Title: Inventing for Boys

Author: A. Frederick Collins

Release date: May 28, 2015 [EBook #49064]

Language: English

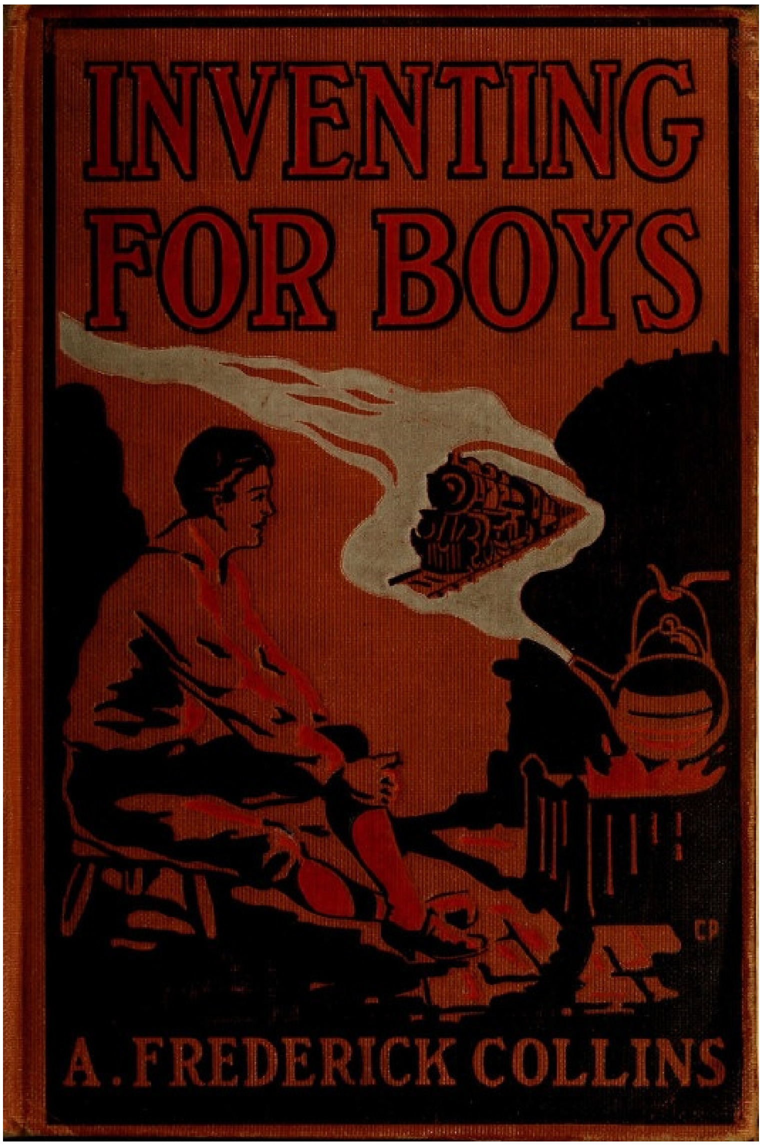
Credits: Produced by Chris Curnow, Elisa and the Online Distributed Proofreading Team at http://www.pgdp.net (This file was produced from images generously made available by The Internet Archive)



**Transcriber's Notes:**

In the html version of this eBook, links to larger scale illustrations have been provided where details are not easily visible. Please see the detailed transcriber's note at the end of this text.

---




No. 614942

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Whereas Archie Frederick Collins, of New York, N.Y.

has presented to the Commissioner of Patents a petition praying for the grant of Letters Patent for an alleged new and useful improvement in

Wireless Telephony,

a description of which invention is contained in the specification of which a copy is hereunto annexed and made a part hereof, and has complied with the various requirements of Law in such cases made and provided, and

Whereas upon due examination made the said Claimant is adjudged to be justly entitled to a patent under the Law.

Now therefore these Letters Patent are to grant unto the said

Archie Frederick Collins, his heirs or assigns

for the term of Seventeen years from the thirteenth day of March one thousand nine hundred and six

the exclusive right to make, use and vend the said invention throughout the United States and the Territories thereof.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington this thirteenth day of March in the year of our Lord one thousand nine hundred and six and of the Independence of the United States of America the one hundred and thirtieth.

Acting Commissioner of Patents.

PATENT GRANTED TO THE AUTHOR

Large illustration

# INVENTING FOR BOYS

BY

A. FREDERICK COLLINS

INVENTOR OF THE WIRELESS TELEPHONE

*WITH NUMEROUS ILLUSTRATIONS AND DIAGRAMS*

NEW YORK
FREDERICK A. STOKES COMPANY
PUBLISHERS



TO
JOHN ROLLER COLLINS
A THINKER OF THOUGHTS
NEW AND NOVEL

---

## A WORD TO THE BOY

Every boy is a born inventor.

And since you are a boy it follows as the night the day that you have your share of inventive ability and you ought to make good use of it.

To find out some new way of making or doing a thing—for this is what inventing means—is the most fascinating game that I know of to take up a fellow's time and thought and energy.

