechanical

A line about which a body rotates.

825 tensile modulus Law Mechanical

The tangent or secant modulus of elasticity of a material in tension. tensile specimen See tensile bar.

1684 modulus of resilience Law Mechanical

The maximum mechanical energy stored per unit volume of material when it is stressed to its elastic limit.

11188 line of impact Law Mechanical

A line tangent to the trajectory of a missile at t h e point of impact.

2003 set forward force Law Mechanical

The forward force of inertia which is created by the deceleration of a projectile, missile, or bomb when impact occurs; the forces are directly proportional to the deceleration and mass of the parts being decelerated.

1677 creep limit Law Mechanical

The maximum stress a given material can withstand in a given time without exceeding a specified quantity of creep.

786 ultimate strength Law Mechanical

The tensile stress, per unit of the original surface area, at which a body will fracture, or continue to deform under a decreasing load.

143 simultaneity Law Mechanical

Two events have simultaneity, relative to an observer, if they take place at the same time according to a clock which is 501 simultaneous motion-cycle chart fixed relative to the observer.

145 orbital plane Law Mechanical

The plane which contains the orbit of a body or particle in a central force field; it passes through the center of force.

1434 point of fall Law Mechanical

The point in the curved path of a falling projectile that is level with the muzzle of the gun. Also known as level point.

787 proof resilience Law Mechanical

The tensile strength necessary to stretch an elastomer from zero elongation to the breaking point, expressed in footpounds per cubic inch of original dimension.

9036 normal coordinates Law Mechanical

A set of coordinates for a coupled system such that the equations of motion each involve only one of these coordinates.

9033 Hamilton's equations of motion Law Mechanical

A set of first-order, highly symmetrical equations describing the motion of a classical dynamical system, namely q.j = 3H/3pj , p.j = - 3H/3qj; here qj (j = 1, 2, . . .) are generalized coordinates of the system, pj is the momentum conjugate to qj, and H is the Hamiltonian. Also known as canonical equations of motion.

8907 hereditary mechanics Law Mechanical

A field of mechanics in which quantities, such as stress, depend not only on other quantities, such as strain, at the same instant but also on integrals involving the values of such quantities at previous times.

1676 fatigue strength Law Mechanical

The maximum stress a material can endure for a given number of stress cycles without breaking. Also known as endurance strength.

8908 conservative force field Law Mechanical

A field of force in which the work done on a particle in moving it from one point to another depends only on the particle's initial and final positions. conservative property

2008 Lagrange-Hamilton theory Law Mechanical

The formalized study of continuous systems in terms of field variables where a Lagrangian density function and Hamiltonian density function are introduced to produce equations of motion.

9024 compatibility conditions Law Mechanical

A set of six differential relations between the strain components of an elastic solid which must be satisfied in order for these components to correspond to a continuous and single-valued displacement of the solid.

9023 Euler equations of motion Law Mechanical

A set of three differential equations expressing relations between the force moments, angular velocities, and angular accelerations of a rotating rigid body.

902 generalized coordinates Law Mechanical

A set of variables used to specify the position and orientation of a system, in principle defined in terms of Cartesian coordinates of the system's particles and of the time in some convenient manner; the number of such coordinates equals the number of degrees of freedom of the system Also known as Lagrangian coordinates.

2010 adhesive bond Law Mechanical

The forces such as dipole bonds which attract adhesives and base materials to each other.

2012 sthene Law Mechanical

The force which, when applied to a body whose mass is 1 metric ton, results in an acceleration of 1 meter per second per second; equal to 1000 newtons. Formerly known as funal.

2013 curve resistance Law Mechanical

The force opposing the motion of a railway train along a track due to track curvature.

8972 quarter Law Mechanical

1. A unit of mass in use in the United States, equal to 1/4 short ton, or 500 pounds, or 226.796185 kilograms. 2. A unit of mass used in troy measure, equal to 1/4 troy hundredweight, or 25 troy pounds, or 9.33104304 kilograms. Abbreviated qrtr. 3. A unit of mass used in the United Kingdom, equal to 1/4 hundredweight, or 28 pounds, or 12.70058636 kilograms.

897 dram Law Mechanical

1. A unit of mass, used in the apothecaries' system of mass units, equal to 1/8 apothecaries' ounce or 60 grains or 3.8879346 grams. Also known as apothecaries' dram (dram ap); drachm (British). 2. A unit of mass, formerly used in the United Kingdom, equal to 1/16 ounce (avoirdupois) or approximately 1.77185 grams. Abbreviated dr.

8970 micron Law Mechanical

1. A unit of pressure equal to the pressure exerted by a column of mercury 1 micrometer high, having a density of 13.5951

grams per cubic centimeter, under the standard acceleration of gravity; equal to 0.133322387415 pascal; it differs from the millitorr by less than one part in seven million. Also known as micrometer of mercury. 2. See micrometer micro-opto-electro-mechanical system

8969 chaldron Law Mechanical

1. A unit of volume in common use in the United Kingdom, equal to 36 bushels, or 288 gallons, or approximately 1.30927 cubic meters. 2. A unit of volume, formerly used for measuring solid substances in the United States, equal to 36 bushels, or approximately 1.26861 cubic meters.

8968 gill Law Mechanical

1. A unit of volume used in the United States forthe measurement of liquid substances, equal to 1/4 U.S. liquid pint, or to 1.1829411825 X 10"4 cubic meter. 2. A unit of volume used in the United Kingdom for the measurement of liquid substances, and occasionally of solid substances, equal to 1/4 U.K.

8513 plane stress Law Mechanical

A state of stress in which two of the principal stresses are always parallel to a given plane and are constant in the normal direction.

9029 coupled oscillators Law Mechanical

A set of particles subject to elastic restoring forces and also to elastic interactions with each other.

1126 Andrade's creep law Law Mechanical

A law which states that creep exhibits a transient state in which strain is proportional to the cube root of time and then a steady state in which strain is proportional to time.

2109 barycentric energy Law Mechanical

The energy of a system in its center-of-mass frame.

8294 Foucault pendulum Law Mechanical

A swinging weight supported by a long wire, so that the wire's upper support restrains the wire only in the vertical direction, and the weight is set swinging with no lateral or circular motion; the plane of the pendulum gradually changes, demonstrating t h e rotation of the earth on its axis.

8268 asymmetric top Law Mechanical

A system in which all three principal moments of inertia are different.

8263 holonomic system Law Mechanical

A system in which the constraints are such that the original coordinates can be expressed in terms of independent coordinates and possibly also the time.

8259 resultant of forces Law Mechanical

A system of at most a single force and a single couple whose external effects on a rigid body are identical with the effects of the several actual forces that act on that body.

8249 troy system Law Mechanical

A system of mass units used primarily to measure gold and silver; the 582 tube seat ounce is the same as that in the apothecaries' system, being equal to 480 grains or 31.1034768 grams. Abbreviated t. Also known as troy weight.

10406 pitching moment Law Mechanical

A moment about a lateral axis of an aircraft, rocket, or airfoil. pitch line See cam profile.

137 double pendulum Law Mechanical

Two masses, one suspended from a fixed point by a weightless string or rod of fixed length, and the other similarly suspended from the first; often the system is constrained to remain in a vertical plane.

8235 metric system Law Mechanical

A system of units used in scientific work throughout the world and employed in general commercial transactions and engineering applications; its units of length, time, and mass are the meter, second, and kilogram respectively, or decimal multiples and submultiples thereof.

10428 meter-ton-second system Law Mechanical

A modification of the meter-kilogram-second system in which the metric ton (1000 kilograms) replaces the kilogram as the unit of mass.

10434 cycloidal pendulum Law Mechanical

A modification of a simple pendulum in which a weight is suspended from a cord which is slung between two pieces of metal shaped in the form of cycloids; as the bob swings, the cord wraps and unwraps on the cycloids; the pendulum has a period that is independent of the amplitude of the swing.

13397 mode of vibration Law Mechanical

A characteristic manner in which a system which does not dissipate energy and whose motions are restricted by boundary conditions can oscillate, having a characteristic pattern of motion and one of a discrete set of frequencies. Also known as mode of oscillation.

8328 isostatic surface Law Mechanical

A surface in a threedimensional elastic body such that at each point of the surface one of the principal planes of stress at that point is tangent to the surface.

139 Maupertius' principle Law Mechanical

The principle of least action is sufficient to determine the motion of a mechanical system.

10359 live-end-dead-end room Law Mechanical

A moving load or a load of variable force acting upon a structure, in addition to its own weight.

1622 fracture stress Law Mechanical

The minimum tensile fracture test stress that will cause fracture. Also known as fracture strength.

10514 hectoliter Law Mechanical

A metric unit of volume equal to 100 liters or to 0.1 cubic meter. Abbreviated hl.

10515 decibar Law Mechanical

A metric unit of pressure equal to one-tenth bar.

11262 Hertz's law Law Mechanical

A law which gives the radius of contact between a sphere of elastic material and a surface in terms of the sphere's radius, the normal force exerted on the sphere, and Young's modulus for the material of the sphere.

11263 Bernoulli-Euler law Law Mechanical

A law stating that the curvature of a beam is proportional to the bending moment.

11265 composition-of-velocities law Law Mechanical

A law relating the velocities of an object in two references frames which are moving relative to each other with a specified velocity.

8143 dynamic braking Law Mechanical

A technique of electric braking in which the retarding force is supplied by the same machine that originally was the driving motor dynamic check

11273 pitch axis Law Mechanical

A lateral axis through an aircraft, missile, or similar body, about which the body pitches. Also known as pitching axis.

10516 decimeter Law Mechanical

A metric unit of length equal to one-tenth meter.

222 mistuning Law Mechanical

The difference between the square of the natural frequency of vibration of a vibrating system, without the effect of damping, and the square of the frequency of an external, oscillating force.

745 modulus of decay Law Mechanical

The time required for the amplitude of oscillation of an underdamped harmonic oscillator to drop to 1/e of its initial value; the reciprocal of the damping factor. modulus of deformation

157 cantilever vibration Law Mechanical

Transverse oscillatory motion of a body fixed at one end.

162 damaging stress Law Mechanical

The minimum unit stress for a given material and use that will cause damage to the member and make it unfit for its expected length of service.

8234 liquid measure Law Mechanical

A system of units used to measure the volumes of liquid substances in the United States; the units are the fluid dram, fluid ounce, gill, pint, quart, and gallon.

8420 principal stress Law Mechanical

A stress occurring at right angles to a principal plane of stress.

1994 normal frequencies Law Mechanical

The frequencies of the normal modes of vibration of a system. normal impact

8512 uniaxial stress Law Mechanical

A state of stress in which two of the three principal stresses are zero.

851 microreactor microgravity Law Mechanical

A state of very weak gravity, such that the gravitational acceleration experienced by an observer inside the system in question is of the order of one-millionth of that on earth.

2116 principal strain Law Mechanical

The elongation or compression of one of the principal axes of strain relative to its original length.

8509 redundancy Law Mechanical

A statically indeterminate structure.

2137 elastica Law Mechanical

The elastic curve formed by a uniform rod that is originally straight, then is bent in a principal plane by applying forces, and couples only at its ends.

1395 radial band pressure Law Mechanical

The pressure which is exerted on the rotating band by the walls of the gun tube, and hence against the projectile wall at the band seat, as a result of the engraving of the band by the gun rifling.

167 fatigue limit Law Mechanical

The maximum stress that a material can endure for an infinite number of 211 fatigue ratio stress cycles without breaking. Also known as endurance limit.

8456 centrifugal barrier Law Mechanical

A steep rise, located around the center of force, in the effective potential governing the radial motion of a particle of nonvanishing angular momentum in a central force field, which results from the centrifugal force and prevents the particle from reaching the center of force, or causes its Schrodinger wave function to vanish there in a quantum-mechanical

8438 Rayleigh line Law Mechanical

A straight line connecting points corresponding to the initial and final states on a graph of pressure versus specific volume for a substance subjected to a shock wave.

8428 homogeneous strain Law Mechanical

A strain in which the components of the displacement of any point in the body are linear functions of the original coordinates.

2144 Larson-Miller parameter Law Mechanical

The effects of time and temperature on creep, being defined empirically as P = T (C + log t) X 10"3, where T = test temperature in degrees Rankine (degrees Fahrenheit + 460) and t = test time in hours; the constant C depends upon the material but is frequently taken to be 20.

10405 resisting moment Law Mechanical

A moment produced by internal tensile and compressive forces that balances the external bending moment on a beam.

842 shearing stress Law Mechanical

A stress in which the material on one side of a surface pushes on the material on the other side of the surface with a force which is parallel to the surface. Also known as shear stress; tangential stress.

2110 impact energy Law Mechanical

The energy necessary to fracture a material. Also known as impact strength.

8418 alternating stress Law Mechanical

A stress produced in a material by forces which are such that each force alternately acts in opposite directions.

8417 internal stress Law Mechanical

A stress system within a solid that is not dependent on external forces. Also known as residual stress.

8416 compressive stress Law Mechanical

A stress which causes an elastic body to shorten in the direction of the applied force.

2155 angle variable Law Mechanical

The dynamical variable w conjugate to the action variable J, defined only for periodic motion.

2158 vertical drop Law Mechanical

The drop of an object in trajectory or along a plumb line, measured vertically from its line of departure to the object.

8382 determinate structure Law Mechanical

A structure in which the equations of statics alone are sufficient to determine the stresses and reactions. determinism See causality.

1648 barodynamics Law Mechanical

The mechanics of heavy structures which may collapse under their own weight.

163 collapsing pressure Law Mechanical

The minimum external pressure which causes a thin-walled body or structure to collapse.

7106 equivalent bending moment Law Mechanical

Abending moment which, acting alone, would produce in a circular shaft a normal stress of the same magnitude as the maximum normal stress produced by a given bending moment and a given twisting moment acting simultaneously.

12976 inertial reference frame Law Mechanical

A coordinate system in which a body moves with constant velocity as long as no force is acting on it. Also known as inertial coordinate system.

2174 eccentricity Law Mechanical

The distance of the geometric center of a revolving body from the axis of rotation.

2194 compliance Law Mechanical

The displacement of a linear mechanical system under a unit force. compliance constant

8329 neutral surface Law Mechanical

A surface in a bent beam along which material is neither compressed nor extended.

2147 Poynting effect Law Mechanical

The effect of torsion of avery long cylindrical rod on its length.

10940 harmonic synthesizer Law Mechanical

A machine which combines elementary harmonic constituents into a single periodic function; a tide-predicting machine is an example.

1803 geographical mile Law Mechanical

The length of 1 minute of arc of the Equator, or 6087.08 feet (1855.34 meters), which approximates the length of the nautical mile.

10839 strain ellipsoid Law Mechanical

A mathematical representation of the strain of a homogeneous body by a strain that is the same at all points or of unequal stress at a particular point. Also known as deformation ellipsoid.

13062 motion Law Mechanical

A continuous change of position of a body.

1813 Bobillier's law Law Mechanical

The law that, in general plane rigid motion, when a and b are the respective centers of curvature of points A and B, the angle between Aa and the tangent to the centrode of rotation (pole tangent) and the angle between Bb and a line from the centrode to the intersection of AB and ab (collineation axis) are equal and opposite.

9785 conservation of areas Law Mechanical

A principle governing the motion of a body moving under the action of a central force, according to which a line joining the body with the center of force sweeps out equal areas in equal times.

10840 stress ellipsoid Law Mechanical

A mathematical representation of the state of stress at a point that is defined by the minimum, intermediate, and maximum stresses and their intensities.

977 Routh's procedure Law Mechanical

A procedure for modifying the Lagrangian of a system so that the modified function satisfies a modified form of

Lagrange's equations in which ignorable coordinates are eliminated.

10857 Galitzin pendulum Law Mechanical

A massive horizontal pendulum that is used to measure variations in the direction of the force of gravity with time, and thus serves as the basis of a seismograph.

748 angular acceleration Law Mechanical

The time rate of change of angular velocity.

749 angular velocity Law Mechanical

The time rate of change of angular displacement.

750 strain rate Law Mechanical

The time rate for the usual tensile test.

1595 Newtonian attraction Law Mechanical

The mutual attraction of any two particles in the universe, as given by Newton's law of gravitation.

1686 bearing strength Law Mechanical

The maximum load that a column, wall, footing, or joint will sustain at failure, divided by the effective bearing area.

679 newton-meter of torque Law Mechanical

The unit of torque in the meter-kilogram-second system, equal to the torque produced by 1 newton of force acting at a perpendicular distance of 1 meter from an axis of rotation. Abbreviated N-m.

1713 inertial mass Law Mechanical

The mass of an object as determined by Newton's second law, in contrast to the mass as determined by the proportionality to the gravitational force.

142 dynamical similarity Law Mechanical

Two flow fields are dynamically similar if one can be transformed into the other by a change of length and velocity scales. All dimensionless numbers of the flows must be the same.

9676 mechanical property Law Mechanical

A property that involves a relationship between stress and strain or a reaction to an applied force.

964 shock Law Mechanical

A pulse or transient motion or force lasting thousandths to tenths of a second which is capable of exciting mechanical resonances; for example, a blast produced by explosives.

1843 rotational energy Law Mechanical

The kinetic energy of a rigid body dueto rotation.

727 wind pressure Law Mechanical

The total force exerted upon a structure by wind. Also known as velocity pressure.

1848 cubical dilation Law Mechanical

The isotropic part of the strain tensor describing the deformation of an elastic solid, equal to the fractional increase in volume.

1853 center of suspension Law Mechanical

The intersection of the axis of rotation of a pendulum with a plane perpendicular to the axis that passes through the center of mass.

14 shearing forces Law Mechanical

Two forces that are equal in magnitude, opposite in direction, and act along two distinct parallel lines.

1857 meter Law Mechanical

The international standard unit of length, equal to the length of the path traveled by light in vacuum during a time interval of 1/299,792,458 of a second. Abbreviated m.

1858 erection stress Law Mechanical

The internal forces exerted on a structural member during construction.

9588 mass Law Mechanical

A quantitative measure of a body's resistance to being accelerated; equal to the inverse of the ratio of the body's acceleration to the acceleration of a standard mass under otherwise identical conditions.

1697 compressive strength Law Mechanical

The maximum compressive stress a material can withstand without failure.

9680 toughness Law Mechanical

A property of a material capable of absorbing energy by plastic deformation; intermediate between softness and

10834 inertia matrix Law Mechanical

A matrix M used to express the kinetic energy T of a mechanical system during small displacements from an equilibrium position, by means of the equation T = 1/2 qTMq, where q is the vector whose components are the derivatives of the generalized coordinates of the system with respect to time, and qT is the transpose of q.

1080	dry measure	Law	Mechanical

A measure of volume for commodities that are dry.

1733	yield point	Law	Mechanical

The lowest stress at which strain increases without increase in stress. yield rate

1734	yield stress	Law	Mechanical

The lowest stress at which extension of the tensile test piece increases without increase in load.

10805	flexural modulus	Law	Mechanical

A measure of the resistance of a beam of specified material and cross section to bending, equal to the product of Young's modulus for the material and the square of the radius of gyration of the beam about its neutral axis.

1760	updraft furnace unit stress	Law	Mechanical

The load per unit of area. unity power factor

1768	translation	Law	Mechanical

The linear movement of a point in space without any rotation. translational motion

9986	inclined plane	Law	Mechanical

A plane surface at an angle to some force or reference line.

9982	invariable plane	Law	Mechanical

A plane which is perpendicular to the angular momentum vector of a rotating rigid body not subject to external torque, and which is always tangent to its inertia ellipsoid.

177	effective gun bore line	Law	Mechanical

The line which a projectile should follow when the muzzle velocity of the antiaircraft gun is vectorially added to the aircraft velocity.

747	speed	Law	Mechanical

The time rate of change of position of a body without regard to direction; in other words, the magnitude of the velocity vector.

104	centigram	Law	Mechanical

Unit of mass equal to 0.01 gram or 10~5 kilogram. Abbreviated cg.

10815	transmissibility	Law	Mechanical

A measure of the ability of a system either to amplify or to suppress an input vibration, equal to the ratio of the response amplitude of the system in steady-state forced vibration to the excitation amplitude; the ratio may be in forces, displacements, velocities, or accelerations.

171	air density	Law	Mechanical

The mass per unit volume of air.

10827	modulus of elasticity in shear	Law	Mechanical

A measure of a material's resistance to shearing stress, equal to the shearing stress divided by the resultant angle of deformation expressed in radians.

179	elastic axis	Law	Mechanical

The lengthwise line of a beam along which transverse loads must be applied in order to produce bending only, with no torsion of the beam at any section.

10835	stiffness matrix	Law	Mechanical

A matrix K used to express the potential energy V of a mechanical system during small displacements from an equilibrium position, by means of the equation V = 1/2qTKq, where q is the vector whose components are the generalized components of the system with respect to time and qT is the transpose of q. Also known as stability matrix.

9910	instantaneous center	Law	Mechanical

A point about which a rigid body is rotating at a given instant in time. Also known as instant center.

9909	point of contraflexure	Law	Mechanical

A point at which the direction of bending changes. Also known as point of inflection.

9905	center of twist	Law	Mechanical

A point on a line parallel to the axis of a beam through which any transverse force must be applied to avoid twisting of the section. Also known as shear center.

9904	set forward point	Law	Mechanical

A point on the expected course of the target at which it is predicted the target will arrive at the end of the time of flight.

1714	density	Law	Mechanical

The mass of a given substance per unit volume.

9902	center of attraction	Law	Mechanical

A point toward which a force on a body or particle (such as gravitational or electrostatic force) is always directed; the magnitude of the force depends only on the distance of the body or particle from this point.

13063 rectilinear motion Law Mechanical

A continuous change of position of a body so that every particle of the body follows a straight-line path. Also known as linear motion.

1773 line of fall Law Mechanical

The line tangent to t h e ballistic trajectory at the level point.

1775 line of flight Law Mechanical

The line of movement, or the intended line of movement, of an aircraft, guided missile, or projectile in the air.

178 effective launcher line Law Mechanical

The line along which the aircraft rocket would go if it were not affected by gravity.

10837 Galilean transformation Law Mechanical

A mathematical transformation used to relate the space and time variables of two uniformly moving (inertial) reference systems in nonrelativistic kinematics.

1869 impulse Law Mechanical

The integral of a force over an interval of time.

10816 bursting strength Law Mechanical

A measure of the ability of a material to withstand pressure without rupture; it is the hydraulic pressure required to burst a vessel of given thickness.

10184 strain rosette Law Mechanical

A pattern of intersecting lines on a surface along which linear strains are 536 stress ellipsoid measured to find stresses at a point.

1867 angular impulse Law Mechanical

The integral of the torque applied to a body over time.

1490 body centrode Law Mechanical

The path traced by the instantaneous center of a rotating body relative to the body.

13067 vibration Law Mechanical

A continuing periodic change in a displacement with respect to a fixed reference.

1467 surge stress Law Mechanical

The physical stress on process equipment or systems resulting from a sudden surge in fluid (gas or liquid) flow rate or pressure.

1453 plane of yaw Law Mechanical

The plane determined by the tangent to the trajectory of a projectile in flight and the axis of the projectile.

169 allowable load Law Mechanical

The maximum force that may be safely applied to a solid, or is permitted by applicable regulators.

1946 total pressure total pressure Law Mechanical

The gross load applied on a given surface.

1948 proportional elastic limit Law Mechanical

The greatest stress intensity for which stress is still proportional to strain.

1949 proportional limit Law Mechanical

The greatest stress a material can sustain without departure from linear proportionality of stress and strain.

1950 Euler force Law Mechanical

The greatest load that a long, slender column can carry without buckling, according to the Euler formula for long columns. Euler formula for long columns

9232 rotator Law Mechanical

A rotating rigid body.

1952 gravitational displacement Law Mechanical

The gravitational field strength times the gravitational constant. Also known as gravitational flux density.

1492 centrode Law Mechanical

The path traced by t h e instantaneous center of a plane figure when it undergoes plane motion.

1953 gravitometer See densimeter gravity Law Mechanical

The gravitational attraction at the surface of a planet or other celestial body.

722 torsional angle Law Mechanical

The total relative rotation of the ends of a straight cylindrical bar when subjected to a torque.

1963 generalized force Law Mechanical

The generalized force corresponding to a generalized coordinate is the ratio of the virtual work done in an infinitesimal virtual displacement, which alters that coordinate and no other, to the change in the coordinate.

9144 stress tensor Law Mechanical

A second-rank tensor whose components are stresses exerted across surfaces perpendicular to the coordinate

9143 strain tensor Law Mechanical

A second-rank tensor whose components are the nine possible strains. strake

11143 moving load Law Mechanical

A load that can move, such as vehicles or pedestrians.

11147 uniform load Law Mechanical

A load distributed uniformly over a portion or over the entire length of a beam; measured in pounds per foot.

1977 Mersenne's law Law Mechanical

The fundamental frequency of a vibrating string is proportional to the square root of the tension and inversely proportional both to the length and the square root of the mass per unit length.

1978 Lagrangian function Law Mechanical

The function which measures the difference between the kinetic and potential energy of a dynamical system. Lagrangian generalized velocity See generalized velocity.

716 ballistic trajectory Law Mechanical

The trajectory followed by a body being acted upon only by gravitational forces and resistance of the medium through which it passes.

715 mean trajectory Law Mechanical

The trajectory of a missile that passes through the center of impact or center of burst.

1984 kinetic friction Law Mechanical

The friction between two surfaces which are sliding over each other. kinetic momentum

11185 invariable line Law Mechanical

A line which is parallel to the angular momentum vector of a body executing Poinsot motion, and which passes through the fixed point in the body about which there is no torque.

9118 secondary stress Law Mechanical

A self-limiting normal or shear stress which is caused by the constraint of a structure and which is expected to cause minor distortions that would not result in a failure of the structure.

1690 burst pressure Law Mechanical

The maximum inside pressure that a process vessel can safely withstand.

9225 screw displacement Law Mechanical

A rotation of a rigid body about an axis accompanied by a translation of the body along the same axis.

13066 longitudinal vibration Law Mechanical

A continuing periodic change in the displacement of elements of a rod-shaped object in the direction of the long axis of the rod.

824 octahedral shear stress Law Mechanical

The tangential component of stress across the faces of a regular octahedron whose vertices lie on the principal axes of stress; it is a measure of the strength of the deviatoric stress.

10159 harmonic motion Law Mechanical

A periodic motion that is a sinusoidal function of time, that is, motion along a line given by the equation $x = a \cos (kt + 0)$, where t is the time parameter, and a, k, and 0 are constants. Also known as harmonic vibration; simple harmonic motion (SHM).

10160 torsional vibration Law Mechanical

A periodic motion of a shaft in which the shaft is twisted about its axis first in one direction and then in the other; this motion may be superimposed on rotational or other motion.

1883 primary creep Law Mechanical

The initial high strainrate region in a material subjected to sustained stress.

1588 kinetic reaction Law Mechanical

The negative of the mass of a body multiplied by its acceleration. kinetics

1585 octahedral normal stress Law Mechanical

The normal component of stress across the faces of a regular octahedron whose vertices lie on the principal axes of stress; it is equal in magnitude to the spherical stress across any surface. Also known as mean stress.

158 fatigue life Law Mechanical

The number of applied repeated stress cycles a material can endure before failure.

772 viscoelastic theory Law Mechanical

The theory which attempts to specify the relationship between stress and strain in a material displaying viscoelasticity.

9449 laboratory coordinate system Law Mechanical

A reference frame attached to the laboratory of the observer, in contrast to the center-of-mass system.

9448 center-of-mass coordinate system Law Mechanical

A reference frame which moves with the velocity of the center of mass, so that the center of mass is at rest in this system, and the total momentum of the system is zero. Also known as center of momentum coordinate system.

1560 ballistic coefficient Law Mechanical

The numerical measure of the ability of a missile to overcome air resistance; dependent upon the mass, diameter, and form factor.

566 isodynamic Law Mechanical

Pertaining to equality of two or more forces or to constancy of a force. isoelectric

149 space centrode Law Mechanical

The path traced by the instantaneous center of a rotating body relative to an inertial frame of reference.

1692 allowable stress Law Mechanical

The maximum force per unit area that may be safely applied to a solid.

1868 principal function Law Mechanical

The integral of the Lagrangian of a system over time; it is involved in the statement of Hamilton's principle. principal item

1499 central orbit Law Mechanical

The path followed by a body moving under the action of a central force.

776 Clapeyron's theorem Law Mechanical

The theorem that the strain energy of a deformed body is equal to one-half the sum over three perpendicular directions of t h e displacement component times the corresponding force component, including deforming loads and body forces, but not the six constraining forces required to hold the body in equilibrium.

1495 free-flight trajectory Law Mechanical

The path of a body in free fall.

13006 characteristic length Law Mechanical

A convenient reference length (usually constant) of a given configuration, such as overall length of an aircraft, the maximum diameter or radius of a body of revolution, or a chord or span of a lifting surface.

778 Varignon's theorem Law Mechanical

The theorem that the moment of a force is the algebraic sum of the moments of its vector components acting at a common point on the line of action of the force.

9403 ballistic density Law Mechanical

A representation of the atmospheric density encountered by a projectile in flight, expressed as a percentage of the density according to the standard artillery atmosphere.

11083 roll axis Law Mechanical

A longitudinal axis through an aircraft, rocket, or similar body, about which the body rolls.

1903 instantaneous recovery Law Mechanical

The immediate reduction in the strain of a solid when a stress is removed or reduced, in contrast to creep recovery.

1904 instantaneous strain Law Mechanical

The immediate deformation of a solid upon initial application of a stress, in contrast to creep strain.

1905 rotational reactance Law Mechanical

The imaginary part of the rotational impedance. Also known as mechanical rotational reactance.

1910 free fall Law Mechanical

The ideal falling motion of a body acted upon only by the pull of the earth's gravitational field.

1494 elliptical orbit Law Mechanical

The path of a body moving along an ellipse, such as that described by either of two bodies revolving under their mutual gravitational attraction but otherwise undisturbed.

9365 top Law Mechanical

A rigid body, one point of which is held fixed in an inertial reference frame, and which usually has an axis of symmetry passing through this point; its motion is usually studied when it is spinning rapidly about the axis of symmetry.

13185 station roof state of strain Law Mechanical

A complete description, including the six components of strain, of the deformation within a homogeneously deformed volume.

7495 lambda Law Mechanical

A unit of volume equal to 10"6 liter or 10"9 cubic meter.

7512 millimeter of water Law Mechanical

A unit of pressure, equal to the pressure exerted by a column of water 1 millimeter high with a density of 1 gram per cubic centimeter under the standard acceleration of gravity; equal to 9.80665 pascals. Abbreviated mmH2O.

896 breaking load Law Mechanical

The stress which, when steadily applied to a structural member, is just sufficient to break or rupture it. Also known as ultimate load.

897 creep strength Law Mechanical

The stress which, at a given temperature, will result in a creep rate of 1% deformation within 100,000 hours.

898 creep rupture strength Law Mechanical

The stress which, at a given temperature, will cause a material to rupture in a given time.

899 operating stress Law Mechanical

The stress to which a structural unit is subjected in service.

7504 blink Law Mechanical

A unit of time equal to 10~5 day or to 0.864 second.

7503 hour Law Mechanical

A unit of time equal to 3600 seconds. Abbreviated h; hr.

7502 nanosecond Law Mechanical

A unit of time equal to one-billionth of a second, or 10"9 second.

750 microsecond Law Mechanical

A unit of time equal to one-millionth of a second. Abbreviated JJLs.

