

from *And Suddenly the Inventor Appeared*, by Genrich Altshuller:



Chapter 36

Into the Inventor's Card Index

Make an index card! Jules Verne did not patent his ideas, he just simply described them in his novels. In order to develop his technical and scientific knowledge, Jules Verne — starting in his youth and lasting throughout his life — collected new technical and scientific information from books, magazines and papers. Biographers state that his card index contained more than 20,000 entries with information about technology, geography, physics and astronomy.

Today many inventors maintain their own index cards. These cards contain information about physical, chemical and geometrical effects. There are also descriptions of successful methods and inventive tricks — information about new materials. In other words, everything that can contribute to the solution of a technical problem.

Index cards slowly accumulate and become very helpful during the search for new ideas. Sometimes an old forgotten card immediately helps solve a complicated new problem.

There is a piece of paper among my index cards with an extract from a book that is 100 years old. The book is called *Magic of the World* and was published in 1886.

Here is an extract from that book:

#89. Instant blossoming of a flower under the influence of electricity.

The magician takes a fresh-cut bud of any flower (a rose with the cut end of the stem covered with wax is best) and shows it to the audience in order to prove there is nothing inside the bud. Then he removes the wax, inserts a thin, long wire inside the stem, and installs the stem in a hole on the table, all the while describing what he is doing so that

everyone can see that the flower is unchanged.

After that he signals his assistant, who connects a battery to the wire, and the current travels through the stem into the bud. And, under the great power of electricity, the bud opens up very fast in front of the eyes of the amazed audience.

One hundred years ago it was almost a super-trick, but today, in physics classes we learn that identically charged particles repel. The magician charged the petals with an identical charge. That's the whole trick!

This simple trick, however, solves **Problems #76 & #78**. The hair of the fur will stand on end if an identical charge is applied (Patent #563437). And, petals with identical charges will stay open in spite of the wind (Patent #755247). They are modern inventions made with the help of old tricks.

The inventor listens to the "pulse."

How can we determine if there is a crack in a ball bearing while it is working? The "healthy" bearing has one frequency of oscillation — it may be measured before the test. A cracked bearing has a different frequency because the bearing now is actually divided in half.

In the past few years many patents were issued for similar inventions. The polishing process of metal belts had to be interrupted in order to measure their thickness. Now the thickness is measured continuously by measuring the vibration frequency of the belt while it is placed inside the acid solution for processing.

Doctors measure the pulse of the human body to determine its condition. Frequency of vibration is like a pulse — it tells about the health of parts of a machine, or of the machine in general. When the length, mass, pressure — and so on — change, so does the frequency.

It is a bad doctor who does not know anything about a patient's pulse.

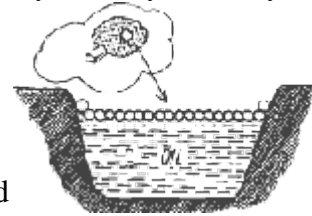
Now, a simple task: A pole is driven into the ground. How can we determine how firmly the ground is holding it?

Balls, water and fantasy

In many countries people have thought about how to reduce the waste of oil from large open reservoirs. Indeed, in the summer, reservoirs are heated by sun light and a lot of oil evaporates. It seems easy to protect the oil with a floating "cover." This "float" would go down as the level of oil goes down. But the problem is that the walls of the reservoir are not straight. This creates gaps between the float and the walls, letting oil evaporate. People have designed covers with flexible sides which were complicated and expensive. Here is a technical contradiction: Reducing the waste of oil complicates the construction of the cover. A very simple solution suddenly appeared. Cover the surface of the oil in the reservoir with floating balls smaller than tennis balls. The balls will cover the oil very securely, and they take on the shape of the reservoir.

Isn't this a smart solution?

The ingenuity of the inventor appears when he solves a complicated problem with a simple solution.



Now, try to imagine a plant that has a process for covering metal parts with Chrome or Nickel. Instead of machines there are big tanks where the parts are dipped. There is a solution of harmful liquids inside. What should we do? Make covers? But those parts go in and out all the time. Covers would be interrupting the process. Here is a contradiction again. This is similar to the previous one, and it should be solved the same way. You have probably figured it out. The tank should be covered with a layer of balls. This cover will seal the tank and prevent the liquid from splashing.