You may say how about wireless, or star-gazing, or baseball, or shooting, or chess, or any one of a dozen other pastimes and sports and I shall be bound to admit that all of them are highly entertaining and some of them instructive but inventing is all that the others are and besides it is *constructive* while they are not.

By constructive I mean that you take an idea that had its origin in your brain and this vague, intangible conception, which takes up no space, has no weight and is not bound by time, you build up step by step of wood and steel and like materials until at last you have created something out of nothing, or as nearly as it can be done.

To watch your invention grow, especially if you build it with your own hands, from the time you make the first rough sketch of your idea until it stands completed and in working order, gives you a wonderful feeling of pride and satisfaction for you are the *creator* of it and this means that you are more than a mere boy, greater than an ordinary man—that you are in very truth a *demi-god*.

These are the real pleasures of inventing but to make a success of it you have to drop back to earth again and take up the mean, the sordid part, and that is to try to make money out of it. And if you have an invention of merit you will have to forget that you are a demi-god and become a hard and fast mortal again or it will not be long before some other body owns it lock, barrel and stock; and then you will have a chance to start another idea rolling and to build up another invention.

In this book I have tried to point out to you not only how to invent, but how to make money out of your invention as well, and so, I say unto you, from the moment the big idea strikes you be as gentle as a dove and as wise as a serpent, to the end that your days as an inventor may be long and that any profits which may accrue from your invention will be yours instead of some one's else. And now may peace be with you.

A. Frederick Collins.

Lyndon Arms,
524 Riverside Drive,
New York City.

---

## CONTENTS

# ILLUSTRATIONS

---

# CHAPTER I

## GETTING AN IDEA

Almost every one has had, at some time or other an *idea* for a new *invention* or of how some old *device* could be improved.

To get an original idea for an invention is in itself a mark of genius, but it is not enough to make it a success and if you do not know how to develop it you are almost certain to give up before you have completed it.

And to give up a good idea and then find that some one else has thought of the same thing later, worked it up and made money out of it gives a fellow a most uncomfortable feeling about what might have been.

Now my purpose is not to tell you *what* to invent as much as it is to tell you *how* to invent and, if when you get an idea that you believe worth while you will follow it up step by step as I have outlined in this book you will at least save yourself time, worry and money and you stand a chance of winning fame, glory, and a bank account.

[2]

**How to Get an Idea.—**There is only one way to invent a new thing or to make an improvement on something that has already been invented and that is to get an idea.

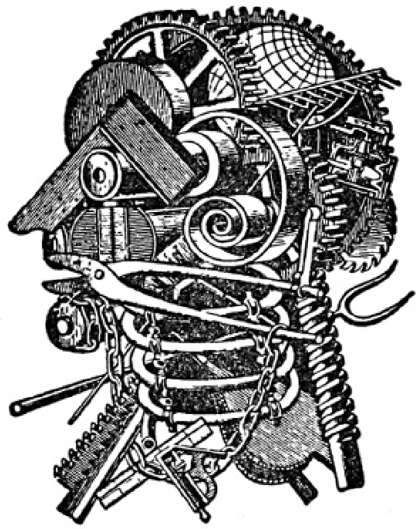


FIG. 1. A POPULAR IDEA OF AN INVENTIVE GENIUS

And what, you may wonder, is an idea? It is easy to say that it is a *notion* that comes into your head, or a thought that springs into your mind. But I doubt if even a *psychologist* could explain just what an idea is or how one originates in the mind any more than a *biologist* could tell how the germ of life is retained in a seed and how it grows when it is planted.

One good thing about an idea, though, is that we don't have to know what the mysterious thing is or how it springs into being in the mind. In this way an idea is very much like electricity—we don't know exactly what it is but we do know a good deal about how it works and this is enough for our present purpose.

[3]

**The First Raw Idea.—**There are several ways by which you may get an idea for an invention but in any case the first raw idea, or *inductive discovery*, as it is called in *philosophy*, must and does come from something outside the mind, something that you have seen, heard, smelled, tasted or felt, and when your mind is in the right condition to receive an idea of this kind you will know it when it comes and grasp it very quickly, that is if you are a real inventor.

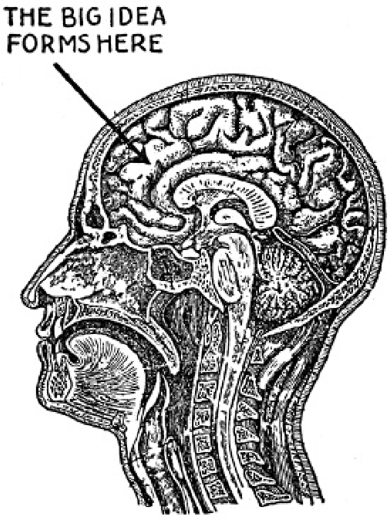



FIG. 2. WHERE THE BIG IDEA REALLY ORIGINATES

There are many kinds of raw, or original ideas and they show themselves in various ways. You may get a very vague idea of an invention, or of an improvement, or it may be a clean cut one on the jump; it may be a very valuable idea or it may be a wholly worthless one, but it is generally easy after you get one to enlarge upon it, as we shall presently see, and to build up in the mind's eye a [4]
structure so that you can guess pretty nearly whether you will have a palace, an architectural monstrosity or a chicken-coop when it is done.