7500 millisecond Law Mechanical

A unit of time equal to one-thousandth of a second. Abbreviated ms; msec.

7499 megasecond Law Mechanical

A unit of time, equal to 1,000,000 seconds. Abbreviated Ms; Msec. megawatt

7498 eon Law Mechanical

A unit of time, equal to 109 years. Eotvos effect

2376 biaxial stress Law Mechanical

The condition in which there are three mutually perpendicular principal stresses; two act in the same plane and one is

7496 stere Law Mechanical

A unit of volume equal to 1 cubic meter; it is used mainly in France, and in measuring timber volumes.

7515 technical atmosphere Law Mechanical

A unit of pressure in the metric technical system equal to one kilogram-force per square centimeter. Abbreviated at.

7494 kiloliter Law Mechanical

A unit of volume equal to 1000 liters or to 1 cubic meter. Abbreviated kl. kilometer

7493 fluid ton Law Mechanical

A unit of volume equal to 32 cubic feet or approximately 0.90614 cubic meter; used for many hydrometallurgical, hydraulic, and other industrial purposes.

7492 centiliter Law Mechanical

A unit of volume equalto 0.01 liter or to 10~5 cubic meter.

749 cusec Law Mechanical

A unit of volume flow rate, used primarily to describe pumps, equal to a uniform flow of 1 cubic foot in 1 second. Also known as cubic foot per second (cfs).

7490 minim Law Mechanical

A unit of volume in the apothecaries' measure; equals 1/60 fluidram (approximately 0.061612 cubic centimeter) or about 1 drop (of water). Abbreviated min.

7488 liter Law Mechanical

A unit of volume or capacity, equal to 1 decimeter cubed, or 0.001 cubic meter, or 1000 cubic centimeters. Abbreviated l;

7486 teaspoonful Law Mechanical

A unit of volume used particularly in cookery and pharmacy, equal to 11/3 fluid drams, or 1/3 tablespoonful; in the United States this is equal to approximately 4.9289 cubic centimeters, in the United Kingdom to approximately 4.7355 cubic centimeters. Abbreviated tsp; tspn.

7485 tablespoonful Law Mechanical

A unit of volume used particularly in cookery, equal to 4 fluid drams or 1/2 fluid ounce; in the United States this is equal to approximately 14.7868 cubic centimeters, in the United Kingdom to approximately 14.2065 cubic centimeters. Abbreviated tbsp.

7484 deciliter Law Mechanical

A unit of volume, equal to 0.1 liter, or 10"4 cubic meter.

7483 decastere Law Mechanical

A unit of volume, equal to 10 cubic meters.

7482 decaliter Law Mechanical

A unit of volume, equal to 10 liters, or to 0.01 cubic meter.

7479 cubic measure Law Mechanical

A unit or set of units to measure volume.

7547 pli Law Mechanical

A unit of line density (mass per unit length) equal to 1 pound per inch, or approximately 17.8580 kilograms per meter.

7497 minute Law Mechanical

A unit of time, equal to 60 seconds. mired

753 livre Law Mechanical

A unit of mass, used in France, equal to 0.5 kilogram.

10517 meter-kilogram-second system Law Mechanical

A metric system of units in which length, mass, and time are fundamental quantities, and the units of these quantities are the meter, the kilogram, and the second respectively. Abbreviated mks system. { ' me¯ d-sr 'kil-3,gram 'sek-snd ,sistsm meter prover

7545 gamma Law Mechanical

A unit of mass equal to 10"6 gram or 10"9 kilogram.

7544 hectogram Law Mechanical

A unit of mass equal to 100 grams. Abbreviated hg.

7543 milligram Law Mechanical

A unit of mass equal to onethousandth of a gram. Abbreviated mg. 356 minor diameter millihg See millimeter of mercury. milli-inch See mil milliliter

7542 stone Law Mechanical

A unit of mass in common use in the United Kingdom, equal to 14 pounds or 6.35029318 kilograms.

754 slug Law Mechanical

A unit of mass in the British gravitational system of units, equal to the mass which experiences an acceleration of 1 foot per second per second when a force of 1 pound acts on it; equal to approximately 32.1740 pound mass or 14.5939 kilograms. Also known as geepound.

7540 tonne Law Mechanical

A unit of mass in the metric system, equal to 1000 kilograms or to approximately 2204.62 pound mass. Also known as metric ton; millier; ton; tonneau.

7539 grain Law Mechanical

A unit of mass in the United States and United Kingdom, common to the avoirdupois, apothecaries', and troy systems, equal to 1/7000 of a pound, or to 6.479891 X 10~5 kilogram. Abbreviated gr.

7538 decigram Law Mechanical

A unit of mass, equal to 0.1 gram.

7537 avogram Law Mechanical

A unit of mass, equal to 1 gram divided by the Avogadro number.

7536 mounce Law Mechanical

A unit of mass, equal to 25 grams. Also known as metric ounce. mount

7535 metric grain Law Mechanical

A unit of mass, equal to 50 milligrams; used in commercial transactions in precious stones.

7534 glug Law Mechanical

A unit of mass, equal to the mass which is accelerated by 1 centimeter per second per second by a force of 1 gram-force, or to 980.665 grams.

7513 millimeter of mercury Law Mechanical

A unit of pressure, equal to the pressure exerted by a column of mercury 1 millimeter high with a density of 13.5951 grams per cubic centimeter under the standard acceleration of gravity; equal to 133.322387415 pascals; it differs from the torr by less than 1 part in 7,000,000. Abbreviated mmHg. Also known as millihg.

7522 atmosphere Law Mechanical

A unit of pressure equal to 101.325 kilopascals, which is the air pressure measured at mean sea level. Abbreviated atm. Also known as standard atmosphere.

2377 hydrostatic stress Law Mechanical

The condition in which there are equal compressive stresses or equal tensile stresses in all directions, and no shear stresses on any plane.

7516 centimeter of mercury Law Mechanical

A unit of pressure equal to the pressure that would support a column of mercury 1 centimeter high, having a density of 13.5951 grams per cubic centimeter, when the acceleration of gravity is equal to its standard value (980.665 centimeters per second per second); it is equalto 1333.22387415 pascals; it differs from the dekatorr by less than 1 part in 7,000,000. Abbreviated cmHg. Also known as centihg.

7517 pound per square inch Law Mechanical

A unit of pressure equal to the pressure resulting from a force of 1 pound applied uniformly over an area of 1 square inch. Abbreviated psi.

7518 pound per square foot Law Mechanical

A unit of pressure equal to the pressure resulting from a force of 1 pound applied uniformly over an area of 1 square foot. Abbreviated psf.

7519 pascal Law Mechanical

A unit of pressure equal to the pressure resulting from a force of 1 newton acting uniformly over an area of 1 square meter. Symbolized Pa.

7533 metric-technical unit of mass Law Mechanical

A unit of mass, equal to the mass which is accelerated by 1 meter per second per second by a force of 1 kilogram-force; it is equal to 9.80665 kilograms.

752 bar Law Mechanical

A unit of pressure equal to 105 pascals, or 105 newtons per square meter, or 106 dynes per square centimeter.

7532 crith Law Mechanical

A unit of mass, used for gases, equal to the mass of 1 liter of hydrogen at standard pressure and temperature; it is found experimentally to equal 8.9885 X 10~5 kilogram.

7523 centibar Law Mechanical

A unit of pressure equal to 0.01 bar or to 1000 pascals.

7525 milliwatt Law Mechanical

A unit of power equal to onethousandth of a watt. Abbreviated mW. mill length See random length.

7526 microwatt Law Mechanical

A unit of power equal to onemillionth of a watt. Abbreviated JJLW.

7527 picowatt Law Mechanical

A unit of power equal to 10"12 watt, or one-millionth of a microwatt. Abbreviated pW.

7529 mohm Law Mechanical

A unit of mechanical mobility, equal to the reciprocal of 1 mechanical ohm.

7514 torr Law Mechanical

A unit of pressure, equal to 1/760 atmosphere; it differs from 1 millimeter of mercury by less than one part in seven million; approximately equal to 133.3224 pascals.

7520 millibar Law Mechanical

A unit of pressure equal to onethousandth of a bar. Abbreviated mb. Also known as vac.

1128 Poisson number Law Mechanical

The reciprocal of the Poisson ratio.

1377 superposition theorem. Law Mechanical

The principle that when two or more forces act on a particle at the same time, the resultant force is the vector sum of the two.

1376 principle of least action Law Mechanical

The principle that, for a system whose total mechanical energy is conserved, the trajectory of the system in configuration space is that path which makes the value of the action stationary relative to nearby paths between the same configurations and for which the energy has the same constant value.

246 potential energy Law Mechanical

The capacity to do work that a body or system has by virtue of its position or configuration.

2468 ballistic uniformity Law Mechanical

The capability of a propellant, when fired under identical conditions from round to round, to impart uniform muzzle velocity and produce similar interior ballistic results.

902 yield strength Law Mechanical

The stress at which a material exhibits a specified deviation from proportionality of stress and strain.

2479 British imperial pound Law Mechanical

The British standard of mass, of which a standard is preserved by the government.

7128 bushel Law Mechanical

Abbreviated bu. 1. A unit of volume (dry measure) used in the United States, equal to 2150.42 cubic inches or approximately 35.239 liters. 2. A unit of volume (liquid and dry measure) used in Britain, equal to 2219.36 cubic inches or 8 imperial gallons (approximately 36.369 liters).

248 shattering Law Mechanical

The breaking up into highly irregular, angular blocks of a very hard material that has been subjected to severe stresses.

7126 fluid dram Law Mechanical

Abbreviated fl dr. 1. A unit of volume used in the United States for measurement of liquid substances, equal to 1/8 fluid ounce, or 3.6966911953125 X 10"6 cubic meter.

7125 fluid ounce Law Mechanical

Abbreviated fl oz. 1. A unit of volume that is used in the United States for measurement of liquid substances, equal to 1/16 liquid pint, or 231/128 cubic inches, or 2.95735295625 X 10~5 cubic meter. 2. A unit of volume used in the United Kingdom for measurement of liquid substances, and occasionally of solid substances, equal to 1/20 pint or 2.84130625 X 10~5 cubic meter.

7124 gallon Law Mechanical

Abbreviated gal. 1. A unit of volume used in the United States for measurement of liquid substances, equal to 231 cubic inches, or to 3.785 411 784 X 10"3 cubic meter, or to 3.785 411 784 liters; equal to 128 fluid ounces. 2. A unit of volume used in the United Kingdom for measurement of liquid and solid substances, usually the former; equal to 4.54609 X 10"3 cubic meter, or to 4.54609 liters; equal to 160 fluid ounces. Also known as imperial gallon.

7123 peck Law Mechanical

Abbreviated pk. 1. A unit of volume used in the United States for measurement of solid substances, equal to 8 dry quarts, or 1/4 bushel, or 537.605 cubic inches, or 0.00880976754172 cubic meter. 2. A unit of volume used in the United Kingdom for measurement of solid and liquid substances, although usually the former, equal to 2 gallons, or 0.00909218 cubic

1379 principle of virtual work Law Mechanical

The principle that the total work done by all forces acting on a system in static equilibrium is zero for any infinitesimal displacement from equilibrium which is consistent with the constraints of the 425 printed circuit system. Also known as virtual work principle.

712 quart Law Mechanical

Abbreviated qt. 1. A unit of volume used for measurement of liquid substances in the United States, equal to 2 pints, or 1/4 gallon, or 573/4 cubic inches, or 9.46352946 X 10"4 cubic meter. 2. A unit of volume used for measurement of solid substances in the United States, equal to 2 dry pints, or 1/32 bushel, or 107,521/1600 cubic inches, or approximately 1.10122 X 10"3 cubic meter. 3. A unit of volume used for measurement of both liquid and solid substances, although mainly the former, in the United Kingdom and Canada, equal to 2 U.K.

11630 two-degrees-of-freedom gyro Law Mechanical

A gyro whose spin axis is free to rotate about two orthogonal axes, not counting the spin axis.

13877 gal Law Mechanical

1. The unit of acceleration in the centimeter-gram-second system, equal to 1 centimeter per second squared; commonly used in geodetic measurement. Formerly known as galileo.

353 principal axis of stress Law Mechanical

One of the three mutually perpendicular axes of a body that are perpendicular to the principal planes of stress. Also known as stress axis.

7105 Airy stress function Law Mechanical

Abiharmonic function of two variables whose second partial derivatives give the stress components of a body subject to a plane strain.

7094 nutation Law Mechanical

Abobbingor nodding up-anddown motion of a spinning rigid body, such as a top, as it precesses about its vertical axis.

7085 macrorheology Law Mechanical

Abranchofrheologyin which materials are treated as homogeneous or quasi-homogeneous, and processes are treated as isothermal.

7059 negative acceleration Law Mechanical

Acceleration in a direction opposite to the velocity, or in t h e direction of the negative axis of a coordinate system.

7038 rotational impedance Law Mechanical

Acomplex quantity, equal to the phasor representing the alternating torque acting on a system divided by the phasor representing the resulting angular velocity in the direction of the torque at its point of application. Also known as mechanical rotational impedance.

2484 bulk rheology Law Mechanical

The branch of rheology wherein study of t h e behavior of matter neglects effects due to the surface of a system.

2485 statics Law Mechanical

The branch of mechanics which treats of force and force systems abstracted from matter, and of forces which act on bodies in equilibrium.

7016 centrifugal Law Mechanical

Acting or moving in a direction away from the axis of rotation or the center of a circle along which a body is moving.

7015 centripetal Law Mechanical

Acting or moving in a direction toward the axis of rotation or the center of a circle along which a body is moving.

10595 Betti's method Law Mechanical

A method of finding t h e solution of the equations of equilibrium of an elastic body whose surface displacements are specified; it uses the fact that the dilatation is a harmonic function to reduce the problem to the Dirichlet problem.

2486 gyroscopics Law Mechanical

The branch of mechanics concerned with gyroscopes and their use in stabilization and control of ships, aircraft, projectiles, and other objects.

7122 pint Law Mechanical

Abbreviated pt. 1. A unit of volume, used in t h e United States for measurement of liquid substances, equal to 1/8 U.S. gallon, or 231/8 cubic inches, or 4.73176473 X 10"4 cubic meter. Also known as liquid pint (liq pt).

7382 bound vector Law Mechanical

A vector whose line of application and point of application are both prescribed, in addition to its direction.

2388 crushing strength Law Mechanical

The compressive stress required to cause a solid to fail by fracture; in essence, it is the resistance of the solid to vertical pressure placed upon it.

2390 radial velocity Law Mechanical

The component of the velocity of a body that is parallel to a line from an observer or reference point to the body; the radial velocities of stars are valuable in determining the structure and dynamics of the Galaxy.

2392 longitudinal acceleration Law Mechanical

The component of the linear acceleration of an aircraft, missile, or particle parallel to its longitudinal, or X, axis.

2393 tangential acceleration Law Mechanical

The component of linear acceleration tangent to the path of a particle moving in a circular path.

2399 mechanical impedance Law Mechanical

The complex ratio of a phasor representing a sinusoidally varying force applied to a system to a phasor representing the velocity of a point in the system. mechanical lift dock

105 centiare Law Mechanical

Unit of area equal to 1 square meter. Also spelled centare.

11619 pendulous gyroscope Law Mechanical

A gyroscope whose axis of rotation is constrained by a suitable weight to remain horizontal; it is the basis of one type of gyrocompass.

900 normal stress Law Mechanical

The stress component at a point in a structure which is perpendicular to the reference plane.

90 strength Law Mechanical

The stress at which material ruptures or fails.

7390 Hamilton's principle Law Mechanical

A variational principle which states that the path of a conservative system in configuration space between two configurations is such that the integral of the Lagrangian function over time is a minimum or maximum relative to nearby paths between the same end points and taking the same time.

7388 random vibration Law Mechanical

A varying force acting on a mechanical system which may be considered to be the sum of a large number of irregularly timed small shocks; induced typically by aerodynamic turbulence, airborne noise from rocket jets, and transportation over road surfaces.

7386 Navier's equation Law Mechanical

A vector partial differential equation for the displacement vector of an elastic solid in equilibrium and subjected to a body force.

7384 Runge vector Law Mechanical

A vector which describes certain unchanging features of a nonrelativistic two-body interaction obeying an inverse-square law, either in classical or quantum mechanics; its constancy is a reflection of the symmetry inherent inthe inverse-square interaction.

1378 principle of dynamical similarity Law Mechanical

The principle that two physical systems which are geometrically and kinematically similar at a given instant, and physically similar in constitution, will retain this similarity at later corresponding instants if and only if the Froude number 1 for each independent type of force has identical values in the two systems. Also known as similarity principle.

7324 nonlinear vibration Law Mechanical

A vibration whose amplitude is large enough so that the elastic restoring force on the vibrating object is not proportional to its displacement.

7548 survey foot Law Mechanical

A unit of length, used by the U.S. Coast and Geodetic Survey, equal to 12/39.37 meter, or approximately 1.000002 feet. surveying altimeter

7248 Rayleigh wave Law Mechanical

A wave which propagates on the surface of a solid; particle trajectories are ellipses in planes normal to the surface and parallel to the direction of propagation.

7250 shear wave Law Mechanical

A wave that causes an element of an elastic medium to change its shape without changing its volume. Also known as rotational wave.

2446 secondary creep Law Mechanical

The change in shape of a substance under a minimum and almost constant differential stress, with the strain-time relationship a constant. Also known as steadystate creep.

10603 Poincare surface of section Law Mechanical

A method of displaying the character of a particular trajectory without examining its complete time development, in which the trajectory is sampled periodically, and the rate of change of a quantity under study is plotted against the value of that quantity at the beginning of each period. Also known as surface of section.

7383 sliding vector Law Mechanical

A vector whose direction and line of application are prescribed, but whose point of application is not prescribed.

2442 dynamic stability Law Mechanical

The characteristic of a body, such as an aircraft, rocket, or ship, that causes it, when disturbed from an original state of steady motion in an upright position, to damp the oscillations set up by restoring moments and gradually return to its original state. Also known as stability.

685 dyne Law Mechanical

The unit of force in the centimeter-

2428 nonquantum mechanics Law Mechanical

The classical mechanics of Newton and Einstein as opposed tothe quantum mechanicsofHeisenberg, Schrodinger, and Dirac; particles have definite position and velocity, and they move according to Newton's laws.

7370 yaw axis Law Mechanical

A vertical axis through an aircraft, rocket, or similar body, about which the body yaws; it may be a body, wind, or stability axis. Also known as yawing axis.

684 newton Law Mechanical

The unit of force in the meterkilogram-

7374 Coriolis force Law Mechanical

A velocity-dependent pseudoforce in a reference frame which is rotating with respect to an inertial reference frame; it is equal and opposite to the product of the mass of the particle on which the force acts and its Coriolis acceleration.

738 localized vector Law Mechanical

A vector whose line of application or point of application is prescribed, in addition to its direction.

1163 single-degree-of-freedom gyro Law Mechanical

A gyro the spin reference axis of which is free to rotate about only one of the orthogonal axes, such as the input or output axis.

13837 foot-pound Law Mechanical

1. Unit of energy or work in the English gravitational system, equal to the work done by 1 pound of force when the point at which the force is applied is displaced 1 foot in the direction of the force; equal to approximately 1.355818 joule. Abbreviated ft-lb; ft-lbf.

7777 torsion Law Mechanical

A twisting deformation of a solid body about an axis in which lines that were initially parallel to the axis become helices.

2307 ballistic curve Law Mechanical

The curve described by the path of a bullet, a bomb, or other projectile as determined by the ballistic conditions, by the propulsive force, and by gravity.

7897 aerodynamic trajectory Law Mechanical

A trajectory or part of a trajectory in which the missile or vehicle encounters sufficient air resistance to stabilize its flight or to modify its course significantly.

2308 trajectory Law Mechanical

The curve described by an object moving through space, as of a meteor through the atmosphere, a planet around the sun, a projectile fired from a gun, or a rocket in flight.

7875 canonical transformation Law Mechanical

A transformation which occurs among the coordinates and momenta describing the state of a classical dynamical system and which leaves the form of Hamilton's equations of motion unchanged.

2309 brachistochrone Law Mechanical

The curve along which a smooth-sliding particle, under the influence of gravity alone, will fall from one point to another in the minimum time.

13707 plane lamina Law Mechanical

A body whose mass is concentrated in a single plane.

87 rheology Law Mechanical

The study of the deformation and flow of matter, especially non-Newtonian flow of liquids and plastic flow of solids.

10545 Euler method Law Mechanical

A method of studying fluid motion and the mechanics of deformable bodies in which one considers volume elements at fixed locations in space, across which material flows; the Euler method is in contrast to the Lagrangian method.

1609 relative momentum Law Mechanical

The momentum of a body in a reference frame in which another specified body is fixed.

10550 Muskhelishvili's method Law Mechanical

A method of solving problems concerning the elastic deformation of a planar body that involves using methods from the theory of functions of a complex variable to calculate analytic functions which determine the plane strain of the body.

783 triangle of forces Law Mechanical

A triangle, two of whose sides represent forces acting on a particle, while the third represents the combined effect of these forces.

10635 transfer-matrix method Law Mechanical

A method of analyzing vibrations of complex systems, in which the system is approximated by a finite number of elements connected in a chainlike manner, and matrices are constructed which can be used to determine the configuration and forces acting on one element in terms of those on another.

1157 torsion function Law Mechanical

A harmonic function, 4>(x,y) = w/T, expressing the warping of a cylinder undergoing torsion, where the x, y, and z coordinates are chosen so that the axis of torsion lies along the z axis, w is the z component of the displacement, and T is the torsion angle. Also known as warping function.

1375 inextensional deformation Law Mechanical

A bending of a surface that leaves unchanged the length of any line drawn on the surface and the curvature of the surface at each point.

7919 balloting Law Mechanical

A tossing or bounding movement of a projectile, within the limits of t h e bore diameter, while moving through the bore under the influence of the propellant gases.

13768 duration Law Mechanical

A basic concept of kinetics which is expressed quantitatively by time measured by a clock or comparable mechanism. durometer

10627 Stodola method Law Mechanical

A method of calculating the deflection of a uniform or nonuniform beam in free transverse vibration at a specified frequency, as a function of distance along the beam, in which one calculates a sequence of 534 straight beam deflection curves each of which is the deflection resulting from the loading corresponding to the previous deflection, and these deflections converge to the solution.

1384 Gauss' principle of least constraint Law Mechanical

The principle that the motion of a system of interconnected material points subjected to any influence is such as to minimize the constraint on the system; here the constraint, during an infinitesimal period of time, is the sum over the points of the product of the mass of the point times the square of its deviation from the position it would have occupied at the end of the time period if it had not been connected to other points.

1062 Otto-Lardillon method Law Mechanical

A method of computing trajectories of missiles with low velocities (so that drag is proportional to t h e velocity squared) and quadrant angles of departure that may be high, in which exact solutions of the equations of motion are arrived at by numerical integration and are then tabulated.

1383 least-energy principle Law Mechanical

The principle that the potential energy of a system in stable equilibrium is a minimum relative to that of nearby configurations.

117 free flight Law Mechanical

Unconstrained or unassisted flight.

13287 force polygon Law Mechanical

A closed polygon whose sides are vectors representing the forces acting on a body in equilibrium.

2352 relative motion Law Mechanical

The continuous change of position of a body with respect to a second body or to a reference point that is fixed. Also known as apparent motion.

2353 mechanical vibration Law Mechanical

The continuing motion, often repetitive and periodic, of parts of machines and structures.

7546 pennyweight Law Mechanical

A unit of mass equal to 1/20 troy ounce or to 1.55517384 grams; the term is employed in the United States and in England for the valuation of silver, gold, and jewels. Abbreviated dwt; pwt.

873 kinematics Law Mechanical

The study of t h e motion of a system of material particles without reference to the forces which act on the system.

11376 Chapman-Jouguet plane Law Mechanical

A hypothetical, infinite plane, behind the initial shock front, in which it is variously assumed that reaction (and energy release) has effectively been completed, that reaction product gases have reached thermodynamic equilibrium, and that reaction gases, streaming backward out of the detonation, have reached such a condition that a forward- moving sound wave located at this precise plane would remain a fixed distance behind the initial shock.

2336 friction damping Law Mechanical

The conversion of the mechanical vibrational energy of solids into heat energy by causing one dry member to slide on another.

866 particle mechanics Law Mechanical

The study of the motion of a single material particle.

10 mass units Law Mechanical

Units of measurement having to do with masses of materials, such as pounds or grams.

8097 inertia tensor Law Mechanical

A tensor associated with a rigid body whose product with the body's rotation vector yields the body's angular momentum. inert primer

830 avoirdupois weight Law Mechanical

The system of units which has been commonly used in Englishspeaking countries for measurement of the mass of any substance except precious stones, precious metals, and drugs; it is based on the pound (approximately 453.6 grams) and includes the short ton (2000 pounds), long ton (2240 pounds), ounce (one-sixteenth pound), and dram (onesixteenth

8056 Betti reciprocal theorem Law Mechanical

A theorem in the mathematical theory of elasticity which states that if an elastic body is subjected to two systems of surface and body forces, then the work that would be done by the first system acting through the displacements resulting from 60 bifilar electrometer the second system equals the work that would be done by the second system acting through the displacements resulting from the first system.

8055 stress concentration factor Law Mechanical

A theoretical factor Kt expressing the ratio of the greatest stress in the region of stress concentration to the corresponding nominal stress.

1619 ballistic limit Law Mechanical

The minimum velocity at which a particular armor-piercing projectile is expected to consistently and completely penetrate armor plate of given thickness and physical properties at a specified angle of obliquity.

2248 level measurement Law Mechanical

The determination of the linear vertical distance between a reference point or datum plane and the surface of a liquid or t h e t op of a pile of divided solid.

805 finite strain theory Law Mechanical

A theory of elasticity, appropriate for high compressions, in which it is not assumed that strains are infinitesimally small. Also known as finite elasticity theory. Fink truss

2264 generalized velocity Law Mechanical

The derivative with respect to time of one of the generalized coordinates of a particle. Also known as Lagrangian generalized velocity.

8049 Hamilton-Jacobi theory Law Mechanical

A theory that provides a means for discussing the motion of a dynamic system in terms of a single partial differential equation of the first order, the Hamilton- Jacobi equation.

13619 penetration ballistics Law Mechanical

A branch of terminal ballistics concerned with the motion and behavior of a missile during and after penetrating a target.

839 environmental stress cracking Law Mechanical

The susceptibility of a material to crack or craze in the presence of surface-active agents or other environmental test

2305 deflection curve Law Mechanical

The curve, generally downward, described by a shot deviating from its true course.

10532 substitution weighing Law Mechanical

A method of weighing to allow for differences in lengths of the balance arms, in which the object to be weighed is first balanced against a counterpoise, and the known weights needed to balance the same counterpoise are then determined. Also known as counterpoise method.

2304 elastic curve Law Mechanical

The curved shape of the longitudinal centroidal surface of a beam when the transverse loads acting on it produced wholly elastic stresses.

867 elastodynamics Law Mechanical

The study of the mechanical properties of elastic waves.

2272 mechanical hysteresis Law Mechanical

The dependence of the strain of a material not only on the instantaneous value of the stress but also on the previous history of the stress; for example, the elongation is less at a given value of tension when the tension is increasing than when it is decreasing.

869 aeroballistics Law Mechanical

The study of the interaction of projectiles or high-speed vehicles with the atmosphere.

870 particle dynamics Law Mechanical

The study of the dependence of the motion of a single material particle on the external forces acting upon it, particularly electromagnetic and gravitational forces. particle energy

10533 double weighing Law Mechanical

A method of weighing to allow for differences in lengths of the balance arms, in which object and weights are balanced twice, the second time with their positions interchanged.

2279 elastic aftereffect Law Mechanical

The delay of certain substances in regaining their original shape after being deformed within their elastic limits. Also known as elastic lag.

229 aeroelasticity Law Mechanical

The deformation of structurally elastic bodies in response to aerodynamic loads.

1362 metarheology Law Mechanical

A branch of rheology whose approach is intermediate between those of macrorheology and microrheology; certain processes that are not isothermal are taken into consideration, such as kinetic elasticity, surface tension, and rate processes.

2292 bearing strain Law Mechanical

The deformation of bearing parts subjected to a load.

2293 ballistic deflection Law Mechanical

The deflection of a missile due to its ballistic characteristics.

2295 coefficient of compressibility Law Mechanical

The decrease in volume per unit volume of a substance 108 cog resulting from a unit increase in pressure; it is the reciprocal of the bulk modulus.

1610 Routh's rule of inertia Law Mechanical

The moment of inertia of a body about an axis of symmetry equals M(a2 + b2)/n, where M is the body's mass, a and b are the lengths of the body's two other perpendicular semiaxes, and n equals 3, 4, or 5 depending on whether the body is a rectangular parallelepiped, elliptic cylinder, or ellipsoid, respectively.

1382 d'Alembert's principle Law Mechanical

The principle that the resultant of the external forces and the kinetic reaction acting on a body equals zero. Dall tube

855 moment of force Law Mechanical

The sum of the products formed by multiplying the mass (or sometimes, the area) of each element of a figure by the square of its distance from a specified line. Also known as rotational inertia.

7562 hectometer Law Mechanical

A unit of length equal to 100 meters. Abbreviated hm.

2359 coefficient of restitution Law Mechanical

The constant e, which is the ratio of the relative velocity of two elastic spheres after direct impact to that before impact; e can vary from 0 to 1, with 1 equivalent to an elastic collision and 0 equivalent to a perfectly elastic collision. Also known as restitution coefficient.

7574 tondal Law Mechanical

A unit of force equal to the force which will impart an acceleration of 1 foot per second to a mass of 1 long ton; equal to approximately 309.6911 newtons.

2357 gravitational constant Law Mechanical

The constant of proportionality in Newton's law of gravitation, equal to the gravitational force between any two particles times the square of the distance between them, divided by the product of their masses. Also known as constant of gravitation.

7572 poundal Law Mechanical

A unit of force in the British absolute system of units equal to the force which will impart an acceleration of 1 ft/s2 to a pound mass, or to 0.138254954376 newton.

757 gram-force Law Mechanical

A unit of force in the centimeter-

2373 elastic equilibrium Law Mechanical

The condition of an elastic body in which each volume element of the body is in equilibrium under the combined effect of elastic stresses and externally applied body forces.

879 nonrelativistic kinematics Law Mechanical

The study of motions of systems of objects at speeds which are small compared tothe speed of light, without reference to the forces which act on the system. nonrelativistic mechanics

894 flow curve Law Mechanical

The stress-strain curve of a plastic material.

686 joule Law Mechanical

The unit of energy or work in the meter-kilogram-second system of units, equal to the work done by a force of 1 newton magnitude when the point at which the force is applied is displaced 1 meter in the direction of the force.

13827 windage Law Mechanical

1.The deflection of a bullet or other projectile due to wind. 2. The correction made for such deflection.

895 safe load Law Mechanical

The stress, usually expressed in tons per square foot, which a soil or foundation can safely support.

13836 land measure Law Mechanical

1. Units of area used in measuring land. 2. Any system for measuring land.

7576 tsi Law Mechanical

A unit of force equal to 1 ton-force per square inch; equal to approximately 1.54444 X 107 pascals.

7563 cape foot Law Mechanical

A unit of length equal to 1.033 feet or to 0.3148584 meter.

7575 ouncedal Law Mechanical

A unit of force equal to the force which will impart an acceleration of 1 foot per second per second to a mass of 1 ounce; equal to 0.0086409346485 newton.