Recently, one steel plant had to lay out thick metal sheets. During this process the sheets had to be moved and turned. How is that possible if the sheet weighs 1.5 tons and is 6 meters long? Once again, floating balls helped to solve this problem, because every ball can carry some weight. There could be many balls and their sizes might vary so they can carry a heavier loads. This is how the idea of the floating conveyor was originated. The simplicity of this conveyor surprises us. Water runs down through the trough and the hollow metal balls floating on top of the water receive the load. These balls carry the weight, that's all.

A bag + air.

How can we transport fragile glass devices by railroad cars? Twenty years ago, inventors suggested the use of plastic bags for that purpose. Air is pumped into the bags, and the product is



secured very safely for transportation. "Bag + air" is a very simple and handy mechanism. It is not surprising that inventors started using this mechanism to solve different problems where two objects are held against each other. For instance, it was necessary to hold a very brittle object tightly while it was sawed. The air bag is used - Patent #409875. One plate of a powerful electric switch has to be pressed against another: The air bag is used - USA Patent #3305652. Even the heavy gypsum cast applied to broken bones has been replaced with "air bags."

Now the question is: Can we make improvements on "air bags"?

You know a very powerful method: Iron powder added to a substance and acted upon by a magnet or electromagnet.

Recently, a new invention appeared (Patent #534551). Iron powder was placed inside an air bag and an electromagnet was used from the outside to activate the powder. The air bag thus got new properties. It was now possible to adjust the pressure of the air bag to properly "press" an object. At first the new air bag was used only to hold parts during a grinding process. It is not difficult to imagine that inventors will also magnetize other types of air bags.

Invented by Nature

What should a machine that moves inside the earth look like? This question was published in the magazine *Pioneer Truth*.

Here is a typical answer: "Take a tractor and install shovels in front of it to cut the ground."

This mechanism has to shovel a lot of dirt just to move a couple of meters. A tractor is too big, and was not made to move in a narrow space. Machines made to do one type of work cannot be used in a different environment. Other people offered underground vehicles with wings. Why?

In all the projects on underground vehicles, the machine moves dirt from the front to its rear. The mole — a living underground machine — works differently. The mole leaves an empty tunnel behind him in order to easily get back. About 20 years ago, engineer

A. Trebelev conducted an experiment with moles before he developed an underground vehicle. He found that the mole turns its head all the time pressing the dirt into the wall of the tunnel. Several years ago, Soviet engineers got their patent on a



"man made mole." At the front of that machine they installed a cutting cone that not only breaks-up dirt but, like the mole's head, compresses the particles into the wall of the tunnel.

As you see, inventors should not only know technology, but should learn about nature as well.

Bypass Archimedes` principle

When Alex Zdun-Pushkin came to the Baku Institute of Technical Creativity, the Admitting Committee was confused. The question was whether or not an eighth-grade student could be enrolled in a class with engineers and other professionals.

Alex had been studying methods of technical creativity for two years. He had solved many problems, and learned about patent funds. Soon he sent in a patent application for a new solution to a technical problem and was awarded a patent.

This is his invention: Imagine a float in a tank with water. The float supports part of a machine. According to Archimedes' law, the supporting force is equal to the weight of the water displaced by the float. What if we need to increase the supporting force by 10 times? There is no room to make the float bigger. Can we replace the water with a heavier liquid? That is very expensive, and the supporting force will increase only by two or three times. The Archimedes principle should be bypassed. But, how?

The idea of Alex's invention is that if one adds a fine powder of iron to the water and starts to treat this water with a magnetic field, the specific gravity of the water will increase by 10 to 12 times.

Based on that invention, he got his diploma at the Institute of Technical Creativity.

The sun caresses the wings

There are inventions whose fate reminds one of Anderson's Tale about the ugly duckling. They are also kicked, laughed at, and pecked....