A first, or raw idea may come to a fellow, who is on inventing bent, in any one of several ways but chiefly when (1) he is conjuring up in his mind something which he has seen or heard; (2) when something happens by accident which shows him an effect or a result that is new, and (3) when he is looking at or working on some device or machine; and this last way is the one that is most productive of ideas for useful improvements.

As an example of getting an idea behold a young man rocking in a chair with closed eyes; he is thinking of nothing in particular but of a good many things quite vaguely. A thought of his sister packing her trunk—in the way a woman usually packs a trunk—comes into his mind and then an idea strikes him that it would be a good scheme for a trunk to have drawers in it like a bureau. The result of this raw idea is the *wardrobe trunk* as we know it to-day.

**Accidental Discoveries.—**Once in a long while some one hits upon an invention purely by accident.

A good illustration which covers the point was the discovery of *vulcanized rubber*. The story goes that Charles Goodyear happened to drop some crude rubber and sulphur on a hot stove at the same time with the result that it was made much stronger and more elastic than before.

Experiment showed that the vulcanized rubber could be made as soft or as hard [5]
as desired by using more or less sulphur and applying more or less heat. From this discovery of Goodyear's has sprung the gigantic rubber industry of to-day.

Discoveries of this kind were often made in the early days of invention but the principles which underlie all of the sciences are now so well known that invention itself has been brought down to a scientific basis; and instead of inventors being long-haired, dreaming Micawbers they are generally men of education and genius too, trained along the lines they are working in and who look like clean-cut business men; and if they are successful inventors you may depend upon it they are business men.

When I say that they are men of learning I do not mean that it takes a college professor to be a big inventor; indeed very few college professors have the genius to be inventors and too many inventors have too little knowledge along the line in which they are working. Of the two genius is the greatest for it is bred in the bone while any one can educate himself.

To make the point clear here are three famous men of genius and who were largely self-taught.

Faraday who made the dynamo and motor possible was a poor, uneducated boy with a burning thirst for knowledge when he was apprenticed to Davy at the Royal Institution in London. Edison had about as little schooling as the law allows, but he taught himself science and he now stands head and shoulders above all the [6]
rest of the great inventors. And Marconi, a young fellow of 23, invented the wireless telegraph while the greatest scientists of the world could not do it until he showed them how.

**Thought Out Ideas.—**There are very few inventions which are complete when the first idea of it comes into the mind, but instead nearly all of them require thinking out, or *deductive proof* as it is called in philosophy.

This second process of thinking consists of turning the raw idea over and over in your mind so that you can judge whether it is good or not, how it will work out and other things about it, and to do this you must know as many of the facts relating to it as you can and when you have these all clear and catalogued in your mind your idea then takes on the aspect of an invention.

The two usual ways to get the needed facts are (1) to read up on the subject, and (2) to experiment along the line of your idea. Of course if it is your regular work that has called forth your first idea it is quite likely you will have all of the facts you need to go ahead and work the thing out; but if your idea is about a device, or a machine, or a compound you know nothing of your best plan is to read up on the subject and follow up your reading by making a number of experiments.

**Reading up Your Subject.—**In this day of public libraries it is easy to get books on any subject unless it is one on sunsets and sunsets don't count in inventing—in fact nothing counts except the big idea, a shop or a laboratory to [7]
develop it in and burning the midnight incandescent light.

It doesn't matter very much what invention you are working on you ought to read a *first book* on *physics* and one on *chemistry* and what's more you should study them if you expect to ever invent anything of magnitude.

A book on physics tells all you need to know in the beginning about matter, force, motion, the principles of machines, the mechanics of liquids and gases, electricity and magnetism, sound, heat and light.

Suppose you have an idea for an electrical device, if you will read the chapters on electricity and magnetism in your book of *physics* you will learn what you ought to know first about these subjects and then if you need to go deeper you can get a more advanced book.

A book of the elements of chemistry tells about gases, acids, alkalies and metals and of their chemical changes, and you will find a little knowledge of chemistry of considerable use in working out many ideas. There are many books of physics and chemistry but *Avery's Elements of Physics* published by the American Book Company of New York, and *Remsen's Elements of Chemistry* published by Henry Holt and Company of New York are good books for a beginner to read.

**Working Out Ideas by Experiment.—**Though you may think long and hard and read everything you can find that has a bearing on your great idea, you will [8]
soon reach a point where you feel you would like to try it out, that is to build it up in reality so that you can see if it will do the work you want it to do or if it won't do the work where the trouble comes in.

Generally speaking if it is a mechanical or an electro-mechanical scheme you begin by drawing this brain-child of yours on paper and then you make a model, or try to, and you add to it, take away from it, tear it down sometimes and at others you scrap it and build an entirely new one.