756 nautical chain Law Mechanical

A unit of length equal to 15 feet or 4.572 meters.

7560 league Law Mechanical

A unit of length equal to 3 miles or 4828.032 meters.

7559 nanometer Law Mechanical

A unit of length equal to one-billionth of a meter, or 10~9 meter. Also known as millimicron (|jim); nanon.

7558 microangstrom Law Mechanical

A unit of length equal to one-millionth of an angstrom, or 10"16 meter Abbreviated JJLA microbalance

7557 millimeter Law Mechanical

A unit of length equal to one-thousandth of a meter. Abbreviated mm. Also known as metric line; strich.

7556 inch Law Mechanical

A unit of length in common use in the United States and the United Kingdom, equal to 1/12 foot or 2.54 centimeters. Abbreviated in.

7555 mile Law Mechanical

A unit of length in common use in the United States, equal to 5280 feet, or 1609.344 meters. Abbreviated mi. Also known as land mile; statute mile.

7554 decameter Law Mechanical

A unit of length in the metric system equal to 10 meters.

7553 stigma Law Mechanical

A unit of length used mainly in nuclear measurements, equal to 10"12 meter.

7552 french Law Mechanical

A unit of length used to measure small diameters, especially those of fiber optic bundles, equal to 1/3 millimeter.

755 angstrom Law Mechanical

A unit of length, 10"10 meter, used primarily to express wavelengths of optical spectra. Abbreviated A; A Also known as tenthmeter.

7550 furlong Law Mechanical

A unit of length, equal to 1/8 mile, 660 feet, or 201.168 meters.

7549 femtometer Law Mechanical

A unit of length, equal to 10"15 meter; used particularly in measuring nuclear distances. Abbreviated fm. Also known as fermi.

7564 centimeter Law Mechanical

A unit of length equal to 0.01 meter. Abbreviated cm.

7596 leo Law Mechanical

A unit of acceleration, equal to 10 meters per second per second; it has rarely been employed.

2363 body cone Law Mechanical

The cone in a rigid body that is swept out by the body's instantaneous axis 67 body force during Poinsot motion. Also known as polhode cone.

2366 dynamic balance Law Mechanical

The condition which exists in a rotating body when the axis about which it is forced to rotate, or to which reference is made, is parallel with a principal axis of inertia; no products of inertia about the center of gravity of the body exist in relation to the selected rotational axis.

138 Saint Venant's principle Law Mechanical

The principle that the strains that result from application, to a small part of a body's surface, of a system of forces that are statically equivalent to zero force and zero torque become negligible at distances which are large compared with the dimensions of the part.

7635 pressure Law Mechanical

A type of stress which is exerted uniformly in all directions; its measure is the force exerted per unit area.

237 dynamic equilibrium Law Mechanical

The condition of any mechanical system when the kinetic reaction is regarded as a force, so that the resultant force on the system is zero according to d'Alembert's principle. Also known as kinetic equilibrium.

682 gram Law Mechanical

The unit of mass in the centimeter-

761 circular mil Law Mechanical

A unit equal to the area of a circle whose diameter is 1 mil (0.001 inch); used chiefly in specifying cross-sectional areas of round conductors. Abbreviated cir mil.

7606 pull strength Law Mechanical

A unit in tensile testing; the bond strength in pounds per square inch.

7600 ata Law Mechanical

A unit of absolute pressure in the metric technical system equal to 1 technical atmosphere.

1380 law of corresponding times Law Mechanical

The principle that the times for corresponding motions of dynamically similar systems are proportional to L/V and also to J(L/G), where L is a typical dimension of the system, V a typical velocity, and G a typical force per unit mass.

7573 kilogram force Law Mechanical

A unit of force equal to the weight of a 1-kilogram mass at a point on the earth's surface where t h e acceleration of gravity is 9.80665 m/s2. Abbreviated kgf. Also known as kilogram (kg); kilogram weight (kg-wt).

7597 celo Law Mechanical

A unit of acceleration equal to the acceleration of a body whose velocity changes uniformly by 1 foot (0.3048 meter) per second in 1 second.

7577 crinal Law Mechanical

A unit of force equal to 0.1 newton. cripple

7595 hectare Law Mechanical

A unit of area in the metric system equal to 100 ares or 10,000 square meters. Abbreviated ha.

10609 Holzer's method Law Mechanical

A method of determining the shapes and frequencies of the torsional modes of vibration of a system, in which one imagines the system to consist of a number of flywheels on a massless flexible shaft and, starting with a trial frequency and motion for one flywheel, determines the torques and motions of successive flywheels.

7593 rood Law Mechanical

A unit of area, equal to 1/4 acre, or 10,890 square feet, or 1011.7141056 square meters.

7592 acre Law Mechanical

A unit of area, equal to 43,560 square feet, or to 4046.8564224 square meters.

878 astroballistics Law Mechanical

The study of phenomena arising out of the motion of a solid through a gas at speeds high enough to cause ablation; for example, the interaction of a meteoroid with the atmosphere.

759 are Law Mechanical

A unit of area, used mainly in agriculture, equal to 100 square meters.

7590 anker Law Mechanical

A unit of capacity equal to 10 U.S.

7594 deciare Law Mechanical

A unit of area, equal to 0.1 are or 10 square meters.

875 gyrodynamics Law Mechanical

The study of rotating bodies, especially those subject to precession. gyropendulum

7598 milligal Law Mechanical

A unit of acceleration commonly used in geodetic measurements, equal to 10"3 galileo, or 10~5 meter per second per second.

7583 gram-centimeter Law Mechanical

A unit of energy in the centimeter-gram-second gravitational system, equal to the work done by a force of magnitude 1 gram force when the point at which the force is applied is displaced 1 centimeter in the direction of the force. Abbreviated g-cm.

13813 kip Law Mechanical

A 1000-pound (453.6-kilogram) load.

1415 centrifugal force Prime Effect Mechanical

1. An outward pseudo-force, in a reference frame that is rotating with respect to an inertial reference frame, which is equal and opposite to the centripetal force that must act on a particle stationary in the rotating frame. 2. The reaction force to a centripetal force.

3135 dry friction Prime Effect Mechanical

Resistance between two dry solid surfaces, that is, surfaces free from contaminating films or fluids.

Mechanical Engineering

3467 air-suspension system Effect Mechanical Engineering

Parts of an automotive vehicle that are intermediate between the wheels and the frame, and support the car body and frame by means of a cushion of air to absorb road shock caused by passage of the wheels over irregularities.

2993 turning Effect Mechanical Engineering

Shaping a member on a lathe.

12632 Saunders air-lift pump Effect Mechanical Engineering

A device for raising water from a well by the introduction of compressed air below the water level in the well. sauterelle

12557 adsorption system Effect Mechanical Engineering

A device that dehumidifies air by bringing it into contact with a solid adsorbing substance.

3449 electromechanical Effect Mechanical Engineering

Pertaining to a mechanical device, system, or process which is electrostatically or electromagnetically actuated or controlled.

12669 agitator Effect Mechanical Engineering

A device for keeping liquids and solids in liquids in motion by mixing, stirring, or shaking.

12583 Lilly controller Effect Mechanical Engineering

A device on steam and electric winding engines that protects against overspeed, overwind, and other incidents injurious to workers and the engine.

12620 steam dryer Effect Mechanical Engineering

A device for separating liquid from vapor in a steam supply system. steam emulsion test

2942 closed-belt conveyor Effect Mechanical Engineering

Solidsconveying device with zipperlike teeth that mesh to form a closed tube wrapped snugly around the conveyed material; used with fragile materials.

12986 flight conveyor Effect Mechanical Engineering

A conveyor in which paddles, attached to single or double strands of chain, drag or push pulverized or granulated solid materials along a trough. Also known as drag conveyor.

2275 fuel injection Effect Mechanical Engineering

The delivery of fuel to an internal combustion engine cylinder by pressure from a mechanical pump.

1298 accordion roller conveyor Effect Mechanical Engineering

A conveyor with a flexible latticed frame which permits variation in length.

2887 live steam Effect Mechanical Engineering

Steam that is being delivered directly from a boiler under full pressure. Livingstone sphere

12905 Blake jaw crusher Effect Mechanical Engineering

A crusher with one fixed jaw plate and one pivoted at the top so as to give the greatest movement on the smallest lump.

13206 electrolytic grinding Effect Mechanical Engineering

A combined grinding and machining operation in which the abrasive, cathodic grinding wheel is in contact with the anodic workpiece beneath the surface of an electrolyte. Also known as electrochemical grinding.

233 refrigeration Effect Mechanical Engineering

The cooling of a space or substance below the environmental temperature.

294 rotary crusher Effect Mechanical Engineering

Solids-reduction device in which a high-speed rotating cone on a vertical shaft forces solids against a surrounding shell.

2332 compression refrigeration Effect Mechanical Engineering

The cooling of a gaseous refrigerant by first compressing it to liquid form (with resultant heat buildup), cooling the liquid by heat exchange, then releasing pressure to allow the liquid to vaporize (with resultant absorption of latent heat of vaporization and a refrigerative effect).

2943 oscillating screen Effect Mechanical Engineering

Solids separator in which the sifting screen oscillates at 300 to 400 revolutions per minute in a plane parallel to the screen.

2944 pin-type mill Effect Mechanical Engineering

Solids pulverizer in which protruding pins on high-speed rotating disk provide the breaking energy.

2946 sawtooth crusher Effect Mechanical Engineering

Solids crusher in which feed is broken down between two sawtoothed shafts rotating at different speeds. sawtooth

13209 cascade system Effect Mechanical Engineering

A combination of two or more refrigeration systems connected in series to produce extremely low temperatures, with the evaporator of one machine used to cool the condenser of another.

2970 dispersion mill Effect Mechanical Engineering

Size-reduction apparatus that disrupts clusters or agglomerates of solids, rather than breaking down individual particles; used for paint pigments, food products, and cosmetics.

12982 pneumatic conveyor Effect Mechanical Engineering

A conveyor which transports dry, free-flowing, granular material in suspension, or a cylindrical carrier, within a pipe or duct by means of a high-velocity airstream or by pressure of vacuum generated by an air compressor. Also known as air conveyor.

2940 pan crusher Effect Mechanical Engineering

Solids-reduction device in which one or more grinding wheels or mullers revolve in a pan containing the material to be pulverized.

2784 mechanism Effect Mechanical Engineering

That part of a machine which contains two or more pieces so arranged that the motion of one compels the motion of the others.

14284 centrifuge Effect Mechanical Engineering

1. A rotating device for separating liquids of different specific gravities or for separating suspended colloidal particles, such as clay particles in an aqueous suspension, according to particle-size fractions by centrifugal force. 2. A large motor-driven apparatus with a long arm, at the end of which human and animal subjects or equipment can be revolved 95 centrifuge refining and rotated at various speeds to simulate the prolonged accelerations encountered in rockets and

12967 adamantine drill Effect Mechanical Engineering

A core drill with hardened steel shot pellets that revolve under the rim of the rotating tube; employed in rotary drilling in very hard ground.

2564 shock isolation Effect Mechanical Engineering

The application of isolators to alleviate the effects of shock on a mechanical device or system.

2569 electromachining Effect Mechanical Engineering

The application of electric or ultrasonic energy to a workpiece to effect removal of material.

2425 abrasive blasting Effect Mechanical Engineering

The cleaning or finishing of surfaces by the use of an abrasive entrained in a blast of air.

12944 ratchet coupling Effect Mechanical Engineering

A coupling between two shafts that uses a ratchet to allow the driven shaft to be turned in one direction only, and also to permit the driven shaft to overrun the driving shaft.

2299 hydraulic cylinder Effect Mechanical Engineering

The cylindrical chamber of a positive displacement pump.

2776 journal Effect Mechanical Engineering

That part of a shaft or crank which is supported by and turns in a bearing.

298 fleet Effect Mechanical Engineering

Sidewise movement of a rope or cable when winding on a drum.

2346 attemperation of steam Effect Mechanical Engineering

The controlled cooling, in a steam boiler, of steam at the superheater outlet or between the primary and secondary stages of the superheater to regulate the final steam temperature.

2340 ocean thermal-energy conversion Effect Mechanical Engineering

The conversion of energy arising from the temperature difference between warm surface water of oceans and cold deep-ocean current into electrical energy or other useful forms of energy.

2338 solar heating Effect Mechanical Engineering

The conversion of solar radiation into heat for technological, comfort-

2337 solar power Effect Mechanical Engineering

The conversion of the energy of the sun's radiation to useful work. solar power satellite

12906 roll crusher Effect Mechanical Engineering

A crusher having one or two toothed rollers to reduce the material.

2333 aftercooling Effect Mechanical Engineering

The cooling of a gas after its compression.

2764 ballhead Effect Mechanical Engineering

That part of the governor which contains flyweights whose force is balanced, at least in part, by the force of compression of a speeder spring.

1875 driving pinion Effect Mechanical Engineering

The input gear in the differential of an automobile.

12995 screw conveyor Effect Mechanical Engineering

A conveyor consisting of a helical screw that rotates upon a single shaft within a stationary trough or casing, and which can move bulk material along a horizontal, inclined, or vertical plane. Also known as auger conveyor; spiral conveyor; worm conveyor.

3288 turbine propulsion Effect Mechanical Engineering

Propulsion of a vehicle or vessel by means of a steam or gas turbine.

12742 reaction wheel Effect Mechanical Engineering

A device capable of storing angular momentum which may be used in a space ship to provide torque to effect or maintain a given orientation.

12740 Atwood machine Effect Mechanical Engineering

A device comprising a pulley over which is passed a stretchfree cord with a weight hanging on each end.

1940 suction lift Effect Mechanical Engineering

The head, in feet, that a pump must provide on the inlet side to raise the liquid from the supply well to the level of the pump. Also known as suction head.

12997 flat-belt conveyor Effect Mechanical Engineering

A conveyor belt in which the carrying run is supported by flatbelt idlers or pulleys.

12985 drag-chain conveyor Effect Mechanical Engineering

A conveyor in which the open links of a chain drag material along the bottom of a hard-faced concrete or cast iron trough. Also known as dragline conveyor. drag classifier

13037 eddy-current brake Effect Mechanical Engineering

A control device or dynamometer for regulating rotational speed, as of flywheels, in which energy is converted by eddy currents into heat.

3275 cage mill Effect Mechanical Engineering

Pulverizer used to disintegrate clay, press cake, asbestos, packing-house by-products, and various tough, gummy, highmoisture- content or low-melting-point materials.

13064	sprocket chain	Effect	Mechanical Engineering

A continuous chain which meshes with the teeth of a sprocket and thus can transmit mechanical power from one sprocket to another.

463	valve train	Effect	Mechanical Engineering

The valves and valve operating mechanism for the control of fluid flow to and from a piston-cylinder machine, for example, steam, diesel, or gasoline engine.

1847	accelerator jet	Effect	Mechanical Engineering

The jet through which the fuel is injected into the incoming air in the carburetor of an automotive vehicle with rapid demand for increased power output.

12704	Lanchester balancer	Effect	Mechanical Engineering

A device for balancing four-cylinder engines; consists of two meshed gears with eccentric masses, driven by the

338	pumping loss	Effect	Mechanical Engineering

Power consumed in purging a cylinder of exhaust gas and sucking in fresh air instead.

1270	torque converter	Effect	Mechanical Engineering

A device for changing the torque speed or mechanical advantage between an input shaft and an output shaft.

1530	thrust yoke	Effect	Mechanical Engineering

The part connecting the piston rods of the feed mechanism on a hydraulically driven diamond-drill swivel head to the thrust block, which forms the connecting link between the yoke and the drive rod, by means of which link the longitudinal movements of the feed mechanism are transmitted to the swivel-head drive rod. Also known as back end.

12862	trepanning tool	Effect	Mechanical Engineering

A cutting tool in the form of a circular tube, having teeth on the end; the workpiece or tube, or both, are rotated and the tube is fed axially into the workpiece, leaving behind a narrow grooved surface in the workpiece.

3414	expansion engine	Effect	Mechanical Engineering

Piston-cylinder device that cools compressed air via sudden expansion; used in production of pure gaseous oxygen via the Claude cycle.

2992	stretch forming	Effect	Mechanical Engineering

Shaping metals and plastics by applying tension to stretch the heated sheet or part, wrapping it around a die, and then cooling it. Also known as wrap forming. stretch out

3003 shearing Effect Mechanical Engineering

Separation of material by the cutting action of shears.

2159 pawl Effect Mechanical Engineering

The driving link or holding link of a ratchet mechanism, permits motion in one direction only.

13216 epicyclic train Effect Mechanical Engineering

A combination of epicyclic gears, usually connected by an arm, in which some or all of the gears have a motion compounded of rotation about an axis and a translation or revolution of that axis.

13205 Humphrey gas pump Effect Mechanical Engineering

A combined internal combustion engine and pump in which the metal piston has been replaced by a column of water.

12993 rope-and-button conveyor Effect Mechanical Engineering

A conveyor consisting of an endless wire rope or cable with disks or buttons attached at intervals.

3178 absorption refrigeration Effect Mechanical Engineering

Refrigeration in which cooling is effected by the expansion of liquid ammonia into gas and absorption of the gas by water; the ammonia is reused after the water evaporates.

12988 arm conveyor Effect Mechanical Engineering

A conveyor in the form of an endless belt or chain to which are attached projecting arms or shelves which carry the materials.

2069 feed screw Effect Mechanical Engineering

The externally threaded drill-rod drive rod in a screw- or gearfeed swivel head on a diamond drill; also used on percussion drills, lathes, and other machinery.

12987 Redler conveyor Effect Mechanical Engineering

A conveyor in which material is dragged through a duct by skeletonized or U-shaped impellers which move the material in which they are submerged because the resistance to slip through the element is greater than the drag against the walls of the duct.

1285 hydrocyclone Effect Mechanical Engineering

A cyclone separator in which granular solids are removed from a stream of water and classified by centrifugal force.

12838 rotary dryer Effect Mechanical Engineering

A cylindrical furnace slightly inclined to the horizontal and rotated on suitable bearings; moisture is removed by rising hot gases.

12825 Lancashire boiler Effect Mechanical Engineering

A cylindrical steam boiler consisting of two longitudinal furnace tubes which have internal grates at the front.

12777 guy derrick Effect Mechanical Engineering

A derrick having a vertical pole supported by guy ropes to which a boom is attached by rope or cable suspension at the top and by a pivot at the foot.

297 disk mill Effect Mechanical Engineering

Size-reduction apparatus in which grinding of feed solids takes place between two disks, either or both of which rotate. Also known as disk attrition mill.

2093 herringbone gear Effect Mechanical Engineering

The equivalent of two helical gears of opposite hand placed side by side.

13165 superheater Effect Mechanical Engineering

A component of a steam-generating unit in which steam, after it has left the boiler drum, is heated above its saturation temperature.

11633 Gates crusher Effect Mechanical Engineering

A gyratory crusher which has a cone or mantle that is moved eccentrically by the lower bearing sleeve.

8537 Robins-Messiter system Effect Mechanical Engineering

A stacking conveyor system in which material arrives on a conveyor belt and is fed to one or two wing conveyors.

670 available draft Effect Mechanical Engineering

The usable differential pressure in the combustion air in a furnace, used to sustain combustion of fuel or to transport products of combustion.

8499 uniflow engine Effect Mechanical Engineering

A steam engine in which steam enters the cylinder through valves at one end and escapes through openings uncovered by the piston as it completes its stroke.

8496 Parsons-stage steam turbine Effect Mechanical Engineering

A steam turbine having a reaction-type stage in which the pressure drop occurs partially across the stationary nozzles and partly across the rotating blades.

8495 helical-flow turbine Effect Mechanical Engineering

A steam turbine in which the steam is directed tangentially and radially inward by nozzles against buckets milled in the wheel rim; the steam flows in a helical path, reentering the buckets one or more times. Also known as tangential helical-flow turbine.

8425 steam nozzle Effect Mechanical Engineering

A streamlined flow structure in which heat energy of steam is converted to the kinetic form.

8424 needle nozzle Effect Mechanical Engineering

A streamlined hydraulic turbine nozzle with a movable element for converting the pressure and kinetic energy in the pipe leading from the reservoir to the turbine into a smooth jet of variable diameter and discharge but practically constant velocity.

665 forced circulation Effect Mechanical Engineering

The use of a pump or other fluid-movement device in conjunction with liquid-processing equipment to move the liquid through pipes and process vessels; contrasted to gravity or thermal circulation. forced-circulation boiler

1354 friction sawing Effect Mechanical Engineering

A burning process to cut stock to length by using a blade saw operating at high speed; used especially for the structural parts of mild steel and stainless steel. friction shoe

859 dual-bed dehumidifier Effect Mechanical Engineering

A sorbent dehumidifier with two beds, one bed dehumidifying while the other bed is reactivating, thus providing a continuous flow of air.

13198 Philips hot-air engine Effect Mechanical Engineering

A compact hot-air engine that is a Philips Research Lab (Holland) design; it uses only one cylinder and piston, and operates at 3000 revolutions per minute, with hot-chamber temperature of 1200°F (650°C), maximum pressure of 50 atmospheres (5.07 megapascals), and mean effective pressure of 14 atmospheres (1.42 megapascals).

8612 friction bearing Effect Mechanical Engineering

A solid bearing that directly contacts and supports an axle end.

804 electromechanics Effect Mechanical Engineering

The technology of mechanical devices, systems, or processes which are electrostatically or electromagnetically actuated or controlled.

8242 rope drive Effect Mechanical Engineering

A system of ropes running in grooved pulleys or sheaves to transmit power over distances too great for belt drives.

13153 vacuum pump Effect Mechanical Engineering

A compressor for exhausting air and noncondensable gases from a space that is to be maintained at subatmospheric pressure.

8133 impact grinding Effect Mechanical Engineering

A technique used to break up particles by direct fall of crushing bodies on them.

819 rifling Effect Mechanical Engineering

The technique of cutting helical grooves inside a rifle barrel to impart a spinning motion to a projectile around its long axis.

159 gear drive Effect Mechanical Engineering

Transmission of motion geared turbine or torque from one shaft to another by means of direct contact between toothed wheels. geared turbine

804 steam engine Effect Mechanical Engineering

A thermodynamic device for the conversion of heat in steam into work, generally in the form of a positive displacement, piston and cylinder mechanism.

11404 bicycle Effect Mechanical Engineering

A human-powered land vehicle with two wheels, one behind the other, usually propelled by the action of the rider's feet on the pedals.

11413 ram-type turret lathe Effect Mechanical Engineering

A horizontal turret lathe in which the turret is mounted on a ram or slide which rides on a saddle.

11427 Dorr classifier Effect Mechanical Engineering

A horizontal flow classifier consisting of a rectangular tank with a sloping bottom, a rake mechanism for moving sands uphill along the bottom, an inlet for feed, and outlets for sand and slime.

13590 involute spline broach Effect Mechanical Engineering

A broach that cuts multiple keys in the form of internal or external involute gear teeth.

8765 pole lathe Effect Mechanical Engineering

A simple lathe in which the work is rotated by a cord attached to a treadle.

8996 counterweight Effect Mechanical Engineering

1. A device which counterbalances the original load in elevators and skip and mine hoists, going up when the load goes down, so that the engine must only drive against the unbalanced load and overcome friction. 2. Any weight placed on a mechanism which is out of balance so as to maintain static equilibrium. Also known as counterbalance; counterpoise.

11214 scissor jack Effect Mechanical Engineering

A lifting jack driven by a horizontal screw; the linkages of the jack are parallelograms whose horizontal diagonals are lengthened or shortened by the screw.

8876 opposed engine Effect Mechanical Engineering

A reciprocating engine having the pistons on opposite sides of the crankshaft, with the piston strokes on each side working in a direction opposite to the direction of the strokes on the other side.

8875 two-cycle engine Effect Mechanical Engineering

A reciprocating internal combustion engine that requires two piston strokes or one revolution to complete a cycle.

887 hydropneumatic recoil system Effect Mechanical Engineering

A recoil mechanism that absorbs the energy of recoil by the forcing of oil through orifices and returns the gun to battery by compressed gas.

8870 Schneider recoil system Effect Mechanical Engineering

A recoil system for artillery, employing the hydropneumatic principle without a floating piston.

13486 downdraft carburetor Effect Mechanical Engineering

A carburetor in which the fuel is fed into a downward current of air.

145 sliding pair Effect Mechanical Engineering

Two adjacent links, one of which is constrained to move in a particular path with respect to the other; the lower, or closed, pair is completely constrained by the design of the links of the pair.

11218 walking beam Effect Mechanical Engineering

A lever that oscillates on a pivot and transmits power in a manner producing a reciprocating or reversible motion; used in rock drilling and oil well pumping.

883 shear spinning Effect Mechanical Engineering

A sheet-metalforming process which forms parts with rotational symmetry over a mandrel with the use of a tool or roller in which deformation is carried out with a roller in such a manner that t h e diameter of t h e original blank does not change but the thickness of the part decreases by an amount dependent on the mandrel angle.

8574 Rzeppa joint Effect Mechanical Engineering

A special application of the Bendix-Weiss universal joint in which four large balls are transmitting elements, while a center ball acts as a spacer; it transmits constant angular velocity through a single universal joint.

11219 tappet Effect Mechanical Engineering

A lever or oscillating member moved by a cam and intended to t ap or touch another part, such as a push rod or valve system.

11470 gin Effect Mechanical Engineering

A hoisting machine in the form of a tripod with a windlass, pulleys, and ropes.

8762 shell pump Effect Mechanical Engineering

A simple pump for removing wet sand or mud; consists of a hollow cylinder with a ball or clack valve at the bottom.

8754 rate integrating gyroscope Effect Mechanical Engineering

A single- degree-of-freedom gyro having primarily viscous restraint of its spin axis about the output axis; an output signal is produced by gimbal angular displacement, relative to the base, which reactance drop is proportional to the integral of the angular rate of the base about the input axis.

13510 poppet valve Effect Mechanical Engineering

A cam-operated or spring-loaded reciprocating-engine mushroomtype valve used for control of admission and exhaust of working fluid; the direction of movement is at right angles to the plane of its seat.

8718 needle valve Effect Mechanical Engineering

A slender, pointed rod fitting in a hole or circular or conoidal seat; used in hydraulic turbines and hydroelectric systems.

8715 slide valve Effect Mechanical Engineering

A sliding mechanism to cover and uncover ports for the admission of fluid, as in some steam engines.

8692 pilot drill Effect Mechanical Engineering

A small drill to start a hole to ensure that a larger drill will run true to center.

1351 rocker cam Effect Mechanical Engineering

A cam that moves with a rocking motion.

13512 inverse cam Effect Mechanical Engineering

A cam that acts as a follower instead of a driver.

8617 active solar system Effect Mechanical Engineering

A solar heating or cooling system that operates by mechanical means, such as motors, pumps, or valves. active sonar

8616 passive solar system Effect Mechanical Engineering

A solar heating or cooling system that operates by using gravity, heat flows, or evaporation rather than mechanical devices to collect and transfer energy. passive sonar

8824 oleo strut Effect Mechanical Engineering

A shock absorber consisting of a telescoping cylinder that forces oil into an air chamber, thereby compressing the air; used on aircraft landing gear.

11589 gin pole Effect Mechanical Engineering

A hand-operated derrick which has a nearly vertical pole supported by guy ropes; the load is raised on a rope that passes through a pulley at the top and over a winch at the foot. Also known as guyed-mast derrick; pole derrick; standing derrick.

11562 adiabatic engine Effect Mechanical Engineering

A heat engine or thermodynamic system in which there is no gain or loss of heat.

13792 floating scraper Effect Mechanical Engineering

A balanced scraper blade that rests lightly on a drum filter; removes solids collected on the rotating drum surface by riding on the drum's surface contour.

7648 Unsin engine Effect Mechanical Engineering

A type of rotary engine in which the trochoidal rotors of eccentricrotor engines are replaced with two circular rotors, one of which has a single gear tooth upon which gas pressure acts, and the second rotor has a slot which accepts the gear

7646 screw elevator Effect Mechanical Engineering

A type of screw conveyor for vertical delivery of pulverized materials. screw fastener See screw.

7645 ribbon conveyor Effect Mechanical Engineering

A type of screw conveyor which has an open space between the shaft and a ribbon-shaped flight, used for wet or sticky materials which would otherwise build up on the spindle.

13799 knife-edge bearing Effect Mechanical Engineering

A balance beam or lever arm fulcrum in the form of a hardened steel wedge; used to minimize friction.

13152 Roots blower Effect Mechanical Engineering

A compressor in which a pair of hourglass-shaped members rotate within a casing to deliver large volumes of gas at relatively low pressure increments.

182 abrasive cloth Effect Mechanical Engineering

Tough cloth to whose surface an abrasive such as sand or emery has been bonded for use in grinding or polishing.

7478 feeder-breaker Effect Mechanical Engineering

A unit that breaks and feeds ore or crushed rock to a materialshandling system at a required rate.

7477 impact mill Effect Mechanical Engineering

A unit that reduces the size of rocks and minerals by the action of rotating blades projecting the material against steel plates.

13314 pendulum saw Effect Mechanical Engineering

A circular saw that swings in a vertical arc for crosscuts.

747 constant-velocity universal joint Effect Mechanical Engineering

A universal joint that transmits constant angular velocity from the driving to the driven shaft, such as the Bendix-Weiss universal joint.

7704 Telsmith breaker Effect Mechanical Engineering

A type of gyratory crusher, often used for primary crushing; consists of a spindle mounted in a long eccentric sleeve which rotates to impart a gyratory motion to the crushing head, but gives a parallel stroke, that is, the axis of the spindle describes a cylinder rather than a cone, as in the suspended spindle gyratory.

3549 planet pinion Effect Mechanical Engineering

One of the gears in a planetary gear train that meshes with and revolves around the sun gear.

7437 ball valve Effect Mechanical Engineering

A valve in which the fluid flow is regulated by a ball moving relative to a spherical socket as a result of fluid pressure and the weight of the ball.

1159 deadman's handle Effect Mechanical Engineering

A handle on a machine designed so that the operator must continuously press on it in order to keep the machine running.

7326 ultrasonic drilling Effect Mechanical Engineering

A vibration drilling method in which ultrasonic vibrations are generated by the compression and extension of a core of electrostrictive or magnetostrictive material in a rapidly alternating electric or magnetic field.

11625 rate gyroscope Effect Mechanical Engineering

A gyroscope that is suspended in just one gimbal whose bearings form its output axis and which is restrained by a spring;

rotation of the gyroscope frame about an axis perpendicular to both spin and output axes produces precession of the gimbal within the bearings proportional to the rate of rotation.

726 undershot wheel Effect Mechanical Engineering

A water wheel operated by the impact of flowing water against blades attached around the periphery of the wheel, the blades being partly or totally submerged in the moving stream of water.

7205 multirope friction winder Effect Mechanical Engineering

A winding system in which the drive to the winding ropes is the frictional resistance between the ropes and the driving sheaves.

7204 Savonius windmill Effect Mechanical Engineering

A windmill composed of two semicylindrical offset cups rotating about a vertical axis.

7203 Fales-Stuart windmill Effect Mechanical Engineering

A windmill developed for farm use from the two-blade airfoil propeller. Also known as Stuart windmill. Falk flexible coupling

7188 Bowden cable Effect Mechanical Engineering

A wire made of spring steel which is enclosed in a helical casing and used to transmit longitudinal motions over distances, particularly around corners.