The first steamboat that crossed the Atlantic Ocean covered more than half the distance under sail. The boat had no passengers nor cargo. All the space was filled with coal, and in spite of that, there was not enough fuel to cover the whole distance. Major newspapers wrote: "Steamboats cruising across the ocean are nonsense. The ships can carry only their

own fuel!"

The first vacuum cleaner was built in 1901, and it could barely fit into a horse carriage. This contraption would come to a house where workers would unwind its hose and stretch it out into a room. As soon as they started the engine and began cleaning, a laughing crowd would immediately gather around throwing stones at the machine....

The first pocketwatch was so heavy that it was impossible to carry in your pocket. Owners very often would hire a butler to carry the watch. This provided a lot of laughs.

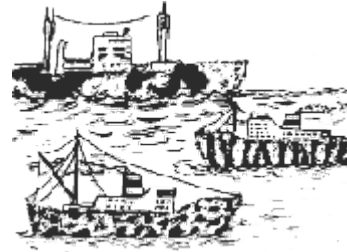


The energy of the first solar engine was barely enough to run a small printing press. On cloudy days the paper could not be printed. This was cause for many jokes, caricatures and laughs. Was the idea to use solar energy a mistake? In our time, solar elements work on many installations — including spaceships.

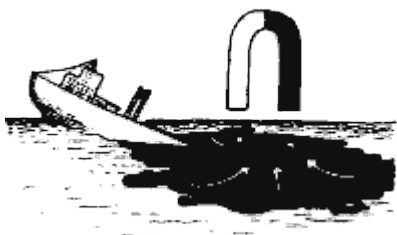
New machines should not be judged by their looks but by the power of their ideas. Days will pass, and the "ugly duckling" will become a "beautiful swan." And, as Andersen said, old swans will bow their heads before him and the sun will caress his wings.

A ship in tiger's skin

An inventor, G. Sutiagin, offered to cover the outer sides of a ship with tiger skins, thereby reducing friction between the ship, water, and air. Imagine a harbor with this type of vessel; ocean liners covered with leopard's furs, high-speed boats covered with synthetic tiger's skin, heavy tankers with bear's furs.



Yet it does make sense to consider this idea when making sports boat prototypes.



The ocean has to stay clean.

Thor Heyerdahl was surprised to see pollution throughout the Atlantic Ocean during his voyage on RA-1 and RA-2. Oil spills sometimes spread from horizon to horizon. About one percent of all oil transported spills into the sea — millions of tons. Inventors have put a lot of effort into solving these pollution problems. People try to burn the spills, or collect the oil with giant plastic sponges. One of the most interesting methods is to cover the oil spills with magnetic powder. This mixture, having magnetic properties, could be collected by large magnets.

Today, the size of oil tankers is increasing. Recently, a large, halve-million ton, tanker had an accident. Fortunately it was empty. What would have happened had it been full? How could we collect this giant oil lake? There is still no satisfactory solution. Inventors continue to search.

Fairy tales may not be true, but they do contain hints

At first glance, the story told by Captain Vroongel (*Liar*) is absolutely unreal. But, if you search hard, you can find grains of inventive ideas, just as in the stories of Baron Munchausen. There are many inventive ideas in books about Gulliver, Alice in Wonderland and the Little Prince.

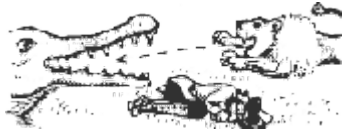
Writers make up very unusual stories. Sometimes they create hopeless situations for their heroes to somehow later find a way out. Comic books can not only make us laugh, they can also teach us to think about how to get out of unpredictable situations.

Do you remember what happened to Captain Vroongel in Canada? He had to reach Alaska by sled. A group called "Misfortune" bought a deer and dog only to suddenly realize that the "deer" was really a cow, and the dog was really a wolf.

Vroongel found a very smart solution. He harnessed the dog behind the cow, and the frightened cow drew the sled at greater speed.



A similar story happened to Baron Munchausen when he was chased by a lion, and found a crocodile in front of him. Munchausen invented a way to combine two minuses so that they destroyed each other.



In inventive theory, this method is stated as follows:

Harmful factors can be combined in such a way as to cancel each other out.