But usually it is some one part that needs patience and effort and skill put upon it and as you try out idea after idea, plan after plan and scheme after scheme you are not only almost sure to find just what you are looking for but very often experimental work will lead you to fresh ideas for other and even more important improvements.

Another curious thing I have found about experimenting is this: you may start out on a certain line and find that the result you want is so hard to get it seems hopeless to go ahead. Now if you quit it is all off but if you go on and on trying everything you can think of, keeping up your belief that the thing you are striving for must come and in your own ability to do that which you want to do, after long hours, or days, or weeks of constant work the result will come to you like a flash and just as though the guardian angel of invention hovered over you and put the desired thing right into your mind and hand. The moral is that everything comes [9]
to the inventor who keeps on experimenting and does not give up.

**Ideas for Inventions in General.—**Inventions may be divided into three general classes and these are (1) *mechanical*, (2) *electrical* and (3) *chemical*; and there are combinations of these classes as (a) *electro-mechanical* and (b) *electro-chemical* inventions and your idea may come under the head of any one of them.

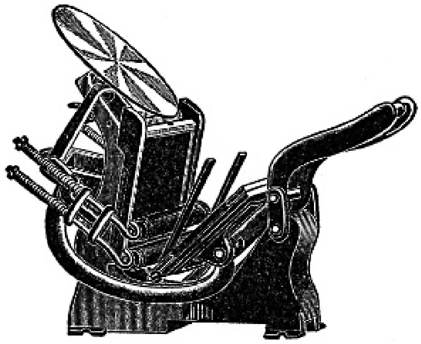


FIG. 3. A MODEL SELF-INKING PRINTING PRESS

**Ideas for Mechanical Inventions.—**Inventions of a mechanical kind include nearly everything in the broad domain of physics but the term *mechanical inventions* is applied especially to devices that are worked by means of pendulums, springs, weights, levers, wheels and axles, pulleys and inclined planes, screws and pistons and which have to do with force and motion.

To work out an idea for a mechanical device if the latter is a fairly simple one, [10]
as a printing press, see Fig. 3, or a scroll saw, see Fig. 4, should not be a very hard thing to do because all of the parts can be easily seen and if you add a few parts to it and it does not work the fault can be readily picked and the part that is causing the trouble can be redesigned and changed until the whole device is made operative.

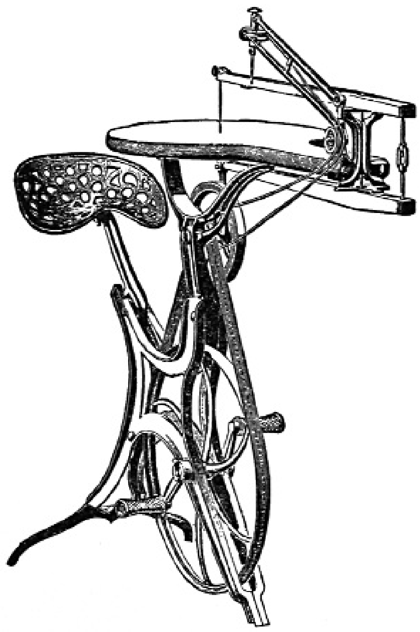


FIG. 4. A VELOCIPEDE SCROLL SAW WITH BORING ATTACHMENT

Of course if the machine is a more complicated affair in which there are pistons, valves and the like as in an air-pump, see Fig. 5, or an ordinary engine,
see Fig. 6, it is liable to develop internal—or perhaps infernal would be more [11]
fitting—troubles that are sometimes very pertinacious and hard to overcome.

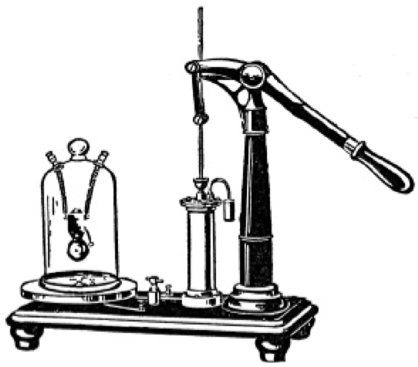


FIG. 5. A STANDARD SINGLE CYLINDER AIR PUMP

The easiest and best paying way to begin a career of inventing is to hit on an idea to improve some simple device that either makes for safety or for saving, for convenience or for lessening mental or manual labor. But if you should happen to get an idea for something big and hard don’t give it the go-by, but follow it up along the lines which I have indicated in this book and you will stand a pretty good chance of finally working it out to a successful conclusion.

**Ideas for Electrical Inventions.—**Ideas for inventions in which electricity and magnetism are used are generally harder to work out than those of a purely mechanical kind for the reason that the cause in the first case which produces the result you want cannot be seen, whereas the cause in the second case which sets [12]
up the effect you want is always visible.

But electrical inventions are like mechanical inventions in that they may be very simple, such as passing a current through the heating element of an electric cooker as shown in Fig. 7, or it may be quite a complex piece of apparatus as for instance a loud speaking telephone for use on ship-board as shown in Fig. 8.