7472 Bendix-Weiss universal joint Effect Mechanical Engineering

A universal joint that provides for constant angular velocity of the driven shaft by transmitting the torque through a set of four balls lying in the plane that contains the bisector of, and is perpendicular to, the plane of the angle between bend

11493 cryosorption pump Effect Mechanical Engineering

A high-vacuum pump that employs a sorbent such as activated charcoal or synthetic zeolite cooled by nitrogen or some other refrigerant; used to reduce pressure from atmospheric pressure to a few millitorr.

9026 mechanical linkage Effect Mechanical Engineering

A set of rigid bodies, called links, joined together at pivots by means of pins or equivalent devices.

799 lead screw Effect Mechanical Engineering

A threaded shaft used to convert rotation to longitudinal motion; in a lathe it moves the tool carriage when cutting threads; in a disk recorder it guides the cutter at a desired rate across the surface of an ungrooved disk.

1147 derrick Effect Mechanical Engineering

A hoisting machine consisting usually of a vertical mast, a slanted boom, and associated tackle; may be operated mechanically or by hand.

13640	drum brake	Effect	Mechanical Engineering

A brake in which two curved shoes fitted with heat- and wear-resistant linings are forced against the surface of a rotating drum.

11475	Chicago boom	Effect	Mechanical Engineering

A hoisting device that is supported on the structure being erected. Chicago caisson

11476	double-drum hoist	Effect	Mechanical Engineering

A hoisting device consisting of two cable drums which rotate in opposite directions and can be operated separately or together.

13643	band brake	Effect	Mechanical Engineering

A brake in which the frictional force is applied by increasing the tension in a flexible band to tighten it around the drum.

790	sun-and-planet motion	Effect	Mechanical Engineering

A train of two wheels moving epicyclically with a small wheel rotating a wheel on the central axis. sun gear See central

13698	bellows seal	Effect	Mechanical Engineering

A boiler seal in the form of a bellows which prevents leakage of air or gas.

1370	porcupine boiler	Effect	Mechanical Engineering

A boiler having dead end tubes projecting from a vertical shell. 415 pore diameter pore diameter

11542	rotary furnace	Effect	Mechanical Engineering

A heat-treating furnace of circular construction which rotates the workpiece around the axis of the furnace during 469 rotary kiln heat treatment; workpieces are transported through the furnace along a circular path.

11480	clapper box	Effect	Mechanical Engineering

A hinged device that permits a reciprocating cutting tool (as in a planer or shaper) to clear the work on the return stroke.

11517	spiral gear	Effect	Mechanical Engineering

A helical gear that transmits power from one shaft to another, nonparallel shaft.

784	cableway	Effect	Mechanical Engineering

A transporting system consisting of a cable extended between two or more points on which cars are propelled to transport bulk materials for construction operations.

7823 slope conveyor Effect Mechanical Engineering

A troughed belt conveyor used fortransporting material on steep grades.

11496 vibratory centrifuge Effect Mechanical Engineering

A high-speed rotating device to remove moisture from pulverized coal or other solids.

1376 thrust bearing Effect Mechanical Engineering

A bearing which 567 thrust load sustains axial loads and prevents axial movement of a loaded shaft.

11497 centrifugal discharge elevator Effect Mechanical Engineering

A high-speed bucket elevator from which free-flowing materials are discharged by centrifugal force at the top of the loop.

7767 Brennan monorail car Effect Mechanical Engineering

A type of car balanced on a single rail so that when the car starts to tip, a force automatically applied at the axle end is converted gyroscopically into a strong righting moment which forces the car back into a position of lateral equilibrium.

7766 Kauertz engine Effect Mechanical Engineering

A type of cat-and mouse rotary engine in which the pistons are vanes which are sections of a right circular cylinder; two pistons are attached to one rotor so that they rotate with constant angular velocity, while the other two pistons are controlled by a gear-and-crank mechanism, so that angular velocity varies.

13787 vertical band saw Effect Mechanical Engineering

A band saw whose blade operates in the vertical plane; ideal for contour cutting.

7747 zipper conveyor Effect Mechanical Engineering

A type of conveyor belt with zipperlike teeth that mesh to form a closed tube; used to handle fragile materials. zirconium oxide-based oxygen transducer

7716 Scotch yoke Effect Mechanical Engineering

A type of four-bar Scott connection linkage; it is employed to convert a steady rotation into a simple harmonic motion.

11467 crane Effect Mechanical Engineering

A hoisting machine with a power-operated inclined or horizontal boom and lifting tackle for moving loads vertically and horizontally.

13705 steam superheater Effect Mechanical Engineering

A boiler component in which sensible heat is added to the steam after it has been evaporated from the liquid phase.

1093 dragline scraper Effect Mechanical Engineering

A machine with a flat, plowlike blade or partially open bucket pulled on rope for withdrawing piled material, such as stone or coal, from a stockyard to the loading platform; the empty bucket is subsequently returned to the pile of material by means of a return rope.

9987 four-bar linkage Effect Mechanical Engineering

A plane linkage consisting of four links pinned tail to head in a closed loop with lower, or closed, joints.

13362 Ross feeder Effect Mechanical Engineering

A chute for conveying bulk materials by means of a screen of heavy endless chains hung on a sprocket shaft; rotation of the shaft causes materials to slide.

9865 rotary engine Effect Mechanical Engineering

A positive displacement engine (such as a steam or internal combustion type) in which the thermodynamic cycle is carried out in a mechanism that is entirely rotary and without the more customary structural elements of a reciprocating piston, connecting rods, and crankshaft.

9863 rotary compressor Effect Mechanical Engineering

A positive-displacement machine in which compression of the fluid is effected directly by a rotor and without the usual piston, connecting rod, and crank mechanism of the reciprocating compressor.

9859 knuckle post Effect Mechanical Engineering

A post which acts as the pivot for the steering knuckle in an automobile.

13437 disk centrifuge Effect Mechanical Engineering

A centrifuge with a large bowl having a set of disks that separate the liquid into thin layers to create shallow settling chambers.

985 fluid drive Effect Mechanical Engineering

A power coupling operated on a hydraulic turbine principle in which the engine flywheel has a set of turbine blades which are connected directly to it and which are driven in oil, thereby turning another set of blades attached to the transmission gears of the automobile. Also known as fluid clutch; hydraulic clutch.

9830 band saw Effect Mechanical Engineering

A power-operated woodworking saw consisting basically of a flexible band of steel having teeth on one edge, running over two vertical pulleys, and operated under tension.

9792 gyratory crusher Effect Mechanical Engineering

A primary breaking machine in the form of two cones, an outer fixed cone and a solid inner erect cone mounted on an eccentric bearing. Also known as gyratory breaker.

9788	free-piston engine	Effect	Mechanical Engineering

A prime mover utilizing free-piston motion controlled by gas pressure in the cylinders.

9605	shearing punch	Effect	Mechanical Engineering

A punch that cuts material by shearing it, with minimal crushing effect.

10928	forklift	Effect	Mechanical Engineering

A machine, usually powered by hydraulic means, consisting of two or more prongs which can be raised and lowered and are inserted under heavy materials or objects for hoisting and moving them.

10009	Pohle air lift pump	Effect	Mechanical Engineering

A pistonless pump in which compressed air fills the annular space surrounding the uptake pipe and is free to enter the rising column at all points of its periphery.

765	feed nut	Effect	Mechanical Engineering

The threaded sleeve fitting around the feed screw on a gear-feed drill swivel head, which is rotated by means of paired gears driven from the spindle or feed shaft.

9682	Kaplan turbine	Effect	Mechanical Engineering

A propeller-type hydraulic turbine in which the positions of the runner blades and the wicket gates are adjustable for load change with sustained efficiency.

10968	air compressor	Effect	Mechanical Engineering

A machine that increases the pressure of air by increasing its density and delivering the fluid against the connected system resistance on the discharge side. air-compressorunloader

9649	crossed belt	Effect	Mechanical Engineering

A pulley belt arranged so that the sides cross, thereby making the pulleys rotate in opposite directions.

13439	supercentrifuge	Effect	Mechanical Engineering

A centrifuge built to operate at faster speeds than an ordinary centrifuge.

9636	rod mill	Effect	Mechanical Engineering

A pulverizer operated by the impact of heavy metal rods.

9635	band wheelball mill	Effect	Mechanical Engineering

A pulverizer that consists of a horizontal rotating cylinder, up to three diameters in length, containing a charge of tumbling or cascading steel balls, pebbles, or rods.

10974	heat engine	Effect	Mechanical Engineering

A machine that converts heat into work (mechanical energy).

9624	pistonpump	Effect	Mechanical Engineering

A pump in which motion and pressure are applied to the fluid by a reciprocating piston in a cylinder. Also known as reciprocating pump.

9009	Cardan shaft	Effect	Mechanical Engineering

A shaft with a universal joint at its end to accommodate a varying shaft angle.

10879	screw propeller	Effect	Mechanical Engineering

A marine and airplane propeller consisting of a streamlined hub attached outboard to a rotating engine shaft on which are mounted two to six blades; the blades form helicoidal surfaces in such a way as to advance along the axis about which they revolve.

10775	air cushion	Effect	Mechanical Engineering

A mechanical device using trapped air to arrest motion without shock.

132	double-block brake	Effect	Mechanical Engineering

Two singleblock brakes in symmetrical opposition, where the operating force on one lever is the reaction on the other.

10700	through-feed centerless grinding	Effect	Mechanical Engineering

A metal cutting process by which the external surface of a cylindrical workpiece of uniform diameter is ground by passing the workpiece between a grinding and regulating wheel.

10544	differential indexing	Effect	Mechanical Engineering

A method of subdividing a circle based on the difference between movements of the index plate and index crank of a dividing engine.

10736	sewing machine	Effect	Mechanical Engineering

A mechanism that stitches cloth, leather, book pages, or other material by means of a double-pointed or eyepointed needle.

10747	core drill	Effect	Mechanical Engineering

A mechanism designed to rotate and to cause an annular-shaped rockcutting bit to penetrate rock formations, produce cylindrical cores of the formations penetrated, and lift such cores to the surface, where they may be collected and examined.

1047 buhrstone mill Effect Mechanical Engineering

A mill for grinding or pulverizing grain in which a flat siliceous rock (buhrstone), generally of cellular quartz, rotates against a stationary stone of the same material.

10388 wave motor Effect Mechanical Engineering

A motor that depends on the lifting power of sea waves to develop its usable energy.

700 windup Effect Mechanical Engineering

The twisting of a shaft under a torsional load, usually resulting in vibration and other undesirable effects as the shaft

10342 Walley engine Effect Mechanical Engineering

A multirotor engine employing four approximately elliptical rotors that turn in the same clockwise sense, leading to excessively high rubbing velocities.

10759 underdrive press Effect Mechanical Engineering

A mechanical press having the driving mechanism located within or under the bed.

1000 Hardinge feeder-weigher Effect Mechanical Engineering

A pivoted, short belt conveyor which controls the rate of material flow from a hopper by weight per cubic foot.

10769 Peaucellier linkage Effect Mechanical Engineering

A mechanical linkage to convert circular motion exactly into straight-line motion.

10008 Kullenberg piston corer Effect Mechanical Engineering

A pistonoperated coring device used to obtain 2-inchdiameter (5-centimeter) core samples.

702 gyroscopic couple Effect Mechanical Engineering

The turning moment which opposes any change of the inclination of the axis of rotation of a gyroscope.

708 belt drive Effect Mechanical Engineering

The transmission of power between shafts by means of a belt connecting pulleys on the shafts.

10226 contrarotating propellers Effect Mechanical Engineering

A pair of propellers on concentric shafts, turning in opposite directions.

10179 cam pawl Effect Mechanical Engineering

A pawl which prevents a wheel from turning in one direction by a wedging action, while permitting it to rotate in the other direction.

13413 elliptic gear Effect Mechanical Engineering

A change gear composed of two elliptically shaped gears, each rotating about one of its focal points.

723 fan static pressure Effect Mechanical Engineering

The total pressure rise diminished by the velocity pressure in the fan outlet.

730 cooling load Effect Mechanical Engineering

The total amount of heat energy that must be removed from a system by a cooling mechanism in a unit time, equal to the rate at which heat is generated by people, machinery, and processes, plus the net flow of heat into the system not associated with the cooling machinery cooling method

13434 roller chain Effect Mechanical Engineering

A chain drive assembled from roller links and pin links.

736 combplate Effect Mechanical Engineering

The toothed portion of the stationary threshold plate that is set into both ends of an escalator or moving sidewalk and meshes with the grooved surface of the moving steps or treadway combustible loss

10043 planet gear Effect Mechanical Engineering

A pinion in a planetary gear train.

10988 jordan Effect Mechanical Engineering

A machine or engine used to refine paper pulp, consisting of a rotating cone, with cutters, that fits inside another cone, also with cutters.

10768 cam mechanism Effect Mechanical Engineering

A mechanical linkage whose purpose is to produce, by means of a contoured cam surface, a prescribed motion of the output link.

9188 vibroenergy separator Effect Mechanical Engineering

A screentype device for classification or separation of grains of solids by a combination of gyratory motion and auxiliary vibration caused by balls bouncing against the lower surface of the screen cloth.

9305 prism joint Effect Mechanical Engineering

A robotic articulation that has only one degree of freedom, in sliding motion only.

9278 polishing roll Effect Mechanical Engineering

A roll or series of rolls on a plastics mold; has highly polished chrome-plated surfaces; used to produce a smooth surface on a plastic sheet as it is extruded.

9276 troughed roller conveyor Effect Mechanical Engineering

A roller conveyor having two rows of rolls set at an angle to form a trough over which objects are conveyed. troughing

9275 squeeze roll Effect Mechanical Engineering

A roller designed to exert pressure on material passing between it and a similar roller.

9248 eccentric rotor engine Effect Mechanical Engineering

A rotary engine, such as the Wankel engine, wherein motion is imparted to a shaft by a rotor eccentric to the shaft.

9246 swash-plate pump Effect Mechanical Engineering

A rotary pump in which the angle between the drive shaft and the plunger-carrying body is varied.

924 screw compressor Effect Mechanical Engineering

A rotary-element gas compressor in which compression is accomplished between two intermeshing, counterrotating

9237 drum feeder Effect Mechanical Engineering

A rotating drum with vanes or buckets to lift and carry parts and drop them into various orienting or chute arrangements. Also known as tumbler feeder.

9234 air propeller Effect Mechanical Engineering

A rotating fan for moving air.

9230 carousel Effect Mechanical Engineering

A rotating transport system that transfers and presents workpieces for loading and unloading by a robot or other machine.

9617 screw pump Effect Mechanical Engineering

A pump that raises water by means of helical impellers in the pump casing.

9194 impact screen Effect Mechanical Engineering

A screen designed to swing or rock forward when loaded and to stop abruptly by coming in contact with a stop. impact strength

9344 pneumatic riveter Effect Mechanical Engineering

A riveting machine having a rapidly reciprocating piston driven by compressed air.

11157 atomizer burner Effect Mechanical Engineering

A liquid-fuel burner that atomizes the unignited fuel into a fine spray as it enters the combustion zone. atomizer mill

11170 planar linkage Effect Mechanical Engineering

A linkage that involves motion in only two dimensions.

11175 crank Effect Mechanical Engineering

A link in a mechanical linkage or mechanism that can turn about a center of rotation.

9116 oilless bearing Effect Mechanical Engineering

A self-lubricating bearing containing solid or liquid lubricants in its material.

13445 turbosupercharger Effect Mechanical Engineering

A centrifugal air compressor, gas-turbine driven, usually used to increase induction system pressure in an internal combustion reciprocating engine.

13463 Virmel engine Effect Mechanical Engineering

A cat-and-mouse engine that employs vanelike pistons whose motion is controlled by a gear-and-crank system; each set of pistons stops and restarts when a chamber reaches the spark plug.

13464 Tschudi engine Effect Mechanical Engineering

A cat-and-mouse engine in which the pistons, which are sections of a torus, travel around a toroidal cylinder; motion of the pistons is controlled by two cams which bear against rollers attached to the rotors.

9047 roll mill Effect Mechanical Engineering

A series of rolls operating at different speeds for grinding and crushing. roll-off

9038 bar linkage Effect Mechanical Engineering

A set of bars joined together at pivots by means of pins or equivalent devices; usedtotransmit power and information.

7447 thermal valve Effect Mechanical Engineering

A valve controlled by an element made of material that exhibits a significant change in properties in response to a change in temperature.

9224 Savonius rotor Effect Mechanical Engineering

A rotor composed of two offset semicylindrical elements rotating about a vertical axis.

9438 steam-jet cycle Effect Mechanical Engineering

A refrigeration cycle in which water is used as the refrigerant; high-velocity steam jets provide a high vacuum in the evaporator, causing the water to boil at low temperature and at the same time compressing the flashed vapor up to the condenser pressure level.

10992 engine Effect Mechanical Engineering

A machine in which power is applied to do work by the conversion of various forms of energy into mechanical force and motion.

10994 centrifugal compressor Effect Mechanical Engineering

A machine in which a gas or vapor is compressed by radial acceleration in an impeller with a surrounding casing, and can be arranged multistage for high ratios of compression.

10996 winch Effect Mechanical Engineering

A machine having a drum on which to coil a rope, cable, or chain for hauling, pulling, or hoisting.

10999 lathe Effect Mechanical Engineering

A machine for shaping a workpiece by gripping it in a holding device and rotating it under power against a suitable cutting tool for turning, boring, facing, or threading. lathing board See backup strip.

9553 Ljungstrom steam turbine Effect Mechanical Engineering

A radial outward-flow turbine having two opposed rotation rotors.

11006 centrifugal fan Effect Mechanical Engineering

A machine for moving a gas, such as air, by accelerating it radially outward in an impeller to a surrounding casing, generally of scroll shape.

11022 multistage compressor Effect Mechanical Engineering

A machine for compressing a gaseous fluid in a sequence of stages, with or without intercooling between stages.

11027 shearing machine Effect Mechanical Engineering

A machine for 493 shearing punch cutting cloth or bars, sheets, or plates of metal or other material.

9496 boom dog Effect Mechanical Engineering

A ratchet device installed on a crane to prevent the boom of the crane from being lowered but permitting it to be raised. Also known as boom ratchet.

9495 escapement Effect Mechanical Engineering

A ratchet device that permits motion in one direction slowly.

9306 revolute joint Effect Mechanical Engineering

A robotic articulation consisting of a pin with one degree of freedom.

9439 vapor-compression cycle Effect Mechanical Engineering

A refrigeration cycle in which refrigerant is circulated through a machine which allows for successive boiling (or vaporization) of liquid refrigerant as it passes through an expansion valve, thereby producing a cooling effect in its surroundings, followed by compression of vapor to liquid.

9328 pedestal design Effect Mechanical Engineering

A robot design centered on the vertical axis of a central pedestal, in which the motion of any workpiece is confined to a spherical working envelope.

9436 domestic refrigerator Effect Mechanical Engineering

A refrigeration system for household use which typically has a compression machine designed for continuous automatic operation and for conservation of the charges of refrigerant and oil, and is usually motor-driven and air-cooled. Also known as refrigerator.

9435 absorption system Effect Mechanical Engineering

A refrigeration system in which the refrigerant gas in the evaporator is taken up by an absorber and is then, with the application of heat, released in a generator.

9434 helium refrigerator Effect Mechanical Engineering

A refrigerator which uses liquid helium to cool substances to temperatures of 4 K or less.

13440 actuated roller switch Effect Mechanical Engineering

A centrifugal sequence-control switch that is placed in contact with a belt conveyor, immediately preceding the conveyor which it controls.

11028 wire saw Effect Mechanical Engineering

A machine employing one- or three-strand wire cable, up to 16,000 feet (4900 meters) long, running over a pulley as a belt; used in quarries to cut rock by abrasion.

13442 volute pump Effect Mechanical Engineering

A centrifugal pump housed in a spiral casing.

9372 hoe shovel Effect Mechanical Engineering

A revolving shovel with a pull-type bucket rigidly attached to a stick hinged on the end of a live boom.

9370 smoothing mill Effect Mechanical Engineering

A revolving stone wheel used to cut and bevel glass or stone.

9369 Selwood engine Effect Mechanical Engineering

A revolving-block engine in which two curved pistons opposed 180° run in toroidal tracks, forcing the entire engine block to rotate.

9368 Mercer engine Effect Mechanical Engineering

A revolving-block engine in which two opposing pistons operate in a single cylinder with two rollers attached to each piston; intake ports are uncovered when the pistons are closest together, and exhaust ports are uncovered when they are farthest apart.

9014 roller bearing Effect Mechanical Engineering

A shaft bearing characterized by parallel or tapered steel rollers confined between outer and inner rings.

949 Francis turbine Effect Mechanical Engineering

A reaction hydraulic turbine of relatively medium speed with radial flow of water in the runner.

12205 bucket-ladder dredge Effect Mechanical Engineering

A dredge whose digging mechanism consists of a ladderlike truss on the periphery of which is attached an endless chain riding on sprocket wheels and carrying attached buckets. Also 77 bucket-ladder excavator known as bucket ladder; bucket-line dredge; ladder-bucket dredge; ladder dredge.

12204 suction-cutter dredger Effect Mechanical Engineering

A dredger in which rotary blades dislodge the material to be excavated, which is then removed by suction as in a sand-pump dredger.

5029 eddy-current clutch Effect Mechanical Engineering

A type of electromagnetic clutch in which torque is transmitted by means of eddy currents induced by a magnetic field set up by a coil carrying direct current in one rotating member.

501 rotary valve Effect Mechanical Engineering

Avalve forthe admission or release of working fluid to or from an engine cylinder where the valve member is a ported piston that turns on its axis.

5010 four-way valve Effect Mechanical Engineering

A valve at the junction of four waterways which allows passage between any two adjacent waterways by means of a movable element operated by a quarter turn.

5009 air valve Effect Mechanical Engineering

A valve that automatically lets air out of or into a liquid-carrying pipe when the internal pressure drops below atmospheric.

4989 bend wheel Effect Mechanical Engineering

Awheel used to interrupt and change the normal path of travel of the conveying or driving medium; most generally used to effect a change in direction of conveyor travel from inclined to horizontal or a similar change.

4986 differential windlass Effect Mechanical Engineering

Awindlass in which the barrel has two sections, each having a different diameter; the rope winds around one section, passes through a pulley (which carries the load), then winds around the other section of the barrel.

4978 vibrating grizzlies Effect Mechanical Engineering

Bar grizzlies mounted on eccentrics so that the entire assembly is given a forward and backward movement at a speed of some 100 strokes a minute.

4965 radiation loss Effect Mechanical Engineering

Boiler heat loss to the atmosphere by conduction, radiation, and convection.

13267 centrifugal clutch Effect Mechanical Engineering

A clutch operated by centrifugal force from the speed of rotation of a shaft, as when heavy expanding friction shoes act on the internal surface of a rim clutch, or a flyball-type mechanism is used to activate clutching surfaces on cones and

4897 vibration separation Effect Mechanical Engineering

Classification or separation of grains of solids in which separation through a screen is expedited by vibration or oscillatory movement of the screening mediums.

1220 self-centering chuck Effect Mechanical Engineering

A drill chuck that, when closed, automatically positions the drill rod in the center of the drive rod of a diamond- drill swivel head.

4892 tube turbining Effect Mechanical Engineering

Cleaning tubes by passing a power-driven rotary device through them.

4876 airdraulic Effect Mechanical Engineering

Combining pneumatic and hydraulic action for operation.

487 afterburning Effect Mechanical Engineering

Combustion in an internal combustion engine following the maximum pressure of explosion.

12258 rotary pump Effect Mechanical Engineering

A displacement pump that delivers a steady flow by the action of two members in rotational contact.

4856 pneumatic drill Effect Mechanical Engineering

Compressed-air drill worked by reciprocating piston, hammer action, or turbo drive.

12262 disk cam Effect Mechanical Engineering

A disk with a contoured edge which rotates about an axis perpendicular to the disk, communicating motion to the cam follower which remains in contact with the edge of the disk.

4815 Ljungstrom heater Effect Mechanical Engineering

Continuous, regenerative, heat-transfer air heater (recuperator) made of slow-moving rotors packed with closely spaced metal plates or wires with a housing to confine the hot and cold gases to opposite sides.

4795 field excitation Effect Mechanical Engineering

Control of the speed of a series motor in an electric or dieselelectric locomotive by changing the relation between the armature current and the field strength, either through a reduction in field current by shunting the field coils with resistance, or through the use of field taps.

12007 Steelflex coupling Effect Mechanical Engineering

A flexible coupling made with two grooved steel hubs keyed to their respective shafts and connected by a specially tempered alloy-steel member called the grid.

4957 gyratory screen Effect Mechanical Engineering

Boxlike machine with a series of horizontal screens nested in a vertical stack with downward-decreasing meshopening sizes; near-circular motion causes undersized material to sift down through each screen in succession.

12177 drill press Effect Mechanical Engineering

A drilling machine in which a vertical drill moves into the work, which is stationary.

12020 vane Effect Mechanical Engineering

A flat or curved surface exposed to a flow of fluid so as to be forced to move or to rotate about an axis, to rechannel the flow, or to act as the impeller; for example, in a steam turbine, propeller fan, or hydraulic turbine.

12074 scotch boiler Effect Mechanical Engineering

A fire-tube boiler with one or more cylindrical internal furnaces enveloped by a boiler shell equipped with five tubes in its upper part; heat is transferred to water partly in the furnace area and partly in passage of hot gases through the tubes. Also known as dry-back boiler; scotch marine boiler (marine usage).

5578 Corliss valve Effect Mechanical Engineering

An oscillating type of valve gear with a trip mechanism for the admission and exhaust of steam to and from an engine cylinder.

5494	antifriction bearing	Effect	Mechanical Engineering

Any bearing having the capability of reducing friction effectively.

5412	conveyor	Effect	Mechanical Engineering

Any materials-handling machine designed to move individual articles such as solids or free-flowing bulk materials over a horizontal, inclined, declined, or vertical path of travel with continuous motion.

13277	abrasive belt	Effect	Mechanical Engineering

A cloth, leather, or paper band impregnated with grit and rotated as an endless loop to abrade materials through continuous friction.

5389	circular saw	Effect	Mechanical Engineering

Any of several power tools for cutting wood or metal, having a thin steel disk with a toothed edge that rotates on a

5373	hammer drill	Effect	Mechanical Engineering

Any of three types of fast-cutting, compressed-air rock drills (drifter, sinker, and stoper) in which a hammer strikes rapid blows on a loosely held piston, and the bit remains against the rock in the bottom of the hole, rebounding slightly at each blow, but does not reciprocate.

5362	windmill	Effect	Mechanical Engineering

Any of various mechanisms, such as a mill, pump, or electric generator, operated by the force of wind against vanes or sails radiating about a horizontal shaft.

5035	push-bar conveyor	Effect	Mechanical Engineering

A type of chain conveyor in which two endless chains are crossconnected at intervals by push bars which propel the load along a stationary bed or trough of the conveyor.

13276	electromagnetic clutch	Effect	Mechanical Engineering

A clutch based on magnetic coupling between conductors, such as a magnetic fluid and powder clutch, an eddy-current clutch, or a hysteresis clutch.

5037	vane motor rotary actuator	Effect	Mechanical Engineering

Atype of rotary motor actuator which consists of a rotor with several spring-loaded sliding vanes in an elliptical chamber; hydraulic fluid enters the 596 variable-area meter chamber and forces the vanes before it as it moves to the outlets.

12195 ultrasonic drill Effect Mechanical Engineering

A drill in which a magnetostrictive transducer is attached to a tapered cone serving as a velocity transformer; with an appropriate tool at the end of the transformer, practically any shape of hole can be drilled in hard, brittle materials such as tungsten carbide and gems.

5227 reciprocating flight conveyor Effect Mechanical Engineering

A reciprocating beam or beams with hinged flights that advance materials along a conveyor trough.

252 ring-oil Effect Mechanical Engineering

To oil (a bearing) by conveying the oil to the point to be lubricated by means of a ring, which rests upon and turns with the journal, and dips into a reservoir containing the lubricant.

5217 engine balance Effect Mechanical Engineering

Arrangement and construction of moving parts in reciprocating or rotating machines to reduce dynamic forces which may result in undesirable vibrations.

7470 double Hooke's joint Effect Mechanical Engineering

A universal joint which eliminates the variation in angular displacement and angular velocity between driving and driven shafts, consisting of two Hooke's downcomer joints with an intermediate shaft.

5168 burton Effect Mechanical Engineering

Asmall hoisting tackle with two blocks, usually a single block and a double block, with a hook block in the running part of the rope.

5147 recirculating-ballsteering Effect Mechanical Engineering

Asteering system that transmits steering movements by means of steel balls placed between a worm gear and a nut.

5120 Dorr agitator Effect Mechanical Engineering

A tank used for batch washing of precipitates which cannot be leached satisfactorily in a tank; equipped with a slowly rotating rake at the bottom, which moves settled solids to the center, and an air lift that lifts slurry to the launders. Also known as Dorr thickener.

13973 spool Effect Mechanical Engineering

1. The drum of a hoist. 2. The movable part of a slide-type hydraulic valve.

4759 slotting Effect Mechanical Engineering

Cutting a mortise or a similar narrow aperture in a material using a machine with a vertically reciprocating tool. slotting machine

533 connecting rod Effect Mechanical Engineering

Any straight link that transmits motion or power from one linkage to another within a mechanism, especially linear to rotary motion, as in a reciprocating engine or compressor.

12446 dashpot Effect Mechanical Engineering

A device used to dampen and control a motion, in which an attached piston is loosely fitted to move slowly in a cylinder containing oil.

4210 electric ignition Effect Mechanical Engineering

Ignition of a charge of fuel vapor and air in an internal combustion engine by passing a high-voltage electric 189 electric image current between two electrodes in the combustion chamber.

412 free turbine Effect Mechanical Engineering

In a turbine engine, a turbine wheel that drives the output shaft and is not connected to the shaft driving the compressor.

4077 torque arm Effect Mechanical Engineering

In automotive vehicles, an arm to take the torque of the rear axle. torque-coil magnetometer

26 desilter Effect Mechanical Engineering

Wet, mechanical solids classifier (separator) in which silt particles settle as the carrier liquid is slowly stirred by horizontally revolving rakes; solids are plowed outward and removed at the periphery of the container bowl.

13265 jaw clutch Effect Mechanical Engineering

A clutch that provides positive connection of one shaft with another by means of interlocking faces; may be square or spiral; the most common type of positive clutch.

3800 air cooling Effect Mechanical Engineering

Lowering of air temperature for comfort, process control, or food preservation. air course See airway.

12387 nonreclosing pressure relief device Effect Mechanical Engineering

A device which remains open after relieving pressure and must be reset before it can operate again.

3742 mechanical seal Effect Mechanical Engineering

Mechanical assembly that forms a leakproof seal between flat, rotating surfaces to prevent high-pressure leakage. mechanical separation

12395 Dings magnetic separator Effect Mechanical Engineering

A device which is suspended above a belt conveyor to pull out and separate magnetic material from burden as thick as 40 inches (1 meter) and at belt speeds up to 750 feet (229 meters) per minute.

13272 air-tube clutch Effect Mechanical Engineering

A clutch fitted with a tube whose inflation causes the clutch to engage, and deflation, to disengage.

1272 head pulley Effect Mechanical Engineering

The pulley at the discharge end of a conveyor belt; may be either an idler or a drive pulley.

12333 shearing die Effect Mechanical Engineering

A die with a punch for shearing the work from the stock.