We can give an example to support this rule:

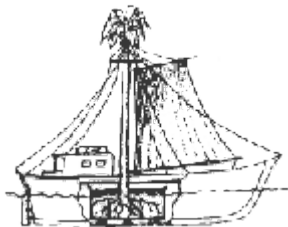
Doctors trying to find a way to remove a red birthmark on the skin, tried several different methods. Nothing worked. Then they used the Vroongel and Munchausen rule to solve the problem. They injected green color under the skin. The green color by itself would stay green, but, in reaction with the red pigment of the birthmark, green and red neutralized each other.

One does the work of two

A good inventor has his own inventive signature. There is a signature that belongs to Vroongel. Most of Vroongel's tricks were created when he let an object play a double role: A life saver becomes a collar, the copper letters "Misfortune" become horseshoes, a fire extinguisher becomes a gun to fight a snake, and even squirrels replace an engine....



To force one object to do double work is a very strong, and widely used, inventive method. When the Soviets developed the space station "Venice-12," at the last moment they needed to add one more device weighing 6 kg. The designers did not want to hear about it, because every kilogram was already calculated into the weight of the ship. However, a solution was found — an exact recipe once used by Captain Vroongel.



Sand, or water, is loaded into the hold of ships returning without cargo. This is to make the vessels more stable. Vroongel once took on dirt as ballast. At the same time, the ballast was also soil for the palm tree used as the ship's mast.

Thus, on one part of the spaceship "Venice-12," a ballast was needed in order to control the ship's landing direction. Instead of ballast, the above mentioned additional 6kg device was installed. It worked both as a device and as ballast.

"Place head on fence."

Do you remember when Alice met the strange Knight in the world through the looking glass?

"I invented a new method for going over a fence," the Knight said.
"Would you like me to tell it to you?"



"Please," said Alice politely.

"Here's how I came-up with the idea," the Knight continued. "I thought that the main difficulty is in lifting-up one's legs. After all, one's head is already over the top. If we stand on the fence with our head, our legs will now be on top, correct? And the next thing you know, you're over the fence...."

Alice could not believe the Knight — he was full of crazy ideas. Yet, this strange way of going over a fence is also a very interesting invention. Soviet inventors G. Katis and I. Melnichenko built an all-terrain vehicle that used this same principle. This vehicle consisted of two carts connected with a frame. One cart rests over the other. When the vehicle reaches an obstacle it places its upper cart on it. As the Knight mentioned, this is not difficult to do. Now, the cargo is moved through the frame from the lower cart to upper cart. The lower cart is then lifted on to the top of the frame, and the vehicle travels forward.

Does an inventor need science fiction?

One day a letter came to the publisher of the magazine *Pioneer Truth* saying that there was a debate in the classroom as to whether or not students should read science fiction stories. Many students said it was a waste of time because such stories were not real. This opinion is very common — and is a mistake. Science fiction writers are trying to see the future, even when it is so remote it is not realistic. They have described airplanes, submarines, television, and more when nothing like them had as yet existed on earth. Writers have written stories about journeys into solar systems, about robots, about the reconstruction of the human body. Today, many of these ideas have become reality. Science fiction is a searchlight into the future. Those who go to school today will live in that future. There is unreal fantasy, too, of course. But even that is very useful because it helps to develop imagination and teaches us to think freely. It is impossible to go to the moon inside a gun shell. However, Konstantin Tsiolkovsky wrote that the first ideas about rockets came to him after reading a novel by Jules Verne called "From Cannon to the Moon." Fantasy is needed in order to make real inventions and discoveries.

The power of mind

Fantasy is mobility of thought. The contemporary inventor has to read books about science fiction because they reduce psychological inertia and increase the power of imagination. Fantasy can be developed using the methods described in this book: Operator STC, MMD

and IFR.

We live in an "Era of Technical Revolution." The main point is that this revolution lies not in the appearance of new machines — that has happened before. The method of developing new machines is changing. Organized ways of thinking replace the old chaotic ones. Every step in the thinking process should be as accurate as the movements of a pilot flying an airplane.

At the dawn of the human race, mankind conquered fire. Now we are learning to conquer something much greater: The power of mind capable of penetrating an unknown future.