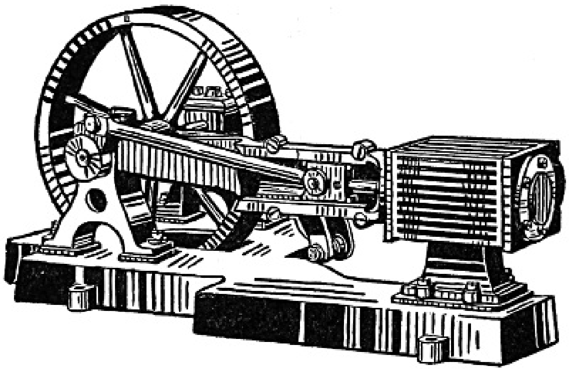


FIG. 6. A HORIZONTAL STEAM ENGINE

Where an electric current is used for some simple device a thorough knowledge of electricity may not be necessary but if your invention requires that a *low voltage* current be changed into *high frequency oscillations* which are in turn varied by the voice and these oscillations are sent out from an *aerial wire*, all of which is done in a wireless telephone, I should say that you ought to have a pretty fair understanding of the theory of electricity before you begin your experiments
—that is if you expect to develop your invention into an apparatus of utility and [13]
hence of worth.

**Ideas for Electro-Mechanical Inventions.—**There are many devices that are partly electrical and partly mechanical, the *operation* of the one *actuating* the other and the other way about.

FIG. 7. A FIRELESS COOKER. THE HEAT IS WHERE YOU WANT IT

The electric bell, see Fig. 9, and the telegraph sounder, see Fig. 10, are types of simple electro-mechanical devices, while the telautograph, see Fig. 11, and the electrical gyroscopic compass for use on ship-board, see Fig. 12, are examples of the more complex electro-mechanical devices.

To work out an idea by bringing both mechanics and electricity to bear in the same device often makes the work much easier for sometimes the armature of an
*electromagnet* or the plunger of a *solenoid* will operate to a better advantage than [14]
a combination of levers. But to use mechanics and electricity in the same device you must of course have a knowledge of them both.

**Ideas for Chemical Inventions.—**There is another class of ideas which require neither mechanics nor electricity for their working out. They are chemical compounds.

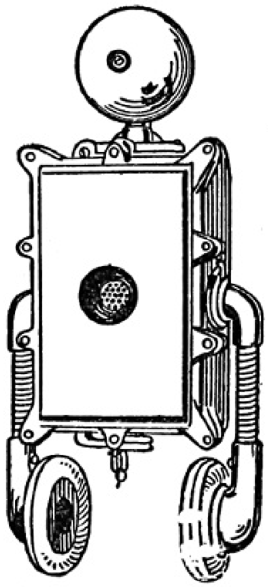


FIG. 8. A LOUD SPEAKING TELEPHONE LARGELY USED ON SHIP-BOARD

Suppose an idea comes to you to make a chemical solution for erasing ink, or to make a new high explosive. While the idea might be a good one you would have a long road to travel if you began experimenting and had no knowledge of chemistry and your road in the latter case would probably be straight up.

Trying out chemical compounds without knowing something of the reactions they produce is far more wasteful of time and money than puttering around with [15] mechanical and electrical devices, especially when one's line of business is selling ribbons, and besides it's more or less dangerous too.

Should you get an idea for making an explosive more powerful than any yet invented, either *dish* the idea or pave the way by taking a course in advanced chemistry and even then your idea is liable to perish with you. Better let the Maxims or the du Ponts do it.

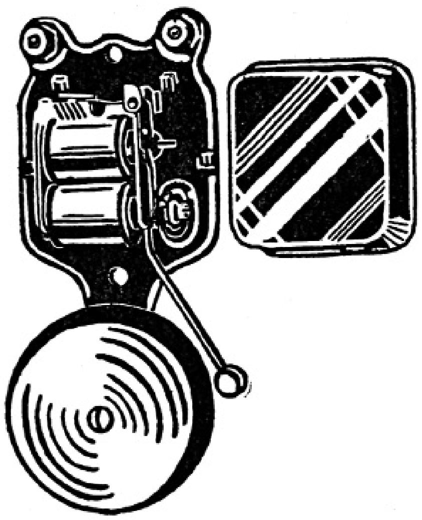


FIG. 9. A COMMON ELECTRIC BELL

**Ideas for Electrochemical Inventions.—**Just as there are ideas that call for the use of mechanics and electricity in a single device so there are ideas for processes that combine both chemistry and electricity.

The action of a common dry cell is electrochemical and so is electroplating. But there are a large number of chemicals and chemical substances that are produced [16] by electricity such as *nitric acid* from the air, *calcium carbide* from which *acetylene gas* is made, *carborundum* which is used as an *abrasive* in the place of emery, and then there is the *electrolytic* refining of copper, the manufacture of *aluminum*, besides a whole string of other electrochemical inventions.