12478 steam condenser Effect Mechanical Engineering

A device to maintain vacuum conditions on the exhaust of a steam prime mover by transfer of heat to circulating water or air at the lowest ambient temperature.

13264 cone clutch Effect Mechanical Engineering

A clutch which uses the wedging action of mating conical surfaces to transmit friction torque.

12490 air washer air separator Effect Mechanical Engineering

A device that uses an air current to separate a material from another of greater density or particles from others of greater size.

25 dewaterer Effect Mechanical Engineering

Wet-type mechanical classifier (solids separator) in which solids settle out of the carrier liquid and are concentrated for recovery.

617 expansion cooling Effect Mechanical Engineering

Cooling of a substance by having it undergo adiabatic expansion.

12516 atomizer Effect Mechanical Engineering

A device that produces a mechanical subdivision of a bulk liquid, as by spraying, sprinkling, misting, or nebulizing.

13244 cooling coil Effect Mechanical Engineering

A coiled arrangement of pipe or tubing for the transfer of heat between two fluids.

3582 bevel gear Effect Mechanical Engineering

One of a pair of gears used to connect two shafts whose axes intersect.

14422 arbor Effect Mechanical Engineering

1. A cylindrical device positioned between the spindle and outer bearing of a milling machine and designed to hold a milling cutter. 2. A shaft or spindle used to hold a revolving cutting tool or the work to be cut.

12415 hoist overwind device Effect Mechanical Engineering

A device which can activate an emergency brake when a hoisted load travels beyond a predetermined point into a danger zone.

1192 mechanical advantage Effect Mechanical Engineering

The ratio of the force produced by a machine such as a lever or pulley to the force applied to it. Also known as force ratio.

4690 pulverizer Effect Mechanical Engineering

Device for breaking down of solid lumps into a fine material by cleavage along crystal faces.

4689 diaphragm compressor Effect Mechanical Engineering

Device for compression of small volumes of a gas by means of a reciprocally moving diaphragm, in place of pistons or rotors.

4687 pellet mill Effect Mechanical Engineering

Device for injecting particulate, granular or pasty feed into holes of a roller, then compacting the feed into a continuous solid rod to be cut off by a knife at the periphery of the roller.

4685 chop-type feeder Effect Mechanical Engineering

Device for semicontinuous feed of solid materials to a process 101 chord unit, with intermittent opening and closing of a hopper gate (bottom closure) by a control arm actuated by an eccentric cam.

4682 ribbon mixer Effect Mechanical Engineering

Device for the mixing of particles, slurries, or pastes of solids by the revolution of an elongated helicoid (spiral) ribbon of metal.

468 rotary feeder Effect Mechanical Engineering

Device in which a rotating element or vane discharges powder or granules at a predetermined rate.

4675 centrifugal atomizer Effect Mechanical Engineering

Device that atomizes liquids with a spinning disk; liquid is fed onto the center of the disk, and the whirling motion (3000 to 50,000 revolutions per minute) forces the liquid outward in thin sheets to cause atomization.

13266 overrunning clutch Effect Mechanical Engineering

A clutch that allows the driven shaft to turn freely only under certain conditions; for example, a clutch in an engine starter that allows the crank to turn freely when the engine attempts to run.

65 sand mill Effect Mechanical Engineering

Variation of a ball-type size-reduction mill in which grains of sand serve as grinding balls.

4214 tumbler gears Effect Mechanical Engineering

Idler gears interposed between spindle and stud gears in a lathe gear train; used to reverse rotation of lead screw or feed rod.

404 unsprung weight Effect Mechanical Engineering

The weight of the various parts of a vehicle that are not carried on the springs, such as wheels, axles, and brakes.

418 piston displacement Effect Mechanical Engineering

The volume which a piston in a cylinder displaces in a single stroke, equal to the distance the piston travels times the internal cross section of the cylinder.

54 rotary annular extractor Effect Mechanical Engineering

Vertical, cylindrical shell with an inner, rotating cylinder; liquids to be contacted flow countercurrently through the annular space between the rotor and shell; used for liquid-liquid extraction processes.

4360 dry abrasive cutting Effect Mechanical Engineering

Frictional cutting using a rotary abrasive wheel without the use of a liquid coolant.

4336 helical gear Effect Mechanical Engineering

Gear wheels running on parallel axes, with teeth twisted oblique to the gear axis.

4309 form grinding Effect Mechanical Engineering

Grinding by use of a wheel whose cutting face is contoured to the reverse shape of the desired form.

1239 gyro wheel Effect Mechanical Engineering

The rapidly spinning wheel in a gyroscope, which resists being disturbed.

12320 revolving shovel Effect Mechanical Engineering

A digging machine, mounted on crawlers or on rubber tires, that has the machinery deck and attachment on a vertical pivot so that it can swing freely.

1233 V-bend die Effect Mechanical Engineering

A die with a triangular cross-sectional opening to provide two edges over which bending is accomplished.

4247 plate-fin exchanger Effect Mechanical Engineering

Heat-transfer device made up of a stack or layers, with each layer consisting of a corrugated fin between flat metal sheets sealed off on two sides by channels or bars to form passages for the flow of fluids.

12332 U U-bend die Effect Mechanical Engineering

A die with a square or rectangular cross section which provides two edges over which metal can be drawn.

522 taper-rolling bearing Effect Mechanical Engineering

A roller bearing capable of sustaining end thrust by means of tapered rollers and coned races.

4609 pneumatic drilling Effect Mechanical Engineering

Drilling a hole when using air or gas in lieu of conventional drilling fluid as the circulating medium; an adaptation of rotary drilling.

6359 Stirling engine Effect Mechanical Engineering

An engine in which work is performed by the expansion of a gas at high temperature; heat for the expansion is supplied through the wall of the piston cylinder.

6253 Carnot engine Effect Mechanical Engineering

An ideal, frictionless engine which operates in a Carnot cycle.

11739 droop governor Effect Mechanical Engineering

A governor whose equilibrium speed decreases as the load on the drop ball machinery controlled by the governor increases.

6536 parallel linkage Effect Mechanical Engineering

An automotive steering system that has a short idler arm mounted parallel to the pitman arm.

11740 overspeed governor Effect Mechanical Engineering

A governor that stops the prime mover when speed is excessive. overspin

6512 Wankel engine Effect Mechanical Engineering

An eccentric-rotortype internal combustion engine with only two primary moving parts, the rotor and the eccentric shaft; the rotor moves in one direction around the trochoidal chamber containing peripheral intake and exhaust ports. Also known as rotarycombustion engine.

1174 isochronous governor Effect Mechanical Engineering

A governor that keeps the speed of a prime mover constant at all loads. Also known as astatic governor.

6485 telpher Effect Mechanical Engineering

An electric hoist hanging from and driven by a wheeled cab rolling on a single overhead rail or a rope.

6413 ball screw Effect Mechanical Engineering

An element used to convert rotation to longitudinal motion, consisting of a threaded rod linked to a threaded nut by ball bearings constrained to roll in the space formed by the threads, in order to reduce friction.

6410 rolamite mechanism Effect Mechanical Engineering

An elemental mechanism consisting of two rollers contained by two parallel planes and bounded by a fixed S-shaped band undertension.

34 kellering Effect Mechanical Engineering

Three-dimensional machining of a contoured surface by tracer-milling the die block or punch; the cutter path is controlled by a tracer that follows the contours on a die model.

11738 centrifugal governor Effect Mechanical Engineering

A governor whose flyweights respond to centrifugal force to sense speed.

5173 vibrating pebble mill Effect Mechanical Engineering

A size-reduction device in which feed is ground by the action of vibrating, moving pebbles.

11737 Hayward orange peel Effect Mechanical Engineering

A grab bucket that operates like the clamshell type but has four blades pivoted to close.

5687 clamshell bucket Effect Mechanical Engineering

A two-sided bucket used in a type of excavator to dig in a vertical direction; the bucket is dropped while its leaves are open and digs as they close. Also known as clamshell grab.

6352 solar engine Effect Mechanical Engineering

An engine which converts thermal energy from the sun into electrical, mechanical, or refrigeration energy; may be used as a method of spacecraft propulsion, either directly by photon pressure on huge solar sails, or indirectly from solar cells or from a reflectorboiler combination used to heat a fluid.

348 roll threading Effect Mechanical Engineering

Threading a metal workpiece by rolling it either between grooved circular rolls or between grooved straight lines.

625 live-roller conveyor Effect Mechanical Engineering

Conveying machine which moves objects over a series of rollers by the application of power to all or some of the rollers.

11768 triplex chain block Effect Mechanical Engineering

A geared hoist using an epicyclic train.

1328 refrigeration system Effect Mechanical Engineering

A closed-flow system in which a refrigerant is compressed, condensed, and expanded to produce cooling at a lower temperature level and rejection of heat at a higher temperature level for the purpose of extracting heat from a controlled space.

6267 metering screw Effect Mechanical Engineering

An extrusion-type screw feeder or conveyor section used to feed pulverized or doughy material at a constant rate.

1028 windmilling Effect Mechanical Engineering

The rotation of a propeller from the force of the air when the engine is not operating.

103 impeller Effect Mechanical Engineering

The rotating member of a turbine, blower, fan, axial or centrifugal pump, or mixing apparatus. Also known as rotor. impeller pump

1034 troughing rolls Effect Mechanical Engineering

The rolls of a troughing idler that are so mounted on an incline as to elevate each edge of the belt into a trough. Trouton's rule

100 autogenous grinding Effect Mechanical Engineering

The secondary grinding of material by tumbling the material in a revolving cylinder, without balls or bars taking part in the operation.

694 roller cam follower Effect Mechanical Engineering

A follower consisting of a rotatable wheel at the end of the shaft.

11643 fairlead Effect Mechanical Engineering

A group of pulleys or rollers used in conjunction with a winch or similar apparatus to permit the cable to be reeled from any direction.

13285 thermosiphon Effect Mechanical Engineering

A closed system of tubes connected to a water-cooled engine which permit natural circulation and cooling of the liquid by utilizing the difference in density of the hot and cool portions.

702 pillar crane Effect Mechanical Engineering

A crane whose mechanism can be rotated about a fixed pillar.

7012 air cylinder Effect Mechanical Engineering

A cylinder in which air is compressed by a piston, compressed air is stored, or air drives a piston.

11676 ring-roller mill Effect Mechanical Engineering

A grinding mill in which material is fed past spring-loaded rollers that apply force against the sides of a revolving bowl. Also known as roller mill.

11677 colloid mill Effect Mechanical Engineering

A grinding mill for the making of very fine dispersions of liquids or solids by breaking down particles in an emulsion or

6992 peristaltic pump Effect Mechanical Engineering

A device for moving fluids by the action of multiple, equally spaced rollers, which rotate and compress a flexible tube.

11678 surface grinder Effect Mechanical Engineering

A grinding machine that produces a plane surface.

11680 ball-and-race-type pulverizer Effect Mechanical Engineering

A grinding machine in which balls rotate under an applied force between two races to crush materials, such as coal, to fine consistency. Also known as ball-bearing pulverizer.

310 feather Effect Mechanical Engineering

To change the pitch on a propeller in order to reduce drag and prevent windmilling in case of engine failure.

654 synchromesh Effect Mechanical Engineering

An automobile transmission device that minimizes clashing; acts as a friction clutch, bringing gears approximately to correct speed just before meshing. synchronization

1168 universal grinding machine Effect Mechanical Engineering

A grinding machine having a swivel table and headstock, and a wheel head that can be rotated on its base.

6353 rocking valve Effect Mechanical Engineering

An engine valve in which a disk or cylinder turns in its seat to permit fluid flow.

11685 air-lift hammer Effect Mechanical Engineering

A gravity drop hammer used in closed die forging in which the ram is raised to its starting point by means of an air

678 sleeve valve Effect Mechanical Engineering

An admission and exhaust valve on an internal-combustion engine consisting of one or two hollow sleeves that fit around the inside of the cylinder and move with the piston so that their openings align with the inlet and exhaust ports in the cylinder at proper stages in the cycle.

6758 variable-volume air system Effect Mechanical Engineering

An airconditioning system in which the volume of air delivered to each controlled zone is varied automatically from a preset minimum to a maximum value, depending on the load in each zone.

1315 supersonic compressor Effect Mechanical Engineering

A compressor in which a supersonic velocity is imparted to the fluid relative to the rotor blades, supersonic diffuser the stator blades, or both, producing oblique shock waves over the blades to obtain a highpressure rise.

649 Hardinge mill Effect Mechanical Engineering

A tri cone type of ball mill; the cones become steeper from the feed end toward the discharge end.

6677 conical bearing Effect Mechanical Engineering

An antifriction bearing employing tapered rollers.

6676 fluid-film bearing Effect Mechanical Engineering

An antifriction bearing in which rubbing surfaces are kept apart by a film of lubricant such as oil.

973 waterwall Effect Mechanical Engineering

The side of a boiler furnace consisting of water-carrying tubes which absorb radiant heat and thereby prevent excessively high furnace temperatures.

986 centrifugal separation Effect Mechanical Engineering

The separation of two immiscible liquids in a centrifuge within a much shorter period of time than could be accomplished solely by gravity.

13128 aftercondenser Effect Mechanical Engineering

A condenser in the second stage of a two-stage ejector; used in steam power plants, refrigeration systems, and air conditioning systems.

6954 timing Effect Mechanical Engineering

Adjustment in the relative position of the valves and crankshaft of an automobile engine in order to produce the largest effective output of power.

1062 brake shoe Effect Mechanical Engineering

The renewable friction element of a shoe brake. Also known as shoe.

5756 inertia governor Effect Mechanical Engineering

A speed-control device utilizing suspended masses that respond to speed changes by reason of their inertia.

11997 ball float Effect Mechanical Engineering

A floating device, usually approximately spherical, which is used to operate a ball valve.

11970 turbine Effect Mechanical Engineering

A fluid acceleration machine for generating rotary mechanical power from the energy in a stream of fluid.

574 air spring Effect Mechanical Engineering

A spring in which the energy storage element is air confined in a container that includes an elastomeric bellows or diaphragm.

5738 constant-force spring Effect Mechanical Engineering

A spring which has a constant restoring force, regardless of displacement.

12003 fast coupling Effect Mechanical Engineering

A flexible geared coupling that uses two interior hubs on the shafts with circumferential gear teeth surrounded by a casing having internal gear teeth to mesh and connect the two hubs.

5843 two-stroke cycle Effect Mechanical Engineering

An internal combustion engine cycle completed in two strokes of the piston.

12004 cog belt Effect Mechanical Engineering

A flexible device used for timing and for slip-free power transmission. cogeneration

5742 torsion bar Effect Mechanical Engineering

A spring flexed by twisting about its axis; found in the spring suspension of truck and passenger car wheels, in production machines where space limitations are critical, and in high-speed mechanisms where inertia forces must be

11966 Dupre equation duct Effect Mechanical Engineering

A fluid flow passage which may range from a few inches in diameter to many feet in rectangular cross section, usually constructed of galvanized steel, aluminum, or copper, through which air flows in a ventilation system or to a compressor, supercharger, or other equipment at speeds ranging to thousands of feet per minute.

1074 ultrasonic machining Effect Mechanical Engineering

The removal of material by abrasive bombardment and crushing in which a flat-ended tool of soft alloy steel is made to vibrate at a frequency of about 20,000 hertz and an amplitude of 0.001-0.003 inch (0.0254-0.0762 millimeter) while a fine abrasive of silicon carbide, aluminum oxide, or boron carbide is carried by a liquid between tool and work.

11930 vacuum brake Effect Mechanical Engineering

A form of air brake which operates by maintaining low pressure in the actuating cylinder; braking action is produced by opening one side of the cylinder to the atmosphere so that atmospheric pressure, aided in some designs by gravity, applies the brake.

11834 continous-type furnace Effect Mechanical Engineering

A furnace used for heat treatment of materials, with or without direct firing; pieces are loaded through one door, progress continuously through the furnace, and are discharged from another door.

5839 spark-ignition engine Effect Mechanical Engineering

An internal combustion engine in which an electrical discharge ignites the explosive mixture of fuel and air.

1083 centrifugal filtration Effect Mechanical Engineering

The removal of a liquid from a slurry by introducing the slurry into a rapidly rotating basket, where the solids are retained on a porous screen and the liquid is forced out of the cake by the centrifugal action.

5689 vacuum heating Effect Mechanical Engineering

A two-pipe steam heating system in which a vacuum pump is used to maintain a suction in the return piping, thus creating a positive return flow of air and condensate. vacuum mat

11784 rack and pinion Effect Mechanical Engineering

A gear arrangement consisting of a toothed bar that meshes with a pinion.

6228 Pelton wheel Effect Mechanical Engineering

An impulse hydraulic turbine in which pressure of the water supply is converted into velocity by a few stationary nozzles, and the water jets then impinge on the buckets mounted on the rim of a wheel; usually limited to high head installations, exceeding 500 feet (150 meters). Also known as Pelton turbine.

5844 four-stroke cycle Effect Mechanical Engineering

An internal combustion engine cycle completed in four piston strokes; includes a suction stroke, compression stroke, expansion stroke, and exhaust stroke. four-track tape

1180 open-cycle gas turbine Effect Mechanical Engineering

A gas turbine prime mover in which air is compressed in the compressor element, fuel is injected and burned in the combustor, and the hot products are expanded in the turbine element and exhausted to the atmosphere.

6196 Flettner windmill Effect Mechanical Engineering

An inefficient windmill with four arms, each consisting of a rotating cylinder actuated by a Savonius rotor.

11779 chain gear Effect Mechanical Engineering

A gear that transmits motion from one wheel to another by means of a chain.

6367 radial engine Effect Mechanical Engineering

An engine characterized by radially arranged cylinders at equiangular intervals around the crankshaft.

1079 mechanical refrigeration Effect Mechanical Engineering

The removal of heat by utilizing a refrigerant subjected to cycles of refrigerating thermodynamics and employing a mechanical compressor.

5737 shock absorber Effect Mechanical Engineering

A spring, a dashpot, or a combination of the two, arranged to minimize the acceleration of the mass of a mechanism or portion thereof with respect to its frame or support.

12005 chain drive Effect Mechanical Engineering

A flexible device for power transmission, hoisting, or conveying, consisting of an endless chain whose links mesh with toothed wheels fastened to the driving and driven shafts.

5842 Sabathe's cycle Law Mechanical Engineering

An internal combustion engine cycle in which part of the combustion is explosive and part at constant pressure.

2142 Rankine efficiency Law Mechanical Engineering

The efficiency of an ideal engine operating on the Rankine cycle under specified conditions of steam temperature and pressure.

214 nozzle efficiency Law Mechanical Engineering

The efficiency with which a nozzle converts potential energy into kinetic energy, commonly expressed as the ratio of the actual change in kinetic energy to the ideal change at the given pressure ratio.

1827 Rittinger's law Law Mechanical Engineering

The law that energy needed to reduce the size of a solid particle is directly proportional to the resultant increase in surface area.

1782 Willans line Law Mechanical Engineering

The line (nearly straight) on a graph showing steam consumption (pounds per hour) versus power output (kilowatt or horsepower) for a steam engine or turbine; frequently extended to show total fuel consumed (pounds per hour) for gas turbines, internal combustion engines, and complete power plants.

2140 energy conversion efficiency Law Mechanical Engineering

The efficiency with which the energy of the working substance is converted into kinetic energy.

4529 Buckingham's equations Law Mechanical Engineering

Equations which give the durability of gears and the dynamic loads to which they are subjected in terms of their dimensions, hardness, surface endurance, and composition.

4540 available energy Law Mechanical Engineering

Energy which can in principle be converted to mechanical work.

11904 Moody formula Law Mechanical Engineering

A formula giving the efficiency e' of a field turbine, whose runner has diameter D', in terms of the efficiency e of a model turbine, whose runner has diameter D; e' = 1 - (1 - e) (D/D')1/5.

8053 Bond and Wang theory Law Mechanical Engineering

A theory of crushing and grinding from which the energy, in horsepower-hours, required to crush a short ton of material is derived.

8050 Betz momentum theory Law Mechanical Engineering

A theory of windmill performance that considers the deceleration in the air traversing the windmill disk.

2099 Thoma cavitation coefficient Law Mechanical Engineering

The equation for measuring cavitation in a hydraulic turbine installation, relating vapor pressure, barometric pressure, runner setting, tail water, and head.

393 Drzewiecki theory Law Mechanical Engineering

In theoretical investigations of windmill performance, a theory concerning the air forces produced on an element of the blade.

8510 Bond's law Law Mechanical Engineering

A statement that relates the work required for the crushing of solid materials (for example, rocks and ore) to the product size and surface area and the lengths 69 Bond's third theory of cracks formed. Also known as Bond's third theory.

4093 mechanical efficiency Law Mechanical Engineering

In an engine, the ratio of brake horsepower to indicated horsepower.

908	Cardan motion	Prime Effect	Mechanical Engineering

The straight-line path followed by a moving centrode in a fourbar centrode linkage.

12383	heat pump	Prime Effect	Mechanical Engineering

A device which transfers heat from a cooler reservoir to a hotter one, expending mechanical energy in the process, especially when the main purpose is to heat the hot reservoir rather than refrigerate the cold one.

4659	rotary cutter	Prime Effect	Mechanical Engineering

Device used to cut tough or fibrous materials by the shear action between two sets of blades, one set on a rotating holder, the other stationary on the surrounding casing.

488	block and tackle	Prime Effect	Mechanical Engineering

Combination of 65 block brake a rope or other flexible material and independently rotating frictionless pulleys. Also known as block and fall.

Systems Engineering

9717	fuzzy system	Effect	Systems Engineering

A process that is too complex to be modeled by using conventional mathematical methods, and that gives rise to data that are, in general, soft, with no precise boundaries; examples are large-scale engineering complex systems, social systems, economic systems, management systems, medical diagnostic processes, and human perception.

Thermal Engineering

713	eddy heat conduction	Effect	Thermal Engineering

The transfer of heat by means of eddies in turbulent flow, treated analogously to molecular conduction.

712	heat convection	Effect	Thermal Engineering

The transfer of thermal energy by actual physical movement from one location to another of a substance in which thermal energy is stored. Also known as thermal convection.

1266	volatility	Effect	Thermal Engineering

The quality of having a low boiling point or subliming temperature at ordinary pressure or, equivalently, of having a high vapor pressure at ordinary temperatures.

620 sublimation cooling Effect Thermal Engineering

Cooling caused by the extraction of energy to produce sublimation.

704 absolute expansion Effect Thermal Engineering

The true expansion of a liquid with temperature, as calculated when the expansion of the container in which the volume of the liquid is measured is taken into account; in contrast with apparent expansion.

115 reduced temperature Effect Thermal Engineering

The ratio of the temperature of a substance to its critical temperature.

1254 heat release Effect Thermal Engineering

The quantity of heat released by a furnace or other heating mechanism per second, divided by its volume.

792 potential temperature Effect Thermal Engineering

The temperature that would be reached by a compressible fluid if it were adiabatically compressed or expanded to a standard pressure, usually 1 bar.

1398 critical pressure Effect Thermal Engineering

The pressure of t h e liquid-vapor critical point.

1096 temperature color scale Effect Thermal Engineering

The relation between an incandescent substance's temperature and the color of the light it emits.

temperature-compensated Zener diode

128 negative temperature Effect Thermal Engineering

The property of a thermally isolated thermodynamic system whose elements are in thermodynamic equilibrium among themselves, whose allowed states have an upper limit on their possible energies, and whose high-energy states are more occupied than the low-energy ones.

1409 exergy Effect Thermal Engineering

The portion of the total energy of a system that is available for conversion to useful work; in particular, the quantity of work that can be performed by a fluid relative to a reference condition, usually the surrounding ambient condition.

1127 thermal resistivity Effect Thermal Engineering

The reciprocal of the thermal conductivity.

1355 sublimation Effect Thermal Engineering

The process by which solids are transformed directly to the vapor state or vice versa without passing through the liquid phase.

1040 magnetocaloric effect Effect Thermal Engineering

The reversible change of temperature accompanying the change of magnetization of a ferromagnetic material.

magnetoelectronics

116 reduced pressure Effect Thermal Engineering

The ratio of the pressure of a substance to its critical pressure. reduced-pressure distillation See vacuum distillation.

reduced property See reduced value.

1508 differential heat of solution Effect Thermal Engineering

The partial derivative of the total heat of solution with respect to the molal concentration of one component of the solution, when the concentration of the other component or components, the pressure, and the temperature are held constant.

856 enthalpy Effect Thermal Engineering

The sum of the internal energy of a system plus the product of the system's volume multiplied by the pressure exerted on the system by its surroundings. Also known as heat content; sensible heat; total heat.

1555 primary phase Effect Thermal Engineering

The only crystalline phase capable of existing in equilibrium with a given liquid.

1160 absorptivity Effect Thermal Engineering

The ratio of the radiation absorbed by a surface to the total radiation incident on the surface.

618 supercooling Effect Thermal Engineering

Cooling of a substance below the temperature at which a change of state would ordinarily take place without such a change of state occurring, for example, the cooling of a liquid below its freezing point without freezing taking place; this results in a metastable state.

1184 fugacity coefficient Effect Thermal Engineering

The ratio of the fugacity of a gas to its pressure.

1297 thermal inductance Effect Thermal Engineering

The product of temperature difference and time divided by entropy flow.

674 consolute temperature Effect Thermal Engineering

The upper temperature of immiscibility for a two-component liquid system. Also known as upper consolute temperature; upper critical solution temperature. constant-amplitude recording

1190 pressure coefficient Effect Thermal Engineering

The ratio of the fractional change in pressure to the change in temperature under specified conditions, usually constant volume.

1264 fusibility Effect Thermal Engineering

The quality or degree of being capable of being liquefied by heat.

798 sublimation point Effect Thermal Engineering

The temperature at which the vapor pressure of the solid phase subtractive synthesis of a compound is equal to the total pressure of the gas phase in contact with it; analogous to the boiling point of a liquid.

1210 thermal capacitance Effect Thermal Engineering

The ratio of t he entropy added to a body to the resulting rise in temperature.

1215 sensible-heat factor Effect Thermal Engineering

The ratio of space sensible heat to space total heat; used 488 sequential collation of range for air-conditioning calculations. Abbreviated SHF.

13088 isometric process Effect Thermal Engineering

A constant-volume, frictionless thermodynamic process in which the system is confined by mechanically rigid boundaries.

1253 heat capacity Effect Thermal Engineering

The quantity of heat required to raise a system one degree in temperature in a specified way, usually at constant pressure or constant volume. Also known as thermal capacity.

1156 vaporization coefficient Effect Thermal Engineering

The ratio of the rate of vaporization of a solid or liquid at a given temperature and corresponding vapor pressure to the rate of vaporization that would be necessary to produce the same vapor pressure at this temperature if every vapor molecule striking the solid or liquid were absorbed there.

1256 diffusivity Effect Thermal Engineering

The quantity of heat passing normally through a unit area per unit time divided by the product of specific heat, density, and temperature gradient. Also known as thermal diffusivity; thermometric conductivity.

1257 heat of vaporization Effect Thermal Engineering

The quantity of energy required to evaporate 1 mole, or a unit mass, of a liquid, at constant pressure and temperature. Also known as enthalpy of vaporization; heat of evaporation; latent heat of vaporization.

1599 thermophoresis Effect Thermal Engineering

The movement of particles in a thermal gradient from high to low temperatures.

1293 compressibility factor Effect Thermal Engineering

The product of the pressure and the volume of a gas, divided by the product of the temperature of the gas and the gas constant; this factor may be inserted in the ideal gas law to take into account the departure of true gases from ideal gas behavior. Also known as deviation factor; gas-deviation factor; supercompressibility factor.

6894 zeroth law of thermodynamics Effect Thermal Engineering

Alaw that if two systems are separately found to be in thermal equilibrium with a third system, the first two systems are in thermal equilibrium with each other, that is, all three systems are at the same temperature.

6397 van derWaals surface tension formula Effect Thermal Engineering

An empirical formula for the dependence of the surface tension on temperature: -y = Kp 2/3 Tc 1/3 (1 - T/Tc)n, where -y is the surface tension, T is the temperature, Tc and pc are the critical temperature and pressure, K is a constant, and n is a constant equal to approximately 1.23.

6584 temperature scale Effect Thermal Engineering

An assignment of numbers to temperatures in a continuous manner, such that the resulting function is single valued; it is either an empirical temperature scale, based on some convenient property of a substance or object, or it measures the absolute temperature.

11725 psychrometric chart Effect Thermal Engineering

A graph each point of which represents a specific condition of a gas-vapor system (such as air and water vapor) with regardtotemperature (horizontal scale) and absolute humidity (vertical scale); other characteristics of the system, such as relative humidity, wet-bulb temperature, and latent heat of vaporization, are indicated by lines on the chart.

13890 melting point Effect Thermal Engineering

1. The temperature at which a solid of a pure substance changes to a liquid. Abbreviated mp. 2. For a solution of two or more components, the temperature at which the first trace of liquid appears as the solution is heated.

31 sublime Effect Thermal Engineering

To change from the solid to the gaseous state without passing through the liquid phase.

11723 steam line Effect Thermal Engineering

A graph of the boiling point of water as a function of pressure.

11722 enthalpy-entropy chart Effect Thermal Engineering

A graph of the enthalpy of a substance versus its entropy at various values of temperature, pressure, or specific volume; useful in making calculations about a machine or process in which this substance is the working medium.

6673 Ingen-Hausz apparatus Effect Thermal Engineering

An apparatus for comparing the thermal conductivities of different conductors; specimens consisting of long wax-coated rods of equal length are placed with one end in a tank of boiling water covered with a radiation shield, and the lengths along the rods from which the wax melts are compared.

1172 ice line Effect Thermal Engineering

A graph of the freezing point of water as a function of pressure.

13889 absolute temperature Effect Thermal Engineering

1. The temperature measurable in theory on the thermodynamic temperature scale. 2. The temperature in Celsius degrees relative to the absolute zero at -273.16℃ (the Kelvin scale) or in Fahrenheit degrees relative to the absolute zero at -459.69℉ (the Rankine scale).

11718 sublimation curve Effect Thermal Engineering

A graph of the vapor pressure of a solid as a function of temperature. sublimation energy

532 adiabatic process Effect Thermal Engineering

Any thermodynamic procedure which takes place in a system without the exchange of heat with the surroundings. adiabatic vaporization

6870 ideal gas Effect Thermal Engineering

Also known as perfect gas. 1. A gas whose molecules are infinitely small and exert no force on each other. 2. A gas that obeys Boyle's law (the product of the pressure and volume is constant at constant temperature) and Joule's law (the internal energy is a function of the temperature alone).

362 barotropic phenomenon Effect Thermal Engineering

The sinking of a vapor beneath the surface of a liquid when the vapor phase has the greater density.

13872 fundamental interval Effect Thermal Engineering

1. The value arbitrarily assigned to the difference in temperature between two fixed points (such as the ice point and steam point) on a temperature scale, in order to define the scale. 2. The difference between the values recorded by a thermometer at two fixed points; for example, the difference between the resistances recorded by a resistance thermometer at the ice point and steam point.

7405 saturated vapor Effect Thermal Engineering

A vapor whose temperature equals the temperature of boiling at the pressure existing on it.

7406 superheated vapor Effect Thermal Engineering

A vapor that has been heated above its boiling point.

7505 thermal ohm Effect Thermal Engineering

A unit of thermal resistance equal to the thermal resistance for which a temperature difference of 1 kelvin produces a flow of entropy of 1 watt perkelvin. Also known as fourier.