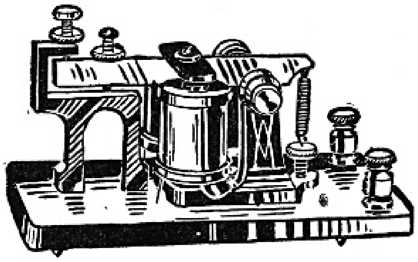


FIG. 10. AN ORDINARY TELEGRAPH SOUNDER

While it is quite safe to work along electrochemical lines still it takes a considerable amount of technical knowledge in these days to invent anything that the kultured German scientists haven’t thought of and worked out.

**Protecting your Raw Ideas.—**Just as soon as you have an idea for an invention write as clear a description of it as you can, read it to the members of your family, have them sign it and file it away as this is a record you may have to produce sometime in the future to prove your *priority,* that is that you were the first in time to conceive the idea.

As soon as you have your idea all thought out and have made a drawing, an experiment, a cardboard or other model, in fact anything that will show what it [17]
will do, at least to some extent, and so prove that you have really made a new invention, invite two or three of your trusted friends to see it.

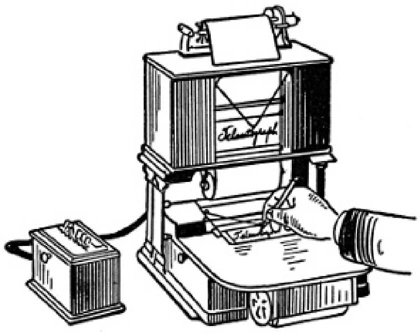


FIG. 11. A TELAUTOGRAPH. A TELEGRAPH FOR REPRODUCING WRITING AT A DISTANCE

Having shown, explained and enthused over it have them go with you to a *notary public* and sign a statement to the effect that they have seen it; then have him put his signature and his seal on it. You have two years from the date you first showed it to develop and file an application for a patent on it but should you fail to do this within the above time limit any one else can take up your idea, if they know of it, work it up and get a patent on it.

Finally keep a note book and write down every thought you have about your
invention, and every experiment you make in good black ink; draw pictures and [18]
diagrams and make photographs if possible of your work as you go along and put them in your book with the dates on them. This kind of a record will furnish you with what patent attorneys call the *evidence of conception,* and which will prove very useful in establishing your prior rights if you should ever get into an *infringement* suit.

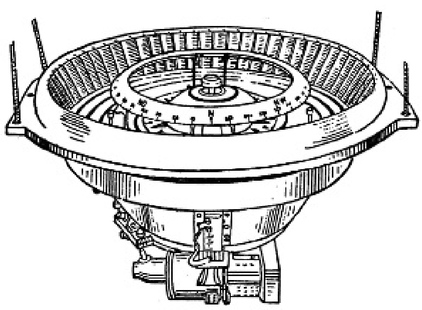


FIG. 12. THE GYRO COMPASS OF A SHIP. A GYROSCOPE TAKES THE PLACE OF THE MAGNETIC NEEDLE

---

[19]

## CHAPTER II

# WORKING IT OUT ON PAPER

The next step after, and sometimes even before, you have thought out your great idea is to make a drawing of the invention it represents.

Nearly every one can do a little *free hand drawing* and this is a good way to make rough sketches to aid the mind in further developing thought.

But if you can make a simple *working drawing* of your device, that is a picture in which all of the parts are drawn in proportion, or to *scale* as it is called, the whole thing will stand out clearly before you and you can see where it is wrong and make the needed changes on paper before you try to build a model.

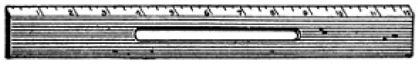


FIG. 13. A TWELVE INCH RULE

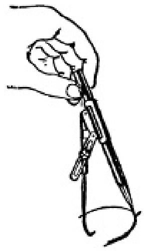


FIG. 14. A PAIR OF CHEAP COMPASSES

**Tools for Making Simple Drawings.—**To make simple working drawings, or *mechanical drawings* as they are called, all the tools you need are a good, straight [20] 12-inch rule, as shown in Fig. 13, *compasses* as shown in Fig. 14, a medium hard lead pencil, a rubber eraser and some smooth white paper.

**How to Make Simple Working Drawings.—**At A in Fig. 15 is shown a drawing in perspective, that is as it would look to the eye, of a *rectangular* box, while B is a top view, C is a side view and D is an end view of the same box; of course the bottom and the other end and side cannot be seen but you can imagine pretty well that they are there if you try to.

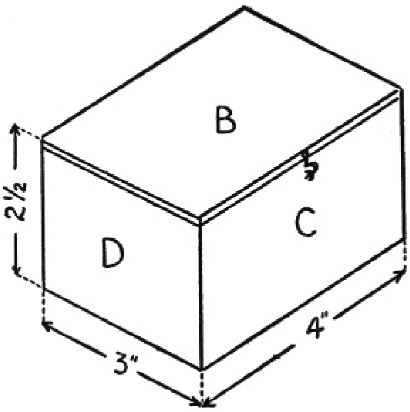



FIG. 15A. AN ISOMETRIC PERSPECTIVE DRAWING OF A BOX

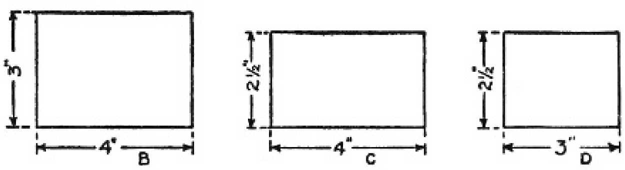



FIG. 15. B, A TOP PLAN VIEW OF THE BOX. C, A SIDE PLAN VIEW OF THE BOX. D, AN END PLAN VIEW OF THE BOX

To show the top, bottom, sides and ends of a box, or other device, you don’t [21] need to draw out the whole thing in perspective but you can make a flat, or plan view of each part as shown at B, C and D in Fig. 15, that is an outline drawing shown as though you were looking squarely at it in the center and with the measurements marked upon it.

If now you will make a set of these working drawings of, say, a box and draw each part to *scale*, that is measured off in proportion, as shown in B, C and D, and saw out of a board the top, bottom, sides and ends and nail them together you will have a box like that shown in perspective at A.

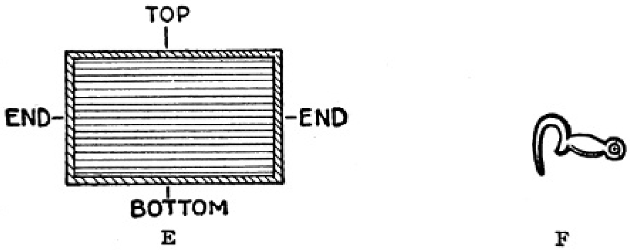



Fig. 15. E, A CROSS SECTION VIEW OF THE BOX. F, DETAILED DRAWING OF THE HOOK

Plan views are easy to draw because they are formed of horizontal and vertical lines, and wheels are shown as true circles. After making your plan views, though, the safest way is to make a perspective drawing to the same scale for when you are looking at a square object as it really is it always appears larger than the plan views would indicate. But this is ahead of the story.

Now suppose you wanted to show how the box would look if it was sawed lengthwise through the middle. You simply make a *cross-section* view of it as shown at E and any one who knows how to read drawings will understand it. To [22] show the hook on the front of the box more clearly it can be drawn separately as at F and this is called a *detail drawing*.

Exactly in the same way any device, apparatus or machine can be shown by top, side and end views and by *cross-section* and detail drawings.

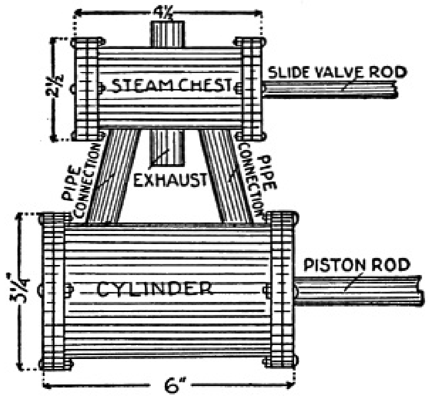



Fig. 16. A SIDE VIEW OF A STEAM ENGINE

Just to see how something a little more complicated would work out on paper, let’s take the cylinder and steam chest of a steam engine. First draw a side view of these parts as shown in Fig. 16.

As the steam chest is a rectangle and every side of it is flat it can be shaded by drawing fine parallel lines spaced equally apart. The cylinder, pipes and rods are round, or rather cylindrical, and to get this effect these parts should be shaded with parallel lines drawn close together beginning at the top and bottom and making them ever farther apart as you get toward the middle and this will give it [23] a rounded appearance.

Next draw the end view of the cylinder and steam-chest. Since the cylinder has been given a diameter of 3¼ inches in the side view, of course it must have the same diameter in the end view as shown in Fig. 17.

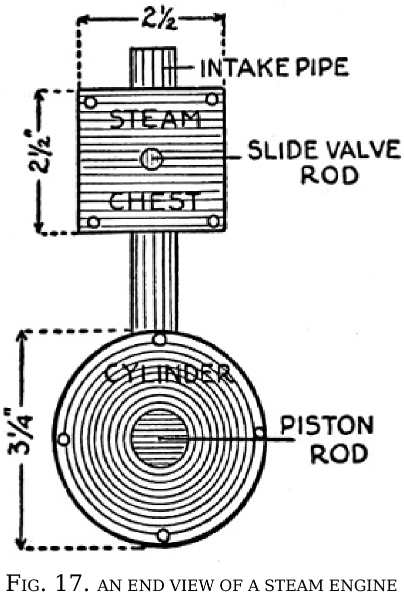



Fig. 17. AN END VIEW OF A STEAM ENGINE

By looking again at Fig. 16 you will see that the steam chest is 4½ inches long and that it is 2½ inches high but it is in the end view Fig. 17, that the width of it is shown. The end of the steam chest is shaded with straight parallel evenly spaced lines and the cylinder head is shaded with *concentric circles*, that is with circles equally spaced apart and having the same center.