7506 thermal henry Effect Thermal Engineering

A unit of thermal inductance equal to the product of a temperature difference of 1 kelvin and a time of 1 second divided by a rate of flow of entropy of 1 watt per kelvin.

7507 thermal farad Effect Thermal Engineering

A unit of thermal capacitance equal to the thermal capacitance of a body for which an increase in entropy of 1 joule perkelvin results in atemperatureriseof 1 kelvin. thermal flame safeguard

751 frigorie Effect Thermal Engineering

A unit of rate of extraction of heat used in refrigeration, equal to 1000 fifteendegree calories per hour, or 1.16264 ± 0.00014 watts.

7566 therm Effect Thermal Engineering

A unit of heat energy, equal to 100,000 international table British thermal units, or approximately 1.055 X 108 joules.

7568 thermie Effect Thermal Engineering

A unit of heat energy equal to the heat energy needed to raise 1 tonne of water from 14.5℃ to 15.5℃ at a constant pressure of 1 standard atmosphere; equal to 106 fifteen- degrees calories or (4.1855 ± 0.0005) X 106 joules. Abbreviated

7569 kilocalorie Effect Thermal Engineering

A unit of heat energy equal to 1000 calories. Abbreviated kcal. Also known as kilogram-calorie (kg-cal); large calorie (Cal).

17 molecular heat diffusion Effect Thermal Engineering

Transfer of heat through the motion of molecules. molecular pump

6845 comparator method Effect Thermal Engineering

Amethod of determining the coefficient of linear expansion of a substance in which one measures the distance that each of two traveling microscopes must be moved in order to remain centered on scratches on a rod-shaped specimen when the temperature of the specimen is raised by a measured amount.

6105 manocryometer Effect Thermal Engineering

An instrument for measuring the change of a substance's melting point with change in pressure; the height of a mercury column in a U-shaped capillary supported by an equilibrium between liquid and solid in an adjoining bulb is measured, and the whole apparatus is in a thermostat.

5322 thermodynamic temperature scale Effect Thermal Engineering

Any temperature scale in which the ratio of the temperatures of two reservoirs is equal to the ratio of the amount of heat absorbed from one of them by a heat engine operating in a Carnot cycle to the amount of heat rejected by this engine to the other reservoir; the Kelvin scale and the Rankine scale are examples of this type.

5335 engine cycle Effect Thermal Engineering

Any series of thermodynamic phases constituting a cycle for the conversion of heat into work; examples are the Otto cycle, Stirling cycle, and Diesel cycle.

1600 heat transfer Effect Thermal Engineering

The movement of heat from one body to another (gas, liquid, solid, or combinations thereof) by means of radiation, convection, or conduction.

5470 heat source Effect Thermal Engineering

Any device or natural body that supplies heat.

485 isentropic compression Effect Thermal Engineering

Compression which occurs without any change in entropy.

5712 spontaneous process Effect Thermal Engineering

A thermodynamic process which takes place without the application of an external agency, because of the inherent properties of a system.

5713 isobaric process Effect Thermal Engineering

A thermodynamic process of a gas in which the heat transfer to or from the gaseous system causes a volume change at constant pressure.

5725 divariant system Effect Thermal Engineering

A system composed of only one phase, so that two variables, such as pressure and temperature, are sufficient to define its thermodynamic state.

5727 open system Effect Thermal Engineering

A system across whose boundaries both matter and energy may pass. open-timbered roof

13953 heat of wetting Effect Thermal Engineering

1. The heat of adsorption of water on a substance. 2. The additional heat required, above the heat of vaporization of free water, to evaporate water from a substance in which it has been absorbed.

13945 free energy Effect Thermal Engineering

1. The internal energy of a system minus the product of its temperature and its entropy. Also known as Helmholtz free energy; Helmholtz function; Helmholtz potential; thermodynamic potential at constant volume; work function. 2. See Gibbs free energy.

6370 graybody Effect Thermal Engineering

An energy radiator which has a blackbody energy distribution, reduced by a constant factor, throughout the radiation spectrum or within a certain wavelength interval.

11964 thermometric fluid Effect Thermal Engineering

A fluid that has properties, such as a large and uniform thermal expansion coefficient, good thermal conductivity, and chemical stability, that make it suitable for use in a thermometer.

6335 equation of piezotropy Effect Thermal Engineering

An equation obeyed by certain fluids which states that the time rate of change of the fluid's density equals the product of a function of the thermodynamic variables and the time rate of change of the pressure.

11844 fugacity Effect Thermal Engineering

A function used as an analog of the partial pressure in applying thermodynamics to real systems; at a constant temperature it is proportional to the exponential of the ratio of the chemical potential of a constituent of a system divided by the product of the gas constant and t h e temperature, and it approaches the partial pressure as the total pressure of the gas approaches zero.

11807 permanent gas Effect Thermal Engineering

A gas at a pressure and temperature far from its liquid state.

11800 real gas Effect Thermal Engineering

A gas, as considered from the viewpoint in which deviations from the ideal gas law, resulting from interactions of gas molecules, are taken into account. Also known as imperfect gas.

6220 anomalous expansion Effect Thermal Engineering

An increase in the volume of a substance that results from a decrease in its temperature, such as is displayed by water at temperatures between 0 and 4℃ (32 and 39℉).

6254 reversible process Effect Thermal Engineering

An ideal thermodynamic process which can be exactly reversed by making an indefinitely small change in the external conditions. Also known as quasistatic process.

6257 reverse Carnot cycle Effect Thermal Engineering

An ideal thermodynamic cycle consisting of the processes of the Carnot cycle reversed and in reverse order, namely, isentropic expansion, isothermal expansion, isentropic compression, and isothermal compression.

6258 Rankine cycle Effect Thermal Engineering

An ideal thermodynamic cycle consisting of heat addition at constant pressure, isentropic expansion, heat rejection at constant pressure, and isentropic compression; used as an ideal standard for the performance of heat-engine and heat-pump installations operating with a condensable vapor as the working fluid, such as a steam power plant.

6262 reversible engine Effect Thermal Engineering

An ideal engine which carries out a cycle of reversible processes.

6264 blackbody Effect Thermal Engineering

An ideal body which would absorb all incident radiation and reflect none. Also known as hohlraum; ideal radiator. blackbody radiation

13909 specific heat Effect Thermal Engineering

1. The ratio of the amount of heat required to raise a mass of material 1 degree in temperature to the amount of 518 Sperry process heat required to raise an equal mass of a reference substance, usually water, 1 degree in temperature; both measurements are made at a reference temperature, usually at constant pressure or constant volume. 2. The quantity of heat required to raise a unit mass of homogeneous material one degree in temperature in a specified way; it is assumed that during the process no phase or chemical change occurs.

6327 thermodynamic equation of state Effect Thermal Engineering

An equation that relates the reversible change in energy of a thermodynamic system to the pressure, volume, and temperature.

11556 cavity radiator Effect Thermal Engineering

A heated enclosure with a small opening which allows some radiation to escape or enter; the escaping radiation approximates that of a blackbody.

584 diesel cycle Effect Thermal Engineering

An internal combustion engine cycle in which the heat of compression ignites the fuel.

10186 reversible path Effect Thermal Engineering

A path followed by a thermodynamic system such that its direction of motion can be reversed at any point by an infinitesimal change in external conditions; thus the system can be considered to be at equilibrium at all points along the path.

7579 thermal coulomb Effect Thermal Engineering

A unit of entropy equal to 1 joule per kelvin.

9679 temperature Effect Thermal Engineering

A property of an object which determines the direction of heat flow when the object is placed in thermal contact with another object: heat flows from a region of higher temperature to one of lower temperature; it is measured either by an empirical temperature scale, based on some convenient property of a material or instrument, or by a scale of absolute temperature, for example, the Kelvin scale.

9703 irreversible process Effect Thermal Engineering

A process which cannot be reversed by an infinitesimal change in external conditions.

973 adiabatic cooling Effect Thermal Engineering

A process in which the temperature of a system is reduced without any heat being exchanged between the system and its surroundings.

9733 reheating Effect Thermal Engineering

A process in which the gas or steam is reheated after a partial isentropic expansion to reduce moisture content. Also known as resuperheating.

9762 thermodynamic cycle Effect Thermal Engineering

A procedure or arrangement in which some material goes through a cyclic process and one form of energy, such as heat at an elevated temperature from combustion of a fuel, is in part converted to another form, such as mechanical energy of a shaft, the remainder being rejected to a lower temperature sink. Also known as heat cycle.

1081 heat of ablation Effect Thermal Engineering

A measure of the effective heat capacity of an ablating material, numerically the heating rate input divided by the mass loss rate which results from ablation. heat of adsorption

10083 thermometric property Effect Thermal Engineering

A physical property that changes in a known way with temperature, and can therefore be used to measure temperature.

10799 heat quantity Effect Thermal Engineering

A measured amount of heat; units are the small calorie, normal calorie, mean calorie, and large calorie.

10114 thermal hysteresis Effect Thermal Engineering

A phenomenon sometimes observed in the behavior of a temperature-

10116 Ludwig-Soret effect Effect Thermal Engineering

A phenomenon in which a temperature gradient in a mixture of substances gives rise to a concentration gradient.

9437 reverse Brayton cycle Effect Thermal Engineering

A refrigeration cycle using air as the refrigerant but with all system pressures above the ambient. Also known as dense-air refrigeration cycle.

1341 first-order transition Effect Thermal Engineering

A change in state of aggregation of a system accompanied by a discontinuous change in enthalpy, entropy, and volume at a single temperature and pressure.

9430 Stirling cycle Effect Thermal Engineering

A regenerative thermodynamic power cycle using two isothermal and two constant volume phases.

13408 homomorphous transformation Effect Thermal Engineering

A change in the values of the thermodynamic variables of a system in which none of the component substances undergoes a change of state.

10214 critical exponent Effect Thermal Engineering

A parameter n that characterizes the temperature dependence of a thermodynamic property of a substance near its critical point; the temperature dependence has the form |T - Tc\n, where T is the temperature and Tc is the critical

10217 heat equation Effect Thermal Engineering

A parabolic secondorder differential equation for the temperature of a substance in a region where no heat source exists: dt/dj = (k/pc)(d2t/dx2 + d2t/dy2 + dt2/dz2), where x, y, and z are space coordinates, T is the time, t(x,y,z,j) is the temperature, k is the thermal conductivity of the body, p is its density, and c is its specific heat; this equation is fundamental to the study of heat flow in bodies. Also known as Fourier heat equation; heat flow equation.

13407 heteromorphic transformation Effect Thermal Engineering

A change in the values of the thermodynamic variables of a system in which one or more of the component substances also undergo a change of state.

13406 transition Effect Thermal Engineering

A change of a substance from one of the three states of matter to another. transitional fit

13405 thermodynamic process Effect Thermal Engineering

A change of any property of an aggregation of matter and energy, accompanied by thermal effects. thermodynamic

13403 second-order transition Effect Thermal Engineering

A change of state through which the free energy of a substance and its first derivatives are continuous functions of temperature and pressure, or other corresponding variables.

13402 isentropic process Effect Thermal Engineering

A change that takes place without any increase or decrease in entropy, such as a process which is both reversible and adiabatic.

10612 method of mixtures Effect Thermal Engineering

A method of determining the heat of fusion of a substance whose specific heat is known, in which a known amount of the solid is combined with a known amount of the liquid in a calorimeter, and the decrease in the liquid temperature during melting of the solid is measured.

10607 differential thermal analysis Effect Thermal Engineering

A method of determining the temperature at which thermal reactions occur in a material undergoing continuous heating to elevated temperatures; also involves a determination of the nature and intensity of such reactions.

13394 internal energy Effect Thermal Engineering

A characteristic property of the state of a thermodynamic system, introduced in the first law of thermodynamics; it includes intrinsic energies of individual molecules, kinetic energies of internal motions, and contributions from interactions between molecules, but excludes the potential or kinetic energy of the system as a whole; it is sometimes erroneously referred to as heat energy.

115 thermodynamic probability Effect Thermal Engineering

Under specified conditions, the number of equally likely states in which a substance may exist; the thermodynamic probability Q, is related to the entropy S by S = k ln il, where k is Boltzmann's constant.

10120 order of phase transition Effect Thermal Engineering

A phase transition in which there is a latent heat and an abrupt change in properties, such as in density, is a first-order transition; if there is not such a change, the order of the transition is one greater than the lowest derivative of such properties with respect to temperature which has a discontinuity.

8124 lambda point Effect Thermal Engineering

A temperature at which the specific heat of a substance has a sharply peaked maximum, observed in many second- order transitions.

5376 thermodynamic function of state Effect Thermal Engineering

Any of the quantities defining the thermodynamic state of a substance in thermodynamic equilibrium; for a perfect gas, the pressure, temperature, and density are the fundamental thermodynamic variables, any two of which are, by the equation of state, sufficient to specify the state. Also known as state parameter; state variable; thermodynamic variable.

13708 nonblackbody Effect Thermal Engineering

A body that reflects some fraction of the radiation incident upon it; all real bodies are of this nature.

8039 saturation specific humidity Effect Thermal Engineering

A thermodynamic function of state; the value of the specific humidity of saturated air at the given temperature and

8040 thetagram Effect Thermal Engineering

A thermodynamic diagram with coordinates of pressure and temperature, both on a linear scale.

8042 vapor cycle Effect Thermal Engineering

A thermodynamic cycle, operating as a heat engine or a heat pump, during which the working substance is in, or passes through, the vapor state.

8043 closed cycle Effect Thermal Engineering

A thermodynamic cycle in which the thermodynamic fluid does not enter or leave the system, but is used over and over again.

8044 open cycle Effect Thermal Engineering

A thermodynamic cycle in which new mass enters the boundaries of the system and spent exhaust leaves it; the automotive engine and the gas turbine illustrate this process.

8045 Otto cycle Effect Thermal Engineering

A thermodynamic cycle for the conversion of heat into work, consisting of two isentropic phases interspersed between two constant-volume phases. Also known as spark-ignition combustion cycle.

8046 Brayton cycle Effect Thermal Engineering

A thermodynamic cycle consisting of two constant-pressure processes interspersed with two constant-entropy processes. Also known as complete-expansion diesel cycle; Joule cycle.

8054 Prevost's theory Effect Thermal Engineering

A theory according to which a body is constantly exchanging heat with its surroundings, radiating an amount of energy which is independent of its surroundings, and increasing or decreasing its temperature depending on whether it absorbs more radiation than it emits, or vice versa.

8094 equivalent temperature Effect Thermal Engineering

A term used in British engineering for that temperature of a uniform enclosure in which, in still air, a sizable blackbody at 75°F (23.9°C) would lose heat at the same rate as in the environment.

9453 adiabatic compression Effect Thermal Engineering

A reduction in volume of a substance without heat flow, in or out.

8122 monochromatic temperature scale Effect Thermal Engineering

A temperature scale based upon the amount of power radiated from a blackbody at a single wavelength.

7599 Also known as thermal volt. Effect Thermal Engineering

A unit of absolute temperature equal to 1/273.16 of the absolute temperature of the triple point of water. Symbolized K. Formerly known as degree Kelvin.

8216 univariant system Effect Thermal Engineering

A system which has only one degree of freedom according to the phase rule.

833 diathermous envelope Effect Thermal Engineering

A surface enclosing a thermodynamic system in equilibrium that is not an adiabatic envelope; intuitively, this means that heat can flow through the surface.

8332 adiabatic envelope Effect Thermal Engineering

A surface enclosing a thermodynamic system in an equilibrium which can be disturbed only by long-range forces or by motion of part of the envelope; intuitively, this means that no heat can flow through the surface.

8356 thermal conductor Effect Thermal Engineering

A substance with a relatively high thermal conductivity.

1125 isothermal layer Effect Thermal Engineering

A layer of fluid, all points of which have the same temperature. isothermal magnetization

8526 international temperature scale Effect Thermal Engineering

A standard temperature scale, adopted in 1990, that approximates the thermodynamic scale, based on assigned temperature values of 17 thermodynamic equilibrium fixed points and prescribed thermometers for interpolation between them. Abbreviated ITS-90.

13518 isothermal calorimeter Effect Thermal Engineering

A calorimeter in which the heat received by a reservoir, containing a liquid in equilibrium with its solid at the melting point or with its vapor at the boiling point, is determined by the change in volume of the liquid.

8845 absolute temperature scale Effect Thermal Engineering

A scale with which temperatures are measured relative to absolute zero. Also known as absolute scale.

11193 isentrope Effect Thermal Engineering

A line of equal or constant entropy.

9054 refrigeration cycle Effect Thermal Engineering

A sequence of thermodynamic processes whereby heat is withdrawn from a cold body and expelled to a hot body.

9057 gas cycle Effect Thermal Engineering

A sequence in which a gaseous fluid undergoes a series of thermodynamic phases, ultimately returning to its original

9420 temperature bath Effect Thermal Engineering

A relatively large volume of a homogeneous substance held at constant temperature, so that an object placed in thermal contact with it is maintained at the same temperature.

8120 Fahrenheit scale Effect Thermal Engineering

A temperature scale; the temperature in degrees Fahrenheit (°F) is the sum of 32 plus 9/5 the temperature in degrees Celsius; water at 1 atmosphere (101,325 pascals) pressure freezes very near 32°F and boils very near 212°F.

2449 minimum resolvable temperature Effect Thermal Engineering

The change in equivalent blackbody temperature that corresponds to a change in radiance which will produce a just barely resolvable change in the output of an infrared imaging device, taking into account the characteristics of the device, the display, and the observer. Abbreviated MRTD.

2107 heat radiation Effect Thermal Engineering

The energy radiated by solids, liquids, and gases in the form of electromagnetic waves as a result of their temperature.

459 boil-off Effect Thermal Engineering

The vaporization of a liquid, such as liquid oxygen or liquid hydrogen, as its temperature reaches its boiling point under conditions of exposure, as in the tank of a rocket being readied for launch.

2218 thermal potential difference Effect Thermal Engineering

The difference between the thermodynamic temperatures of two points.

2220 wall superheat Effect Thermal Engineering

The difference between the temperature of a surface and the saturation temperature (boiling point at the ambient pressure) of an adjacent liquid that is heated by the surface.

2228 heat of mixing Effect Thermal Engineering

The difference between the enthalpy of a mixture and the sum of the enthalpies of its components at the same pressure and temperature.

2334 film cooling Effect Thermal Engineering

The cooling of a body or surface, such as the inner surface of a rocket combustion chamber, by maintaining a thin fluid layer over the affected area.

2339 degradation Effect Thermal Engineering

The conversion of energy into forms that are increasingly difficult to convert into work, resulting from the general tendency of entropy to increase.

2344 volatilization Effect Thermal Engineering

The conversion of a chemical substance from a liquid or solid state to a gaseous or vapor state by the application of heat, by reducing pressure, or by a combination of these processes. Also known as vaporization.

2358 gas constant Effect Thermal Engineering

The constant of proportionality appearing in the equation of state of an ideal gas, equal to the pressure of the gas times its molar volume divided by its temperature.

2367 positive temperature coefficient Effect Thermal Engineering

The condition wherein the resistance, length, or some other characteristic of a substance increases when temperature increases.

2372 heat death Effect Thermal Engineering

The condition of any isolated system when its entropy reaches a maximum, in which matter is totally disordered and at a uniform temperature, and no energy is available for doing work.

3306 supercritical Effect Thermal Engineering

Property of a gas which is above its critical pressure and temperature. supercritical fluid

2448 noise equivalent temperature Effect Thermal Engineering

The change in equivalent blackbody temperature that corresponds to a change in radiance which will produce a signal-to-noise ratio of 1 in an infrared imaging device. Abbreviated NETD.

2095 heat balance heat balance Effect Thermal Engineering

The equilibrium which is known to exist when all sources of heat gain and loss for a given region or body are accounted for heat budget

2453 suspended transformation Effect Thermal Engineering

The cessation of change before true equilibrium is 546 switch reached, or the failure of a system to change immediately after a change in conditions, such as in supercooling and other forms of metastable equilibrium.

2503 steam point Effect Thermal Engineering

The boiling point of pure water whose isotopic composition is the same as that of sea water at standard atmospheric pressure; it is assigned a value of 100℃ on the International Practical Temperature Scale of 1968.

12955 stem correction Effect Thermal Engineering

A correction which must be made in reading a thermometer in which part of the stem, and the thermometric fluid within it, is at a temperature which differs from the temperature being measured.

2655 heat flux Effect Thermal Engineering

The amount of heat transferred across a surface of unit area in a unit time.

2765 unavailable energy Effect Thermal Engineering

That part of the energy which, when an irreversible process takes place, is initially in a form completely available for work and is converted to a form completely unavailable for work.

3018 superheat Effect Thermal Engineering

Sensible heat in a gas above the amount needed to maintain the gas phase.

3028 DesignatedG. Effect Thermal Engineering

See thermal conductance.

12888 cooling curve Effect Thermal Engineering

A curve obtained by plotting time against temperature for a solidliquid mixture cooling under constant conditions.

12884 critical isotherm Effect Thermal Engineering

A curve showing the relationship between the pressure and volume of a gas at its critical temperature.

548 isothermal process Effect Thermal Engineering

Any constanttemperature process, such as expansion or compression of a gas, accompanied by heat addition or removal from the system at a rate just adequate to maintain the constant temperature.

3294 thermodynamic equilibrium Effect Thermal Engineering

Property of a system which is in mechanical, chemical, and thermal equilibrium.

5319 isothermal transformation Effect Thermal Engineering

Any transformation of a substance which takes place at a constant temperature.

2375 isothermal equilibrium Effect Thermal Engineering

The condition in which two or more systems are at the same temperature, so that no heat flows between them.

14390 phase diagram Effect Thermal Engineering

1. A graph showing the pressures at which phase transitions between different states of a pure compound occur, as a function of temperature. 2. A graph showing the temperatures at which transitions between different phases of a binary system occur, as a function of the relative concentrations of its components.

1746 log-mean temperature difference Effect Thermal Engineering

The log-mean temperature difference TLM = (T2 - T1)/lnT2/T1, where T2 andT1 are the absolute (Kor°R) temperatures of the two extremes being averaged; used in heat transfer calculations in which one fluid is cooled or heated by a second held separate by pipes or process vessel walls.

1825 first law of thermodynamics Effect Thermal Engineering

The law that heat is a form of energy, and the total amount of energy of all kinds in an isolated system is constant; it is an application of t h e principle of conservation of energy.

1859 specific energy Effect Thermal Engineering

The internal energy of a substance per unit mass.

1885 coefficient of linear expansion Effect Thermal Engineering

The increment of length of a solid in a unit of length for a rise in temperature of 1° at constant pressure.

1886 coefficient of cubical expansion Effect Thermal Engineering

The increment in volume of a unit volume of solid, liquid, or gas for a rise of temperature of 1° at constant pressure. Also known as coefficient of expansion; coefficient of thermal expansion; coefficient of volumetric expansion; expansion coefficient; expansivity.

1887 coefficient of superficial expansion Effect Thermal Engineering

The increment in area of a solid surface per unit of area for a rise in temperature of 1° at constant pressure. Also known as superficial expansivity.

1892 standard free-energy increase Effect Thermal Engineering

The increase in Gibbs free energy in a chemical reaction, when both the reactants and the products of the reaction are in their standard states. standard gage

1893 heat of aggregation Effect Thermal Engineering

The increase in enthalpy when an aggregate of matter, such as a crystal, is formed at constant pressure.

1894 heat of crystallization Effect Thermal Engineering

The increase in enthalpy when 1 mole of a substance is transformed into its crystalline state at constant pressure.

1895 heat of solidification Effect Thermal Engineering

The increase in enthalpy when 1 mole of a solid is formed from a liquid or, less commonly, a gas at constant pressure and temperature.

1896 heat of transformation Effect Thermal Engineering

The increase in enthalpy of a substance when it undergoes some phase change at constant pressure and temperature.

1897 heat of sublimation Effect Thermal Engineering

The increase in enthalpy accompanying the conversion of 1 mole, or unit mass, of a solid to a vapor at constant pressure and temperature. Also known as latent heat of sublimation.

210 virtual entropy Effect Thermal Engineering

The entropy of a system, excluding that due to nuclear spin. Also known as practical entropy.

1899 heat of condensation Effect Thermal Engineering

The increase in enthalpy accompanying the conversion of 1 mole of vapor into liquid at constant pressure and

460 saturation vapor pressure Effect Thermal Engineering

The vapor pressure of a thermodynamic system, at a given temperature, wherein the vapor of a substance is in equilibrium with a plane surface of that substance's pure liquid or solid phase.

1932 low heat value Effect Thermal Engineering

The heat value of a combustion process assuming that none of the water vapor resulting from the process is condensed out, so that its latent heat is not available. Also known as lower heating value; net heating value.

1933 local coefficient of heat transfer Effect Thermal Engineering

The heat transfer coefficient at a particular point on a surface, equal to the amount of heat transferred to an infinitesimal area of the surface at the point by a fluid passing over it, divided by the product of this area and the difference between the temperatures of the surface and the fluid.

46 sublimation pressure Effect Thermal Engineering

The vapor pressure of a solid.

1936 standard heat of formation Effect Thermal Engineering

The heat needed to produce one mole of a compound from its elements in their standard state. standard hole

1937 thermal conductivity Effect Thermal Engineering

The heat flow across a surface per unit area per unit time, divided by the negative of the rate of change of temperature with distance in a direction perpendicular to the surface. Also known as coefficient of conductivity; heat conductivity.

1938 molecular heat Effect Thermal Engineering

The heat capacity per mole of a substance.

2005 thermal transpiration Effect Thermal Engineering

The formation of a pressure gradient in gas inside a tube when there is a temperature gradient in the gas and when the mean free path of molecules in the gas is a significant fraction of the tube diameter.

2007 film condensation Effect Thermal Engineering

The formation of a continuous film of liquid on a wall in contact with a vapor, when the wall is cooled below the local vapor saturation temperature and the liquid wets the cold surface.

2030 heat conduction Effect Thermal Engineering

The flow of thermal energy through a substance from a higher-to a lower-temperature region.

208 apparent expansion Effect Thermal Engineering

The expansion of a liquid with temperature, as measured in a graduated container without taking into account the container's expansion.

2084 eddy conductivity Effect Thermal Engineering

The exchange coefficient for eddy heat conduction.

3299 thermal equilibrium Effect Thermal Engineering

Property of a system all parts of which have attained a uniform temperature which is the same as that of the system's surroundings.

1898 heat of fusion Effect Thermal Engineering

The increase in enthalpy accompanying the conversion of 1 mole, or a unit mass, of a solid to a liquid at its melting point at constant pressure and temperature.

4506 isenthalpic expansion Effect Thermal Engineering

Expansion which takes place without any change in enthalpy. isenthalpic process

508 diabatic Effect Thermal Engineering

Athermodynamic change of state of a system in which there is a transfer of 155 diagnostics heat across the boundaries of the system. Also known as nonadiabatic diagnostics

442 equivalent blackbody temperature Effect Thermal Engineering

For a surface, the temperature of a blackbody which emits the same amount of radiation per unit area as does the

5080 air-standard cycle Effect Thermal Engineering

Athermodynamic cycle in which the working fluid is considered to be a perfect gas with such properties of air as a volume of 12.4 cubic feet per pound at 14.7 pounds per square inch (approximately 0.7756 cubic meter per kilogram at 101.36 kilopascals) and 492°R and a ratio of specific heats of 1:4.

3348 heat transport Effect Thermal Engineering

Process by which heat is carried past a fixed point or across a fixed plane, as in a warm current.

4964 film boiling Effect Thermal Engineering

Boiling in which a continuous film of vapor forms at the hot surface of the container holding the boiling liquid, reducing heat transfer across the surface.

3292 continuity of state Effect Thermal Engineering

Property of a transition between two states of matter, as between gas and liquid, during which there are no abrupt changes in physical properties.

4942 fluid distributor flowing-temperature Effect Thermal Engineering

Calculation correction factor for gases flowing at temperatures other than that for which a flow equation is valid, that is, other than 60°F (15.5°C).

4429 virial coefficients Effect Thermal Engineering

For a given temperature T, one of the coefficients in the expansion of P/RT in inverse powers of the molar volume, where P is the pressure and R is the gas constant.

443 temperature gradient Effect Thermal Engineering

For a given point, a vector whose direction is perpendicular to an isothermal surface at the point, and whose magnitude equals the rate of change of temperature in this direction.

4434 film coefficient Effect Thermal Engineering

For a fluid confined in a vessel, the rate of flow of heat out of the fluid, per unit area of vessel wall divided by the difference between the temperature in the interior of the fluid and the temperature at the surface of t h e wall. Also known as convection coefficient.

4789 natural convection Effect Thermal Engineering

Convection in which fluid motion results entirely from the presence of a hot body in the fluid, causing temperature and hence density gradients to develop, so that the fluid moves under the influence of gravity.

4453 radial heat flow Effect Thermal Engineering

Flow of heat between two coaxial cylinders maintained at different temperatures; used to measure thermal conductivities of gases.

394 adhesional work Effect Thermal Engineering

The work required to separate a unit area of a surface at which two substances are in contact. Also known as work of adhesion.

4854 isothermal compression Effect Thermal Engineering

Compression at constant temperature.

4507 isentropic expansion Effect Thermal Engineering

Expansion which occurs without any change in entropy. isentropic flow

4508 isothermal expansion Effect Thermal Engineering

Expansion of a substance while its temperature is held constant. isothermal flow

4527 Kirchhoff's equations Effect Thermal Engineering

Equations which state that the partial derivative of the change of enthalpy (or of internal energy) during a reaction, with respect to temperature, at constant pressure (or volume) equals the change in heat capacity at constant pressure (or volume).

4533 Donohue equation Effect Thermal Engineering

Equation used to determine the heat-transfer film coefficient for a fluid on the outside of a baffled shell-and-tube heat exchanger.

4542 heat Effect Thermal Engineering

Energy in transit due to a temperature difference between the source from which the energy is coming and a sink toward which the energy is going; other types of energy in transit are called work.

484 dropwise condensation Effect Thermal Engineering

Condensation of a vapor on a surface in which the condensate forms into drops.

12299 Prandtl number Effect Thermal Engineering

A dimensionless number used in the study of forced and free convection, equal to the dynamic viscosity times the specific heat at constant pressure divided by the thermal conductivity. Symbolized NPr.

12295 Stefan number Effect Thermal Engineering

A dimensionless number used in the study of radiant heat transfer, equal to the Stefan-Boltzmann constant times the cube of t h e temperature times the thickness of a layer divided by the layer's thermal conductivity.

12294 Graetz number Effect Thermal Engineering

A dimensionless number used in the study of streamline flow, equal to the mass flow rate of a fluid times its specific heat at constant pressure divided by the product of its thermal conductivity and a characteristic length. Also spelled Gratz

4449 homenergicflow Effect Thermal Engineering

Fluid flow in which the sum of kinetic energy, potential energy, and enthalpy per unit mass is the same at all locations in the fluid and at all times.

426 heat flow Effect Thermal Engineering

Heat thought of as energy flowing from one substance to another; quantitatively, the amount of heat transferred in a unit time. Also known as heat transmission.

3524 degree Effect Thermal Engineering

One of the units of temperature or temperature difference in any of various temperature scales, such as the Celsius, Fahrenheit, and Kelvin temperature scales (the Kelvin degree is now known as the kelvin).

3565 thermodynamic potential Effect Thermal Engineering

One of several extensive quantities which are determined by the instantaneous state of a thermodynamic system, independent of its previous history, and which are at a minimum when the system is in thermodynamic equilibrium under specified conditions.

3593 primary phase region Effect Thermal Engineering

Onaphasediagram, the locus of all compositions having a common primary phase.

3615 thermal Effect Thermal Engineering

Of or concerning heat. thermal ammeter See hot-wire ammeter.

3618 isobaric Effect Thermal Engineering

Of equal or constant pressure, with respect to either space or time.

3707 explosion method Effect Thermal Engineering

Method of measuring the specific heat of a gas at constant volume by enclosing the gas with an explosive mixture, whose heat of reaction is known, in a chamber closed with a corrugated steel membrane which acts as a manometer, and by deducing the maximum temperature reached on ignition of the mixture from the pressure change.

3745 thermal conductimetry Effect Thermal Engineering

Measurement of thermal conductivities.

3856 thermodynamic principles Effect Thermal Engineering

Laws governing the conversion of energy from one form to another.

3916 adiabatic expansion Effect Thermal Engineering

Increase in volume without heat flow, in or out.

3917 heat of cooling Effect Thermal Engineering

Increase in enthalpy during cooling of a system at constant pressure, 266 heavy force fit resulting from an internal change such as an allotropic transformation.

4417 liquidus line Effect Thermal Engineering

For a two-component system, a curve on a graph of temperature versus concentration which connects temperatures at which fusion is completed as the temperature is raised.

425 superheating Effect Thermal Engineering

Heating of a substance above the temperature at which a change of state would ordinarily take place without such a change of state occurring, for example, the heating of a liquid above its boiling point without boiling taking place; this results in a metastable state.

1408 interface resistance Effect Thermal Engineering

1. Impairment of heat flow caused by the imperfect contact between two materials at an interface. 2. Quantitatively, the temperature difference across the interface divided by the heat flux through it.

4263 radioactive heat Effect Thermal Engineering

Heat produced within a medium as a result of absorption of radiation from decay of radioisotopes in the medium, such as thorium-232, potassium-40, uranium-

4264 thermal value Effect Thermal Engineering

Heat produced by combustion, usually expressed in calories per gram or British thermal units per pound.

4265 heat of compression Effect Thermal Engineering

Heat generated when air is compressed.

4266 forced convection Effect Thermal Engineering

Heat convection in which fluid motion is maintained by some external agency.

4267 steady-state conduction Effect Thermal Engineering

Heat conduction in which the temperature and heat flow at each point does not change with time. steady-state creep See secondary creep.

4268 high heat Effect Thermal Engineering

Heat absorbed by the cooling medium in a calorimeter when products of combustion are cooled to the initial atmospheric (ambient) temperature.

5300 thermodynamic system Effect Thermal Engineering

Apart of the physical world as described by its thermodynamic properties.

4283 isentropic Effect Thermal Engineering

Having constant entropy; at constant entropy.

4356 entropy Effect Thermal Engineering

Function of the state of a thermodynamic system whose change in any differential reversible process is equal to the heat absorbed by the system from its surroundings divided by the absolute temperature of the system.

4426 vapor pressure Effect Thermal Engineering

For a liquid or solid, the pressure of the vapor in equilibrium with the liquid or solid.

4137 coefficient of performance | Effect | Thermal Engineering

In a refrigeration cycle, the ratio of the heat energy extracted by the heat engine at the low temperature to the work supplied to operate the cycle; when used as a heating device, it is the ratio of the heat delivered in the high-temperature coils to the work supplied.

1819 Gay-Lussac's second law | Important Law | Thermal Engineering

The law that the internal energy of an ideal gas is independent of its volume.

2100 third law of thermodynamics | Important Law | Thermal Engineering

The entropy of all perfect crystalline solids is zero at absolute zero temperature.

796 absolute zero | Important Law | Thermal Engineering

The temperature of - 273.16℃, or - 459.69℉, or 0 K, thought to be the temperature at which molecular motion vanishes and a body would have no heat energy.

376 Newton's law of cooling | Important Law | Thermal Engineering

The law that the rate of heat flow out of an object by both natural convection and radiation is proportional to the temperature difference between the object and its environment, and to the surface area of the object.

397 external work | Law | Thermal Engineering

The work done by a system in expanding against forces exerted from outside.

392 Dupre equation | Law | Thermal Engineering

The work WLS done 179 durability by adhesion at a gas-solid-liquid interface, expressed in terms of the surface tensions -y of the three phases, is WLS = -yGS + -yGL - -yLS.

377 sensible-heat flow | Law | Thermal Engineering

The heat given up or absorbed by a body upon being cooled or heated, as the result of the body's ability to hold heat; excludes latent heats of fusion and vaporization.

366 differential thermogravimetric analysis | Law | Thermal Engineering

Thermal analysis in which the rate of material weight change upon heating versus temperature is plotted; used to simplify reading of weight-versus-temperature thermogram peaks that occur close together.

360 blackbody temperature | Law | Thermal Engineering

The temperature of a blackbody that emits the same amount of heat radiation per unit area as a given object; measured by a total radiation pyrometer Also known as brightness temperature.

645 Maxwell equal-area rule Law Thermal Engineering

Attemperatures for which the theoretical isothermal of a substance, on a graph of pressure against volume, has a portion with positive slope (as occurs in a substance with liquid and gas phases obeying the van der Waals equation), a horizontal line drawn at t h e equilibrium vapor pressure and connecting two parts of t h e isothermal with negative slope has the property that the area between the horizontal and the part of t h e isothermal above it is equal to the area between the horizontal and the part of the isothermal below it.

513 emittance Law Thermal Engineering

The power radiated per unit area of a radiating surface. Also known as emissive power; radiating power.

103 Celsius degree Law Thermal Engineering

Unit of temperature interval or difference equal to the kelvin.

812 Kelvin absolute temperature scale Law Thermal Engineering

A temperature scale in which the ratio of the temperatures of two reservoirs is equal to the ratio of the amount of heat absorbed from one of them by a heat engine operating in aCarnotcycle to the amount of heat rejected by this engine to the other reservoir; the temperature of the triple point of water is defined as 273.16 K. Also known as Kelvin temperature

9677 Carnot number Law Thermal Engineering

A property of two heat sinks, equal to the Carnot efficiency of an engine operating between them.

7565 pz See pieze. 434 Q Q Law Thermal Engineering

A unit of heat energy, equal to 1018 British thermal units, or approximately 1.055 X 1021 joules.

7567 centigrade heat unit Law Thermal Engineering

A unit of heat energy, equal to 0.01 of the quantity of heat needed to raise 1 pound of air-free water from 0 to 100°C at a constant pressure of 1 standard atmosphere; equalto 1900.44 joules. Symbolized CHU; (more correctly) CHUmean.

7570 mayer Law Thermal Engineering

A unit of heat capacity equal to the heat capacity of a substance whose temperature is raised 1° Celsius by 1 joule.

7578 clausius Law Thermal Engineering

A unit of entropy equal to the increase in entropy associated with the absorption of 1000 international table calories of heat at a temperature of 1 K, or to 4186.8 joules per kelvin.

7127 calorie Law Thermal Engineering

Abbreviated cal; often designated c. 1. A unit of heat energy, equal to 4.1868 joules. Also known as International Table calorie (IT calorie). 2. A unit of energy, equal to the heat required to raise the temperature of 1 gram of water from 14.5° to 15.5℃ at a constant pressure of 1 standard atmosphere; equal to 4.1855 ± 0.0005 joules. Also known as fifteen-degrees calorie; gram-calorie (g-cal); small calorie. 3. A unit of heat energy equal to 4.184 joules; used in thermochemistry Also known as thermochemical calorie.

8047 Rossby diagram Law Thermal Engineering

A thermodynamic 468 rotary furnace diagram, named after its designer, with mixing ratio as abscissa and potential temperature as ordinate; lines of constant equivalent potential temperature are added.

6960 Rayleigh number 2 Law Thermal Engineering

Adimensionless number used in studying free convection, equal to the product of the Grashof number and the Prandtl number. Symbolized R'2.

8123 Curle scale of temperature Law Thermal Engineering

A temperature scale based on the susceptibility of a paramagnetic substance, assuming that it obeys Curie's law; used at temperatures below about 1 kelvin.

8572 Poynting's law Law Thermal Engineering

A special case of the Clapeyron equation, in which the fluid is removed as fast as it forms, so that its volume may be ignored.

8849 Rankine temperature scale Law Thermal Engineering

A scale of absolute temperature; the temperature in degrees Rankine (°R) is equal to 9/5 of the temperature in kelvins and to the temperature in degrees Fahrenheit plus 459.67.

885 Dalton's temperature scale Law Thermal Engineering

A scale for measuring temperature such that the absolute temperature T is given in terms of the temperature on the Dalton scale T by T = 273.15(373.15/273.15)T/100.

9037 Onsager reciprocal relations Law Thermal Engineering

A set of conditions which state that the matrix, whose elements express various fluxes of a system (such as diffusion and heat conduction) as linear functions of the various conjugate affinities (such as mass and temperature gradients) for systems close to equilibrium, is symmetric when certain definitions are chosen for these fluxes on stream

6294 Ritchie's experiment Law Thermal Engineering

An experiment that uses a Leslie cube and a differential air thermometer to demonstrate that the emissivity of a surface is proportional to its absorptivity.

7580 Q unit Law Thermal Engineering

A unit of energy, used in measuring the heat energy of fuel reserves, equal to 1018 British thermal units, or approximately 1.055 X 1021 joules.

6337 Kelvin equation Law Thermal Engineering

An equation giving the increase in vapor pressure of a substance which accompanies an increase in curvature of its surface; the equation describes the greater rate of evaporation of a small liquid droplet as compared to that of a larger one, and the greater solubility of small solid particles as compared to that of larger particles.

6329 Ostwald's adsorption isotherm Law Thermal Engineering

An equation stating that at a constant temperature the weight of material adsorbed on an adsorbent dispersed through a gas or solution, per unit weight of adsorbent, is proportional to the concentration of the adsorbent raised to some constant power.

6330 Duhem-Margules equation Law Thermal Engineering

An equation showing the relationship between the two constituents of a liquid-vapor system and d ln pA d ln pB their partial vapor pressures: = d ln xA d ln xB where xA and xB are the mole fractions of the two constituents, and pA and pB are the partial vapor pressures.

633 Mie-Gruneisen equation Law Thermal Engineering

An equation of state particularly useful at high pressure, which states that the volume of a system times the difference between the pressure and the pressure at absolute zero equals the product of a number which depends only on the volume times the difference between the internal energy and the internal energy at absolute zero.

6332 Keyes equation Law Thermal Engineering

An equation of state of a gas which is designed to correct the van der Waals equation for the effect of surrounding molecules on the term representing the volume of a molecule.

6333 Clausius equation Law Thermal Engineering

An equation of state in reference to gases which applies a correction to the van der Waals equation: 104 clearance volume (V - nb) = nRT, where P is the pressure, T the temperature, V the volume of the gas, n the number of moles in the gas, R the gas constant, a depends only on temperature, b is a constant, and c is a function of a and b.

7129 British thermal unit Law Thermal Engineering

Abbreviated Btu.

6336 Clausius-Clapeyron equation Law Thermal Engineering

An equation governing phase transitions of a substance, dp/dT = AH/(TAV), in which p is the pressure, T is the temperature at which the phase transition occurs, AH is the change in heat content (enthalpy), and AV is the change in volume during the transition. Also known as Clapeyron- Clausius equation; Clapeyron equation.

10117 Leidenfrost's phenomenon Law Thermal Engineering

A phenomenon in which a liquid dropped on a surface that is above a critical temperature becomes insulated from the surface by a layer of vapor, and does not wet the surface as a result.

6340 Biot-Fourier equation Law Thermal Engineering

An equation for heat conduction which states that the rate of change of temperature at any point divided 62 blackbody radiation by the thermal diffusivity equals the Laplacian of the temperature.

6393 Ramsay-Young rule Law Thermal Engineering

An empirical relationship which states that the ratio of the absolute temperatures at which two chemically similar liquids have the same vapor pressure is independent of this vapor pressure.

6399 Dieterici equation of state Law Thermal Engineering

An empirical equation of state for gases, pea/ RT (v - b) = RT, where p is the pressure, T is the absolute temperature, v is the molar volume, R is the gas constant, and a and b are constants characteristic of the substance under consideration.

6504 Ramsay-Shields-Eotvos equation Law Thermal Engineering

An elaboration of the Eotvos rule which states that at temperatures not too near the critical temperature, the molar surface energy of a liquid is proportional to tc-t-6 K, where t is the temperature and tc is the critical temperature.

664 Kirchhoff vapor pressure formula Law Thermal Engineering

An approximate formula for the variation of vapor pressure p with temperature T, valid over a limited temperature range; it is In p = A - B/T - C In T, where A, B, and C are constants.

6959 Rayleigh number 3 Law Thermal Engineering

Adimensionless number used in the study of combined free and forced convection in vertical tubes, equal to Rayleigh number 2 times the Nusselt number times the tube diameter divided by its entry length.

6334 Kellogg equation Law Thermal Engineering

An equation of state for a gas, of the form p = RTp + N

12312 Bulygen number Law Thermal Engineering

A dimensionless 79 bump contact number used in the study of heat transfer during evaporation.

905 Andrews's curves Law Thermal Engineering

A series of isotherms for carbon dioxide, showing the dependence of pressure on volume at various temperatures.

12296 Clausius number Law Thermal Engineering

A dimensionless number used in the study of heat conduction in forced fluid flow, equal to V3Lp/kAT, where V is the fluid velocity, p is its density, L is a characteristic dimension, k is the thermal conductivity, and AT is the temperature difference.

12297 Stanton number Law Thermal Engineering

A dimensionless number used in the study of forced convection, equal to the heat-transfer coefficient of a fluid divided by the product of the specific heat at constant pressure, the fluid density, and the fluid velocity. Symbolized NSt. Also known as Margoulis number (M).

12298 Nusselt number Law Thermal Engineering

A dimensionless number used in the study of forced convection which gives a measure of the ratio of the total heat transfer to conductive heat transfer, and is equal to the heat-transfer coefficient times a characteristic length divided by the thermal conductivity. Symbolized NNu.

1230 Dufour number Law Thermal Engineering

A dimensionless number used in studying thermodiffusion, equal to the increase in enthalpy of a unit mass during isothermal mass transfer divided by the enthalpy of a unit mass of mixture. Symbol Du2.

11905 Kirchhoff formula Law Thermal Engineering

A formula for the dependence of vapor pressure p on temperature T, valid over limited temperature ranges; it may be written log p = A - (B/T) - C log T, where A, B, and C are constants.

1231 J factor Law Thermal Engineering

A dimensionless equation used for the calculation of free convection heat transmission through fluid films.

11900 Mayer's formula Law Thermal Engineering

A formula which states that the difference between the specific heat of a gas at constant pressure and its specific heat at constant volume is equal to the gas constant divided by the molecular weight of the gas. mb See millibar.

12685 Lee's disk Law Thermal Engineering

A device for determining the thermal conductivity of poor conductors in which a thin, cylindrical slice of the substance under study is sandwiched between two copper disks, a heating coil is placed between one of these disks and a third copper disk, and the temperatures of the three copper disks are measured.

13887 Carnot's theorem Law Thermal Engineering

1. The theorem that all Carnot engines operating between two given temperatures havethe same efficiency, and no cyclic heat engine operating between two given temperatures is more efficient than a Carnot engine. 2. The theorem that any system has two properties, the thermodynamic temperature T and the entropy S, such that the amount of heat exchanged in an infinitesimal reversible process is given bydQ = TdS; the thermodynamic temperature is a strictly increasing function of the empirical temperature measured on an arbitrary scale.

14096 Gibbs-Helmholtz equation Law Thermal Engineering

1. Either of two thermodynamic relations that are useful in calculating the internal energy U or enthalpy H of a system; they may be written U = F - T(3F/3T)V and H = G - T(3G/3T)P where F is the free energy, G is the Gibbs free energy, T is the absolute temperature, V is the volume, and P is the pressure. 2. Any of the similar equations for changes in thermodynamic potentials during an isothermal process.

14158 Kelvin temperature scale Law Thermal Engineering

1. An International Temperature Scale which agrees with the Kelvin absolute temperature scale within the limits of experimental determination. 2. See Kelvin absolute temperature scale.

14180 Joule experiment Law Thermal Engineering

1. An experiment to detect intermolecular forces in a gas, in which one measures the heat absorbed when gas in a small vessel is allowed to expand into a second vessel which has been evacuated. 2. An experiment to measure the mechanical equivalent of heat, in which falling weights cause paddles to rotate in a closed container of water whose temperature rise is measured by a thermometer.

1418 Callendar's equation Law Thermal Engineering

1. An equation of state for steam whose temperature is well above the boiling point at the existing pressure, but is less than the critical temperature: (V - b) = (RT/p) - (a/T), where V is the volume, R is the gas constant, T is the temperature, p is the pressure, n equals 10/3, and a and b are constants.

12304 Gukhman number Law Thermal Engineering

A dimensionless number used in studying convective heat transfer in evaporation, equal to (t0 - tm)/T0, where t0 is the temperature of a hot gas stream, tm is the temperature of a moist surface over which it is flowing, and T0 is the absolute temperature of the gas stream. Symbolized Gu; NGu.

10814 Wobbe index Law Thermal Engineering

A measure of the amount of heat released by a gas burner with a constant orifice, equal to the gross calorific value of the gas in British thermal units per cubic foot at standard temperature and pressure divided by the square root of the specific gravity of the gas.

10426 Morgan equation Law Thermal Engineering

A modification of the Ramsey-Shields equation, in which the expression forthe molar surface energy is set equal to a quadratic function of the temperature rather than to a linear one.

1057 Ramsay-Young method Law Thermal Engineering

A method of measuring the vapor pressure of a liquid, in which a thermometer bulb is surrounded by cotton wool soaked in the liquid, and the pressure, measured by a manometer, is reduced until the thermometer reading is steady.

10572 Griffiths' method Law Thermal Engineering

A method of measuring the mechanical equivalent of heat in which the temperature rise of a known mass of water is compared with the electrical energy needed to produce this rise.

10573 Berthelot method Law Thermal Engineering

A method of measuring the latent heat of vaporization of a liquid that involves determining the temperature rise of a water bath that encloses a tube in which a given amount of vapor is condensed.

10604 Egerton's effusion method Law Thermal Engineering

A method of determining vapor pressures of solids at high temperatures, in which one measures the mass lost by effusion from a sample placed in a tightly sealed silica pot with a small hole; the pot rests at the bottom of a tube that is evacuated for several hours, and is maintained at a high temperature by a heated block of metal surrounding it.

12293 Fourier number Law Thermal Engineering

A dimensionless number used in the study of unsteady-state heat transfer, equal to the product of the thermal conductivity and a characteristic time, divided by the product of the density, the specific heat at constant pressure, and the distance from the midpoint of the body through which heat is passing to the surface. Symbolized NFoh.

10606 Schleiermacher's method Law Thermal Engineering

A method of determining the thermal conductivity of a gas, in which the gas is placed in a cylinder with an electrically heated wire along its axis, and the electric energy supplied to the wire and the temperatures of wire and cylinder are measured.

6325 Huttig equation Law Thermal Engineering

An equation which states that the ratio of the volume of gas adsorbed on the surface of a nonporous solid at a given pressure and temperature to the volume of gas required to cover the surface completely with a unimolecular layer equals (1 + r) cr / (1 + cr), where r is the ratio of the equilibrium gas pressure to the saturated vapor pressure of the adsorbate at the temperature of adsorption, and c is the product of a constant and the exponential of (q - ql)/RT, where q is the heat of adsorption into a first layer molecule, ql is the heat of liquefaction of the adsorbate, T is the temperature, and R is the gas constant.

11260 Watt's law Law Thermal Engineering

A law which states that the sum of the latent heat of steam at any temperature of generation and the heat required to raise water from 0℃ to that temperature is constant; it has been shown to be substantially in error.

11377 Carnot cycle Law Thermal Engineering

A hypothetical cycle consisting of four reversible processes in succession: an isothermal expansion and heat addition, an isentropic expansion, an isothermal compression and heat rejection process, and an isentropic compression.

11699 Ten Broecke chart Law Thermal Engineering

A graphical plot of heat transfer and temperature differences used to calculate the thermal efficiency of a countercurrent cool-fluid-warm-fluid heatexchange system.

11720 emagram Law Thermal Engineering

A graph of the logarithm of the pressure of a substance versus its temperature, when it is held at constant volume; in meteorological investigations, the potential temperature is often the parameter emanometer

11765 second law of thermodynamics Law Thermal Engineering

A general statement of the idea that there is a preferred direction for any process; there are many equivalent statements of the law, the best known being those of Clausius and of Kelvin.

11898 Clausius' statement Law Thermal Engineering

A formulation of the second law of thermodynamics, stating it is not possible that, at the end of a cycle of changes, heat has been transferred from a colder to a hotter body without producing some other effect.

10605 Matthiessen sinker method Law Thermal Engineering

A method of determining the thermal expansion coefficient of a liquid, in which the apparent weight of a sinker when immersed in the liquid is measured for two different temperatures of the liquid.

1817 Fourier law of heat conduction Law Thermal Engineering

The law that the rate of heat flow through a substance is proportional to the area normal to the direction of flow and to the negative of the rate of change of temperature with distance along the direction of flow. Also known as Fourier heat

6328 Beattie and Bridgman equation Law Thermal Engineering

An equation that relates the pressure, volume, and temperature of a real gas to the gas constant. beat tone

1387 Clausius inequality Law Thermal Engineering

The principle that for any system executing a cyclical process, the integral over the cycle of the infinitesimal amount of heat transferred to the system divided by its temperature is equal to or less than zero.

1389 Curie principle Law Thermal Engineering

The principle that a macroscopic cause never has more elements of symmetry than the effect it produces; for example, a scalar cause cannot produce a vectorial effect.

1559 Joule equivalent Law Thermal Engineering

The numerical relation between quantities of mechanical energy and heat; the present accepted value is 1 fifteendegrees calorie equals 4.1855 ± 0.0005 joules. Also known as mechanical equivalent of heat.

1589 Massieu function Law Thermal Engineering

The negative of the Helmholtz free energy divided by the temperature.

1159 spectral emissivity Law Thermal Engineering

The ratio of the radiation emitted by a surface at a specified wavelength to the radiation emitted by a perfect blackbody radiator at the same wavelength and temperature.

1732 Leidenfrost point Law Thermal Engineering

The lowest temperature at which a hot body submerged in a pool of boiling water is completely blanketed by a vapor film; there is a minimum in the heat flux from the body to the water at this temperature.

1158 emissivity Law Thermal Engineering

The ratio of the radiation emitted by a surface to the radiation emitted by a perfect blackbody radiator at the same temperature.

1818 Dulong-Petit law Law Thermal Engineering

The law that the product of the specific heat per gram and the atomic weight of many solid elements at room temperature has almost the same value, about 6.3 calories (264 joules) per degree Celsius.

1830 Clausius law Law Thermal Engineering

The law that an ideal gas's specific heat at constant volume does not depend on the temperature.

1856 Giaque's temperature scale Law Thermal Engineering

The internationally accepted scale of absolute temperature, in which the triple point of water is defined to have a temperature of 273.16 K.

1935 Hildebrand function | Law | Thermal Engineering

The heat of vaporization of a compound as a function of the molal concentration of the vapor; it is nearly the same for many compounds.

2098 ideal gas law | Law | Thermal Engineering

The equation of state of an ideal gas which is a good approximation to real gases at sufficiently high temperatures and low pressures; that is, PV = RT, where P is the pressure, V is the volume per mole of gas, T is the temperature, and R is the gas constant.

2143 Carnot efficiency | Law | Thermal Engineering

The efficiency of a Carnot engine receiving heat at a temperature absolute T1 and giving it up at a lower temperature absolute T2; equal to (T1 - T2)/T1.

1590 Planck function | Law | Thermal Engineering

The negative of the Gibbs free energy divided by the absolute temperature. plane

919 Kelvin's statement of the second law | Law | Thermal Engineering

The statement that it is not possible that, at the end of a cycle of changes, heat has been extracted from a reservoir and an equal amount of work has been produced without producing some other effect.

769 Gibbs free energy | Law | Thermal Engineering

The thermodynamic function G = H - TS, where H is enthalpy, T absolute temperature, and S entropy. Also known as free energy; free enthalpy; Gibbs function.

779 Nernst heat theorem | Law | Thermal Engineering

The theorem expressing that the rate of change of free energy of a homogeneous system with temperature, and also the rate of change of enthalpy with temperature, approaches zero as the temperature approaches absolute zero.

793 brittle temperature | Law | Thermal Engineering

The temperature point below which a material, especially metal, is brittle; that is, the critical normal stress for fracture is reached before the critical shear stress for plastic deformation.

795 gold point | Law | Thermal Engineering

The temperature of the freezing point of gold at a pressure of 1 standard atmosphere (101,325 pascals); used to define the International Temperature Scale of 1940, on which it is assigned a value of 1337.33 K or 1064.18°C.

797 annealing point Law Thermal Engineering

The temperature at which the viscosity of a glass is 10130 poises.

1274 five-fourths power law Law Thermal Engineering

The proposition that the rate of heat loss from a body by free convection is proportional to the fivefourths power of the difference between the temperature of the body and that of its surroundings.

918 Nernst-Simon statement of the third Law Thermal Engineering

The statement that the change in entropy which occurs when a homogeneous system undergoes an isothermal reversible process approaches zero as the temperature approaches absolute zero.

2650 mechanical equivalent of heat Law Thermal Engineering

The amount of mechanical energy equivalent to a unit of heat.

993 psychrometric formula Law Thermal Engineering

The semi empirical relation giving the vapor pressure in terms of the barometer and psychrometer readings.

1013 thermometry Law Thermal Engineering

The science and technology of measuring temperature, and the establishment of standards of temperature measurement.

1014 pyrometry Law Thermal Engineering

The science and technology of measuring high temperatures.

1019 Eotvos rule Law Thermal Engineering

The rule that the rate of change of molar surface energy with temperature is a constant for all liquids; deviations are encountered in practice.

1020 Neumann-Kopp rule Law Thermal Engineering

The rule that the heat capacity of 1 mole of a solid substance is approximately equal to the sum over the elements forming the substance of the heat capacity of a gram atom of the element times the number of atoms of the element in a molecule of the substance.

1152 Joule-Thomson coefficient Law Thermal Engineering

The ratio of the temperature change to the pressure change of a gas undergoing isenthalpic expansion. Joule-Thomson effect

800 oxygen point Law Thermal Engineering

The temperature at which liquid oxygen and its vapor are in equilibrium, that is, the boiling point of oxygen, at standard atmospheric pressure; it is taken as a fixed point on the International Practical Temperature Scale of 1968, at -182.962℃.

6255 Boltzmann engine Law Thermal Engineering

An ideal thermodynamic engine that utilizes blackbody radiation; used to derive the Stefan-Boltzmann law.

4526 Rankine-Hugoniot equations Law Thermal Engineering

Equations, derived from the laws of conservation of mass, momentum, and energy, which relate the velocity of a shock wave and the pressure, density, and enthalpy of the transmitting fluid before and after the shock wave passes.

4528 Ehrenfest's equations Law Thermal Engineering

Equations which state that for the phase curve P(T) of a second-order phase transition the derivative of pressure P with respect to temperature T is equal to (Cfp - Cip)/TV(Y - y) = (Y ~~ Y)/(Kf - Ki), where i and f refer to the two phases, -y is the coefficient of volume expansion, K is the compressibility, Cp is the specific heat at constant pressure, and V is the

4543 Dufour effect Law Thermal Engineering

Energy flux due to a mass gradient occurring as a coupled effect of irreversible processes.

4640 Colburn j factor equation Law Thermal Engineering

Dimensionless heat-transfer equation to calculate the natural convection movement of heat from vertical surfaces or horizontal cylinders to fluids (gases or liquids) flowing past these surfaces.

4642 Nusselt equation Law Thermal Engineering

Dimensionless 375 Nusselt number equation used to calculate convection heat transfer for heating or cooling of fluids outside a bank of 10 or more rows of tubes to which the fluid flow is normal.

2512 Kelvin scale Law Thermal Engineering

The basic scale used for temperature definition; the triple point of water (comprising ice, liquid, and vapor) is defined as 273.16 K; given two reservoirs, a reversible heat engine is built operating in a cycle between them, and the ratio of their temperatures is defined to be equal to the ratio of the heats transferred.

6252 Lambert surface Law Thermal Engineering

An ideal, perfectly diffusing surface for which the intensity of reflected radiation is independent of direction. Lame

4319 Mollier diagram Law Thermal Engineering

Graph of enthalpy versus entropy of a vapor on which isobars, isothermals, and lines of equal dryness are plotted.

6256 Ericsson cycle Law Thermal Engineering

An ideal thermodynamic cycle consisting of two isobaric processes interspersed with processes which are, in effect, isothermal, but each of which consists of an infinite number of alternating isentropic and isobaric processes.

6259 Sargent cycle Law Thermal Engineering

An ideal thermodynamic cycle consisting of four reversible processes: adiabatic compression, heating at constant volume, adiabatic expansion, and isobaric cooling.

6286 Caratheodory's principle Law Thermal Engineering

An expression of the second law of thermodynamics which says that in the neighborhood of any equilibrium state of a system, there are states which are not accessible by a reversible or irreversible adiabatic process. Also known as principle of inaccessibility.

6295 Joule and Playfairs' experiment Law Thermal Engineering

An experiment in which the temperature of the maximum density of water is measured by taking the mean of the temperatures of water in two columns whose densities are determined to be equal from the absence of correction currents in a connecting trough.

6324 Jeans viscosity equation Law Thermal Engineering

An equation which states that the viscosity of a gas is proportional to the temperature raised to a constant power, which is different for different gases.

696 phase Law Thermal Engineering

The type of state of a system, such as solid, liquid, or gas.

5105 Joule-Thomson inversion temperature Law Thermal Engineering

Atemperature at which the Joule-Thomson coefficient of a given gas changes sign.

2822 international practical temperature Law Thermal Engineering

Temperature scale based on six 299 international system of electrical units points: the water triple point, the boiling points of oxygen, water, sulfur, and the solidification points of silver and gold; designated as ℃, degrees Celsius, or tint; replaced in 1990 by the international temperature scale.

6326 Humphries equation Law Thermal Engineering

An equation which gives the ratio of specific heats at constant pressure and constant volume in moist air as a function of water vapor pressure.

2653 heat-transfer coefficient Law Thermal Engineering

The amount of heat which passes through a unit area of a medium or system in a unit time when the temperature difference between the boundaries of the system is 1 degree.

2654 thermal conductance Law Thermal Engineering

The amount of heat transmitted by a material divided by the difference in temperature of the surfaces of the material. Also known as conductance.

2656 latent heat Law Thermal Engineering

The amount of heat absorbed or evolved by 1 mole, or a unit mass, of a substance during a change of state (such as 320 lay-up fusion, sublimation or vaporization) at constant temperature and pressure.

2683 Joule-Thomson expansion Law Thermal Engineering

The adiabatic, irreversible expansion of a fluid flowing through a porous plug or partially opened valve. Also known as Joule-Thomson process.

2693 reduced value Law Thermal Engineering

The actual value of a quantity divided by the value of that quantity at the critical point. Also known as reduced property.

4432 Boyle's temperature Law Thermal Engineering

For a given gas, the temperature at which the virial coefficient B in the equation of state Pv = RT

282 Celsius temperature scale Law Thermal Engineering

Temperature scale in which the temperature Gc in degrees Celsius (℃) is related to the temperature Tk in kelvins by the formula Gc = Tk - 273.15; the freezing point of water at standard atmospheric pressure is very nearly 0℃ and the corresponding boiling point is very nearly 100℃. Formerly known as centigrade temperature scale.

4413 Carnot-Clausius equation Law Thermal Engineering

For any system executing a closed cycle of reversible changes, the integral over the cycle of the infinitesimal amount of heat transferred to the system divided by its temperature equals 0. Also 88 cascade known as Clausius theorem.

2830 psychrometric tables Law Thermal Engineering

Tables prepared from the psychrometric formula and used to obtain vapor pressure, relative humidity, and dew point from values of wet-bulb and dry-bulb temperature.

3214 psychromatic ratio Law Thermal Engineering

Ratio of the heat-transfer coefficient to the product of the mass-transfer coefficient and humid heat for a gas-vapor system; used in calculation of humidity or saturation relationships.

3504 mean calorie Law Thermal Engineering

One-hundredth of the heat needed to raise 1 gram of water from 0 to 100℃.

3567	Maxwell relation	Law	Thermal Engineering

One of four equations for a system in thermal equilibrium, each of which equates two partial derivatives, involving the pressure, volume, temperature, and entropy of the system.

4220	demon of Maxwell	Law	Thermal Engineering

Hypothetical creature who controls a trapdoor over a microscopic hole in an adiabatic wall between two vessels filled with gas at the same temperature, so as to supposedly decrease the entropy of the gas as a whole and thus violate the second law of thermodynamics. Also known as Maxwell's demon.

252	mean specific heat	Law	Thermal Engineering

The average over a specified range of temperature of the specific heat of a substance.

2820	Reaumur temperature scale	Law	Thermal Engineering

Temperature scale where water freezes at 0°R and boils at 80°R.

The Triz 40 Inventive Principles

1. Segmentation.
a. Divide an object into independent parts.
b. Make an object sectional.
c. Increase the degree of an object's segmentation.
2. Extraction.
a. Extract (remove or separate) a "disturbing" part or property from an object, or
b. Extract only the necessary part or property
3. Local Quality.
a. Transition from a homogeneous structure of an object or outside environment/action to a heterogeneous structure
b. Have different parts of the object carry out different functions
c. Place each part of the object under conditions most favourable for its operation
4. Asymmetry.
a. Replace a symmetrical form with an asymmetrical form.
b. If an object is already asymmetrical, increase the degree of asymmetry
5. Combining
a. Combine in space homogeneous objects or objects destined for contiguous operations
b. Combine in time homogeneous or contiguous operations
6. Universality.
Have the object perform multiple functions, thereby eliminating the need for some other object(s)
7. Nesting
a. Contain the object inside another which, in turn, is placed inside a third object
b. Pass an object through a cavity of another object
8. Counterweight.

a. Compensate for the object's weight by joining with another object that has a lifting force
b. Compensate for the weight of an object by interaction with an environment providing aerodynamic or hydrodynamic forces
9. Prior counter-action
a. Perform a counter-action in advance
b. If the object is (or will be) under tension, provide anti-tension in advance
10. Prior action.

a. Carry out all or part of the required action in advance
b. Arrange objects so they can go into action in a timely matter and from a convenient position
11. Cushion in advance.

Compensate for the relatively low reliability of an object by countermeasures taken in advance
12. Equipotentiality
Change the working conditions so that an object need not be raised or lowered.
13. Inversion.
a. Instead of an action dictated by the specifications of the problem, implement an opposite action
b. Make a moving part of the object or the outside environment immovable and the non-moving part movable

c. Turn the object upside-down
14. Spheroidality
a. Replace linear parts or flat surfaces with curved ones; replace cubical shapes with spherical shapes
b. Use rollers, balls spirals
c. Replace a linear motion with rotating movement; utilize a centrifugal force
15. Dynamicity.

a. Make an object or its environment automatically adjust for optimal performance at each stage of operation
b. Divide an object into elements which can change position relative to each other
c. If an object is immovable, make it movable or interchangeable
16. Partial or excessive action.

If it is difficult to obtain 100% of a desired effect, achieve somewhat more or less to greatly simplify the problem
17. Moving to a new dimension.

a. Remove problems with moving an object in a line by two-dimensional movement (i.e. along a plane)
b. Use a multi-layered assembly of objects instead of a single layer
c. Incline the object or turn it on its side
18. Mechanical vibration
a. Set an object into oscillation
b. If oscillation exists, increase its frequency, even as far as ultrasonic
c. Use the resonant frequency
d. Instead of mechanical vibrations, use piezovibrators
e. Use ultrasonic vibrations in conjunction with an electromagnetic field
19. Periodic action.
a. Replace a continuous action with a periodic (pulsed) one
b. If an action is already periodic, change its frequency
c. Use pulsed between impulses to provide additional action
20. Continuity of a useful action.
a. Carry out an action continuously (i.e. without pauses), where all parts of an object operate at full capacity
b. Remove idle and intermediate motions
21. Rushing through
Perform harmful or hazardous operations at very high speed
22. Convert harm into benefit
a. Utilize harmful factors or environmental effects to obtain a positive effect
b. Remove a harmful factor by combining it with another harmful factor
c. Increase the amount of harmful action until it ceases to be harmful
23. Feedback
a. Introduce feedback
b. If feedback already exists, reverse it
24. Mediator
a. Use an intermediary object to transfer or carry out an action
b. Temporarily connect an object to another one that is easy to remove
25. Self-service
a. Make the object service itself and carry out supplementary and repair operations
b. Make use of wasted material and energy
26. Copying
a. Use a simple and inexpensive copy instead of an object which is complex, expensive, fragile or inconvenient to operate.

b. Replace an object by its optical copy or image. A scale can be used to reduce or enlarge the image.
c. If visible optical copies are used, replace them with infrared or ultraviolet copies
27. Inexpensive, short-lived object for expensive, durable one
Replace an expensive object by a collection of inexpensive ones, forgoing properties (e.g. longevity)
Examples:
  Disposable diapers
28. Replacement of a mechanical system
a. Replace a mechanical system by an optical, acoustical or olfactory (odour) system
b. Use an electrical, magnetic or electromagnetic field for interaction with the object
c. Replace fields
1. Stationary fields with moving fields
2. Fixed fields with those which change in time
3. Random fields with structured fields
d. Use a field in conjunction with ferromagnetic particles
29. Pneumatic or hydraulic construction
Replace solid parts of an object by gas or liquid. These parts can use air or water for inflation, or use air or hydrostatic cushions
  For shipping fragile products, air bubble envelopes or foam-like materials are used.
30. Flexible membranes or thin film
a. Replace traditional constructions with those made from flexible membranes or thin film
b. Isolate an object from its environment using flexible membranes or thin film
31. Use of porous material
a. Make an object porous or add porous elements (inserts, covers, etc.)
b. If an object is already porous, fill the pores in advance with some substance
32. Changing the colour
a. Change the colour of an object or its surroundings
b. Change the degree of translucency of an object or processes which are difficult to see
c. Use coloured additives to observe objects or processes which are difficult to see
d. If such additives are already used, employ luminescent traces or tracer elements
33. Homogeneity
Make those objects which interact with a primary object out of the same material or material that is close to it in behavior.
34. Rejecting and regenerating parts
a. After it has completed its function or become useless, reject or modify (e.g. discard, dissolve, evaporate) an element of an object
b. Immediately restore any part of an object which is exhausted or depleted
35. Transformation of the physical and chemical states of an object
Change an object's aggregate state, density distribution, degree of flexibility, temperature
36. Phase transformation
Implement an effect developed during the phase transition of a substance. For instance, during the change of volume, liberation or absorption of heat.
37. Thermal expansion
a. Use a material which expands or contracts with heat
b. Use various materials with different coefficients of heat expansion
38. Use strong oxidisers
a. Replace normal air with enriched air

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b. Replace enriched air with oxygen
c. Treat an object in air or in oxygen with ionising radiation
d. Use ionised oxygen
39. Inert environment
a. Replace the normal environment with an inert one
b. Carry out the process in a vacuum
40. Composite materials
Replace a homogeneous material with a composite one
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Innovators

4th century of the Christian Era

Pappus of Alexandria introduced term Heuristics

1470s

Leonardo da Vinci

1920s

Fritz Zwicky - Morphological Analysis

Pablo Picasso painter

Marcel Duchamp artist

1940s

Lawrence Delos Miles

George Polya

1950s

Alex Osborn

Sid Parnes

1950s

Genrich Altshuller - TRIZ, ARIZ Genrikh Altshuller

1960s

Carl Jung classified creativity as one of the five main instinctive forces in humans

(Jung 1964)

Edward Matchett - Fundamental design method (1968)

Rogers described it in his essay Towards a Theory of Creativity (1961):

Wiliam Gordon - Synectics

Edward de Bono - Lateral thinking

1970s

Albert Rothenberg coined the term 'Janusian thinking'

Yoji Akoa - Quality function deployment

Total creativity is the ultimate goal in the philosophy of John David Garcia

1980s

Peter Drucker

1990s

Clayton Christensen

2000s

Jim Collins

History of Innovation

Palaeolithic Era

2.4 MYA: Stone tools in Africa

2 MYA: Language (controversial - this is the earliest likely)

1 MYA: Controlled fire in Africa

400 KYA: Pigments in Zambia

60 KYA: Ships probably used by settlers of New Guinea

50 KYA: Bow and arrow in Tunisia

43 KYA: Mining

30 KYA: Sewing

26 KYA: Ceramics in Moravia

12 KYA: Pottery by Jomon in Japan

9th millennium BC

8700 BC: Metalworking (copper pendant in Iraq)

8500 BC: Agriculture in the Fertile Crescent

8th millennium BC

Animal husbandry in the Middle East

7th millennium BC

6200 BC: Map in Çatalhöyük

Cloth woven from flax fiber

Wine in Jiahu, China

6th millennium BC

Irrigation in the Fertile Crescent

Ploughs in Mesopotamia

4th millennium BC

3800s BC: Engineered roadway in England

3500 BC: Plywood in Egypt

3500 BC: Writing in Sumer

3500 BC: Carts in Sumer

Bronze by the Maikops

Silk in China

Cement in Egypt

River boats in Egypt

3rd millennium BC

2800 BC: Soap in Babylonia

sledges - Scandinavia

the use of yeast for:

leavened bread

Fermentation to produce beer in Sumeria

2nd millennium BC

Alphabet in Egypt

Glass in Egypt

Rubber in Mesoamerica

Spoked wheel chariot in the Middle East

Water clock in Egypt

Bells in China

1st millennium BC

Arch in Greece

Odometer : Rome: Archimedes?

600s BC: Coinage in Lydia

400s BC: Catapult in Syracuse

300s BC: Compass in China.

300s BC: Screw: Archytas

200s BC: Crossbow in China

200s BC: Compound pulley: Archimedes

150s BC: Astrolabe: Hipparchus

100s BC: Parchment in Pergamon

1st century BC: Glassblowing in Syria

87 BC: Clockwork (the Antikythera mechanism): Posidonius?

1st millennium

1st century: Aeolipile: Hero of Alexandria

1st century: Stern mounted rudder in China

105: Paper: Cai Lun

132: Rudimentary Seismometer: Zhang Heng

200s: Wheelbarrow: Zhuge Liang

200s: Horseshoes in Germany

300s: Stirrup in China

600: Mouldboard plough in Eastern Europe

600s: Windmill in Persia

673: Greek fire: Kallinikos

800s: Gunpowder in China

852: Parachute: Armen Firman

900: Horse collar in Europe

Woodblock printing in China

Porcelain in China

Spinning wheel in China or India

2nd millennium

11th century

1040s: Moveable type printing: Bi Sheng

12th century

1128: Cannon in China

13th century

1280s: Eyeglasses in Northern Italy

14th century

1335: Mechanical clock in Milan

15th century

Arquebus and Rifle in Europe

1450s: Alphabetic, movable type printing press: Johann Gutenberg

1451: Concave lens for eyeglasses: Nicholas of Cusa

16th century

1510: Pocket watch: Peter Henlein

1581: Pendulum: Galileo Galilei

1589: Stocking frame: William Lee

1593: Thermometer: Galileo Galilei

Musket in Europe

17th century

1608: Telescope: Hans Lippershey

1609: Microscope: Galileo Galilei

1620: Slide rule: William Oughtred

1623: Automatic calculator: Wilhelm Schickard

1642: Adding machine: Blaise Pascal

1643: Barometer: Evangelista Torricelli

1645: Vacuum pump: Otto von Guericke

1657: Pendulum clock: Christiaan Huygens

1698: Steam engine: Thomas Savery

18th century

1701: Seed drill: Jethro Tull

1705: Steam piston engine: Thomas Newcomen

1709: Piano: Bartolomeo Cristofori

1710: Thermometer: René Antoine Ferchault de Réaumur

1711: Tuning fork: John Shore

1714: Mercury thermometer: Daniel Gabriel Fahrenheit

1730: Mariner's quadrant: Thomas Godfrey

1731: Sextant: John Hadley

1733: Flying shuttle: John Kay (Flying Shuttle)

1742: Franklin stove: Benjamin Franklin

1750: Flatboat: Jacob Yoder

1752: Lightning rod: Benjamin Franklin

1762: Iron smelting process: Jared Eliot

1767: Spinning jenny: James Hargreaves

1767: Carbonated water: Joseph Priestley

1769: Steam engine: James Watt

1769: Water Frame: Richard Arkwright

1775: Submarine Turtle: David Bushnell

1777: Card teeth making machine: Oliver Evans

1777: Circular saw: Samuel Miller

1779: Spinning mule: Samuel Crompton

1785: Power loom: Edmund Cartwright

1785: Automatic flour mill: Oliver Evans

1783: Multitubular boiler engine: John Stevens

1783: Hot air balloon: Montgolfier brothers

1784: Bifocals: Benjamin Franklin

1784: Shrapnel shell: Henry Shrapnel

1785: Parachute: Jean Pierre Blanchard

1787: Non-condensing high pressure Engine: Oliver Evans

1790: Cut and head nail machine: Jacob Perkins

1791: Steamboat: John Fitch

1791: Artificial Teeth: Nicholas Dubois De Chemant

1793: Cotton gin: Eli Whitney

1793: Optical telegraph: Claude Chappe

1797: Cast iron plow: Charles Newbold

1798: Vaccination: Edward Jenner

1798: Lithography: Alois Senefelder

1799: Seeding machine: Eliakim Spooner

19th century

1800s

1800: Electric battery: Alessandro Volta

1801: Jacquard loom: Joseph Marie Jacquard

1802: Screw propeller steamboat *Phoenix*: John Stevens

1802: gas stove: Zachäus Andreas Winzler

1805: Submarine Nautilus: Robert Fulton

1805: Refrigerator: Oliver Evans

1807: Steamboat Clermont: Robert Fulton

1808: Band saw: William Newberry

1810s

1811: Gun- Breechloader: Thornton (?)

1812: Metronome: Dietrich Nikolaus Winkel

1814: Steam Locomotive *(Blucher)*: George Stephenson

1816: Miner's safety lamp: Humphry Davy

1816: Hand printing press: George Clymer

1816: Metronome: Johann Nepomuk Maelzel (reputed)

1816: Stirling engine: Robert Stirling

1817: Kaleidoscope: David Brewster

1819: Breech loading flintlock: John Hall

1819: Stethoscope: Rene Theophile Hyacinthe Laennec

1820s

1821: Electric motor: Michael Faraday

1823: Electromagnet: William Sturgeon

1826: Photography: Joseph Nicéphore Niépce

1826: internal combustion engine: Samuel Morey

1827: Insulated wire: Joseph Henry

1827: Screw propeller: Josef Ressel

1827: Friction match: John Walker

1830s

1830: Lawn mower: Edwin Beard Budding

1831: Multiple coil magnet: Joseph Henry

1831: Magnetic acoustic telegraph: Joseph Henry

1831: Reaper: Cyrus McCormick

1831: Electrical generator: Michael Faraday

1835: Photogenic Drawing: William Henry Fox Talbot

1835: Revolver: Samuel Colt

1835: Morse code: Samuel Morse

1835: Electromechanical Relay: Joseph Henry

1836: Improved screw propeller: John Ericsson

1836: Sewing machine: Josef Madersberger

1837: Photography: Louis-Jacques-Mandé Daguerre

1837: Steel plow: John Deere

1837: Standard diving dress: Augustus Siebe

1838: Electric telegraph: Charles Wheatstone

1839: Vulcanization of rubber: Charles Goodyear

1840s

1840: Frigate with submarine machinery SS Princeton: John Ericsson

1840: artificial fertilizer: Justus von Liebig

1842: Anaesthesia: Crawford Long

1843: Typewriter: Charles Thurber

1843: Fax machine: Alexander Bain

1844: Telegraph: Samuel Morse

1845: Portland cement: William Aspdin

1845: Double tube tire: Robert Thomson (inventor)

1846: Sewing machine: Elias Howe

1846: Rotary printing press: Richard M. Hoe

1849: Safety pin: Walter Hunt

1849: Francis turbine: James B. Francis

1850s

1852: Airship: Henri Giffard

1852: Passenger elevator: Elisha Otis

1852: Gyroscope: Léon Foucault

1853: Glider: Sir George Cayley

1855: Bunsen burner: Robert Bunsen

1855: Bessemer process: Henry Bessemer

1856: First celluloids: Alexander Parkes

1858: Undersea telegraph cable: Fredrick Newton Gisborne

1858: Shoe sole sewing machine: Lyman R. Blake

1858: Mason jar: John L. Mason

1859: Oil drill: Edwin L. Drake

1860: Linoleum: Fredrick Walton

1860s

1860: Repeating rifle: Oliver F. Winchester, Christopher Spencer

1860: Self-propelled torpedo: Ivan Lupis-Vukić

1861: Ironclad USS Monitor: John Ericsson

1861: Furnace for steel: Wilhelm von Siemens

1862: Revolving machine gun: Richard J. Gatling

1862: Mechanical submarine: Narcís Monturiol i Estarriol

1863: Player piano: Henri Fourneaux

1864: first true typewriter: Peter Mitterhofer

1865: Compression ice machine: Thaddeus Lowe

1866: Dynamite: Alfred Nobel

1867: Practical Typewriter: Christopher L. Sholes

1868: Typewriter: Carlos Glidden, James Densmore and Samuel Soule

1868: Air brake (rail): George Westinghouse

1868: Oleomargarine: Mege Mouries

1869: Vacuum cleaner: I.W. McGaffers

1870s

1870: Magic Lantern projector: Henry R. Heyl

1870: Stock ticker: Thomas Alva Edison

1870: Mobile Gasoline Engine, Automobile: Siegfried Marcus

1871: Cable car (railway): Andrew S. Hallidie

1871: Compressed air rock drill: Simon Ingersoll

1872: Celluloid (later development): John W. Hyatt

1872: Adding machine: Edmund D. Barbour

1873: Barbed wire: Joseph F. Glidden

1873: Railway knuckle coupler: Eli H. Janney

1873: Modern direct current electric motor: Zénobe Gramme

1874: Electric street car: Stephen Dudle Field

1875: Dynamo: William A. Anthony

1875: Gun- (magazine): Benjamin B. Hotchkiss

1876: Telephone: Alexander Graham Bell

1876: Telephone: Elisha Gray

1876: Carpet sweeper: Melville Bissell

1876: Gasoline carburettor: Daimler

1877: Stapler: Henry R. Heyl

1877: Induction motor: Nikola Tesla

1877: Phonograph: Thomas Alva Edison

1877: Electric welding: Elihu Thomson

1877: Twine Knotter: John Appleby

1878: Cathode ray tube: William Crookes

1878: Transparent film: Eastman Goodwin

1878: Rebreather: Henry Fleuss

1878: Incandescent Light bulb: Joseph Swan

1879: Pelton turbine: Lester Pelton

1879: Automobile engine: Karl Benz

1879: Cash register: James Ritty

1879: Automobile (Patent): George B. Seldon ... note did NOT invent auto

1880s

1880: Photophone: Alexander Graham Bell

1880: Roll film: George Eastman

1880: Safety razor: Kampfe Brothers

1880: Seismograph: John Milne

1881: Electric welding machine: Elihu Thomson

1882: Electric fan: Schuyler Skatts Wheeler

1882: Electric flat iron: Henry W. Seely

1883: Auto engine - compression ignition: Gottlieb Daimler

1883: two-phase (alternating current) induction motor: Nikola Tesla

1884: Linotype machine: Ottmar Mergenthaler

1884: Fountain pen: Lewis Waterman NB: Did not invent fountain pen, nor even "first practical fountain pen". Started manufacture in 1883, too.

1884: Punched card accounting: Herman Hollerith

1884: Trolley car, (electric): Frank Sprague, Karel Van de Poele

1885: Automobile, differential gear: Karl Benz

1885: Maxim gun: Hiram Stevens Maxim

1885: Motor cycle: Gottlieb Daimler and Wilhelm Maybach

1885: Alternating current transformer: William Stanley

1886: Dishwasher: Josephine Cochrane

1886: Gasoline engine: Gottlieb Daimler

1886: Improved phonograph cylinder: Tainter & Bell

1887: Monotype machine: Tolbert Lanston

1887: Gramophone record: Emile Berliner

1887: Automobile, (gasoline): Gottlieb Daimler

1888: Polyphase AC Electric power system: Nikola Tesla (30 related patents.)

1888: Kodak hand camera: George Eastman

1888: Ballpoint pen: John Loud

1888: Pneumatic tube tire: John Boyd Dunlop

1888: Harvester-thresher: Matteson (?)

1888: Kinematograph: Augustin Le Prince

1889: Automobile, (steam): Sylvester Roper

1890s

1890: Pneumatic Hammer: Charles B. King

1891: Automobile Storage Battery: William Morrison

1891: Zipper: Whitcomb Judson

1891: Carborundum: Edward G. Acheson

1892: Color photography: Frederic E. Ives

1892: Automatic telephone exchange (electromechanical): Almon Strowger - First in commercial service.

1893: Photographic gun: E.J. Marcy

1893: Half tone engraving: Frederick Ives

1893: Wireless communication: Nikola Tesla

1895: Phatoptiken projector: Woodville Latham

1895: Phantascope: C. Francis Jenkins

1895: Disposable blades: King C. Gillette

1895: Diesel engine: Rudolf Diesel

1895: Radio signals: Guglielmo Marconi

1896: Vitascope: Thomas Armat

1896: Steam turbine: Charles Curtis

1896: Electric stove: William S. Hadaway

1897: Automobile, magneto: Robert Bosch

1898: Remote control: Nikola Tesla

1899: Automobile self starter: Clyde J. Coleman

1899: Magnetic tape recorder: Valdemar Poulsen

1899: Gas turbine: Charles Curtis

20th century

1900s

1900: Rigid dirigible airship: Ferdinand Graf von Zeppelin

1901: Improved wireless transmitter: Reginald Fessenden

1901: Mercury vapor lamp: Peter C. Hewitt

1901: paperclip: Johan Vaaler

1902: Radio magnetic detector: Guglielmo Marconi

1902: Radio telephone: Poulsen Reginald Fessenden

1902: Rayon cellulose ester: Arthur D. Little

1903: Electrocardiograph (EKG): Willem Einthoven

1903: Powered Airplane: Wilbur Wright and Orville Wright

1903: Bottle machine: Michael Owens

1904: Thermionic valve: John Ambrose Fleming

1904: Separable Attachment Plug: Harvey Hubbell

1905: Radio tube diode: John Ambrose Fleming

1906: Triode amplifier: Lee DeForest

1907: Radio amplifier: Lee DeForest

1907: Radio tube triode: Lee DeForest

1907: Vacuum cleaner, (electric): James Spangler

1907: Washing machine, (electric): Alva Fisher (Hurley Corporation)

1909: Monoplane: Henry W. Walden

1909: Bakelite: Leo Baekeland

1909: Gun silencer: Hiram Percy Maxim

1910s

1910: Thermojet engine: Henri Coandă

1911: Gyrocompass: Elmer A. Sperry

1911: Automobile self starter (perfected): Charles F. Kettering

1911: Air conditioner: Willis Haviland Carrier

1911: Cellophane: Jacques Brandenburger

1911: Hydroplane: Glenn Curtiss

1912: Regenerative radio circuit: Edwin H. Armstrong

1912: revolutionary water turbine (Kaplan turbine), Viktor Kaplan

1913: Crossword puzzle: Arthur Wynne

1913: Improved X-Ray: William D. Coolidge

1913: Double acting wrench: Robert Owen

1913: Cracking process for Gasoline: William M. Burten

1913: Gyroscope stabilizer: Elmer A. Sperry

1913: Geiger counter: Hans Geiger

1913: Radio receiver, cascade tuning: Ernst Alexanderson

1913: Radio receiver, heterodyne: Reginald Fessenden

1914: Radio transmitter triode mod.: Ernst Alexanderson

1914: Liquid fuel rocket: Robert Goddard

1914: Tank, military: Ernest Dunlop Swinton

1915: Tungsten Filament: Irving Langmuir

1915: Searchlight arc: Elmer A. Sperry

1915: Radio tube oscillator: Lee DeForest

1916: Browning Gun: John Browning

1916: Thompson submachine gun: John T. Thompson

1916: Incandescent gas lamp: Irving Langmuir

1917: Sonar echolocation: Paul Langevin

1918: Super heterodyne: Edwin H. Armstrong

1918: Interrupter gear: Anton Fokker

1918: Radio crystal oscillator: A.M. Nicolson

1918: Pop-up toaster: Charles Strite

1919: the Theremin: Leon Theremin

1919: First licensed radio station, KDKA AM, in Pennsylvania, USA

1920s

mechanical potato peeler: Herman Lay

1922: Radar: Robert Watson-Watt, A. H. Taylor, L. C. Young, Gregory Breit, Merle Antony Tuve

1922: Technicolor: Herbert T. Kalmus

1922: Water skiing: Ralph Samuelson

1923: Arc tube: Ernst Alexanderson

1923: Sound film: Lee DeForest

1923: Television Electronic: Philo Farnsworth

1923: Wind tunnel: Max Munk

1923: Autogyro: Juan de la Cierva

1923: Xenon flash lamp: Harold Edgerton

1925: ultra-centrifuge: Theodor Svedberg - used to determine molecular weights

1925: Television Iconoscope: Vladimir Zworykin

1925: Television Nipkow System: C. Francis Jenkins

1925: Telephoto: C. Francis Jenkins

1926: Television Mechanical Scanner: John Logie Baird

1926: Aerosol spray: Rotheim

1927: Mechanical cotton picker: John Rust

1928: sliced bread: Otto Frederick Rohwedder

1928: Electric dry shaver: Jacob Schick

1928: Antibiotics: Alexander Fleming

1929: Electroencephelograph (EEG): Hans Berger

1930s

1930: Neoprene: Wallace Carothers

1930: Nylon: Wallace Carothers

1931: the Radio telescope: Karl Jansky Grote Reber

1932: Polaroid glass: Edwin H. Land

1935: microwave radar: Robert Watson-Watt

1935: Trampoline: George Nissen and Larry Griswold

1935: Spectrophotometer: Arthur C. Hardy

1935: Casein fiber: Earl Whittier Stephen

1935: Hammond Organ: Laurens Hammond

1936: Pinsetter (bowling): Gottfried Schmidt

1937: Jet engine: Frank Whittle Hans von Ohain

1938: Fiberglass: Russell Games Slayter John H. Thomas

1938: Computer: Konrad Zuse

1939: FM radio: Edwin H. Armstrong

1939: Helicopter: Igor Sikorsky

1939: View-master: William Gruber

1940s

1942: Bazooka Rocket Gun: Leslie A. Skinner C. N. Hickman

1942: Undersea oil pipeline: Hartley, Anglo-Iranian, Siemens in Operation Pluto

1942: frequency hopping: Hedy Lamarr and George Antheil

1943: Aqua-Lung: Jacques Cousteau and Emile Gagnan

1943: electronic programmable digital computer: Tommy Flowers [1] (*http://c2.com/cgi/wiki?TommyFlowers*)

1944: Electron spectrometer: Deutsch Elliot Evans

1945: Nuclear weapons (but note: chain reaction theory: 1933)

1946: microwave oven: Percy Spencer

1947: Transistor: William Shockley, Walter Brattain, John Bardeen

1947: Polaroid camera: Edwin Land

1948: Long Playing Record: Peter Goldmark

1949: Atomic clocks

1950s

1951: Liquid Paper: Bette Nesmith Graham

1952: fusion bomb: Edward Teller and Stanislaw Ulam

1952: hovercraft: Christopher Cockerell

1953: maser: Charles Townes

1953: medical ultrasonography

1954: transistor radio (dated from the from Regency TR1) (USA)

1954: first nuclear power reactor

1954: geodesic dome: Buckminster Fuller

1955: Velcro: George de Mestral

1957: Jet Boat: William Hamilton

1957: EEG topography: Walter Grey Walter

1957: Bubble Wrap - Alfred Fielding and Marc Chavannes of Sealed Air

1958: the Integrated circuit: Jack Kilby of Texas Instruments, Robert Noyce at Fairchild Semiconductor

1959: snowmobile: Joseph-Armand Bombardier

1960s

1960s: Packet switching: Donald Davies and Paul Baran, video games

1960: lasers: Theodore Maiman, at Hughes Aircraft

1962: Communications satellites: Arthur C. Clarke

1962: Light-emitting diode: Nick_Holonyak

1963: Computer mouse: Douglas Engelbart

1965: 8-track tapes: William Powell Lear

1969: the ARPANET, predecessor of the Internet

1970s

1970: Fiber optics

1971: E-mail: Ray Tomlinson

1971: the Microprocessor

1971: the Pocket calculator

1972: Computed Tomography: Godfrey Newbold Hounsfield

1973: Ethernet: Bob Metcalfe and David Boggs

1974: Scramjet: NASA and United States Navy -- first operational prototype flown in 2002

1974: Rubik's Cube: Ernő Rubik

1976: Gore-Tex fabric: W. L. Gore

1977: the personal computer *(dated from Commodore PET)*

1977: Atari 2600, the first commercial video game console

1978: Philips releases the laserdisc player

1978: Spring loaded camming device: Ray Jardine

1979: the Walkman: Akio Morita, Masaru Ibuka, Kozo Ohsone

1979: the cellular telephone (first commercially fielded version, NTT)

197x: Leaf blower (exact year unknown)

1970s: Tomahawk Cruise Missile (first computerized cruise missile)

1980s

1981: the Xerox Star is the first computer to feature a WIMP graphical user interface

1982: Sony and Philips release compact discs

1983: the Internet Protocol, which created the Internet as we know it

1983: Domain Name System: Paul Mockapetris

1985: polymerase chain reaction: Kary Mullis

1985: DNA fingerprinting: Alec Jeffreys

1985: Tetris: Alexey Pajitnov

1986: breadmaker

1989: the GNU GPL, enabling the free software movement: Richard Stallman

1989: the World Wide Web: Tim Berners-Lee

1990s

1991: genetically modified, herbicide tolerant soybeans developed

1993: Global Positioning System

1995: wiki software: Ward Cunningham

1995: DVD standard devloped

1996: cloning of mammals: Ian Wilmut and others

1997: Self-heating can

1998: Portable digital audio player (MP3 player)

1998: Personal video recorder

1999: IEEE 802.11b

1999: Bluetooth

3rd millennium

21st century

2001: Digital satellite radio

2001: Artificial heart.

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