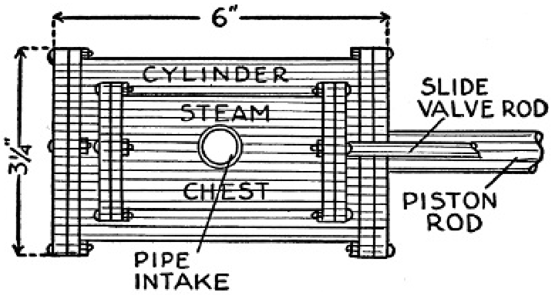



FIG. 18. A TOP VIEW OF A STEAM ENGINE

In this and many other cases a side view and an end view give all the outside dimensions needed but sometimes a top view must also be made, and this is shown in Fig. 18.

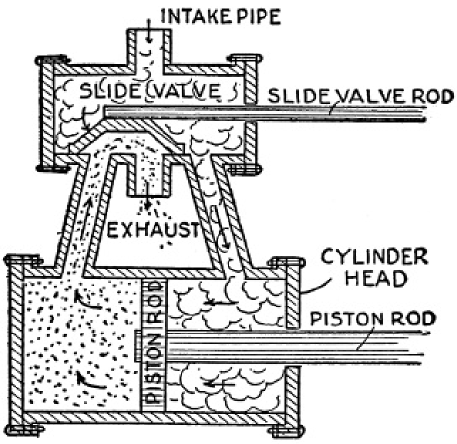



FIG. 19. A CROSS-SECTION OF A STEAM ENGINE

While all of these views show the outside of the steam chest and the cylinder they give no hint as to how the inside is made. Suppose you had invented the steam engine of course you would know how the inside should be made and so you make a cross-sectional drawing of the parts as shown at Fig. 19, and then the construction and even the operation of the engine looms up as though you had turned a searchlight on it. [24]

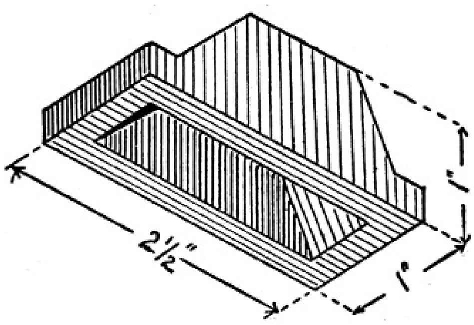



FIG. 20. THE SIDE VALVE SHOWN IN DETAIL

That is all of it will be clear except perhaps the slide valve and this is where a detailed drawing comes in to show a small part, or a part that is hard to understand by looking at the side, end and top views. The slide valve, see Fig. 20, [25] is drawn in detail and the picture is made large and bold. The slide valve is made of a cast piece of metal hollowed out. It and the completed steam chest and cylinder are both drawn in *perspective*, that is just as the eye would see them if they were actually made of metal. The latter is shown in Fig. 21.

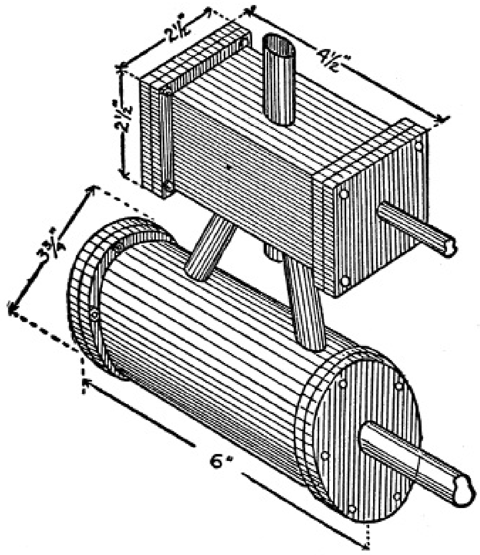



FIG. 21. AN ISOMETRIC PERSPECTIVE DRAWING OF A STEAM ENGINE

[26]

**A Simple Way to Draw in Perspective.**—Did I hear you ask how you can make a drawing in perspective? List and I will tell you the simplest way—a way so that you do it the first time you try.

Buy a quire of *isometric* (pronounced i-so-met´ric) *cross-section paper* 6 by 9 inches, at a cost of 15 cents, of any dealer in drawing materials. This paper is lined in faint colored ink in three directions, as shown in Fig. 22, and which represent length, breadth and thickness.

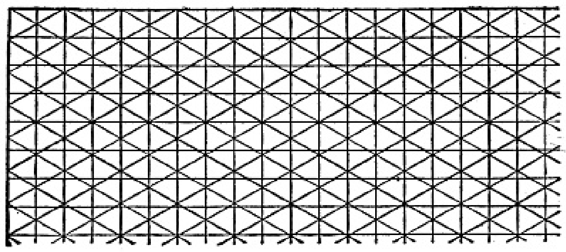


FIG. 22. A SHEET OF ISOMETRIC DRAWING PAPER. THE REAL SHEETS ARE PRINTED IN NEUTRAL TINTS, THAT IS, COLORS WHICH DO NOT INTERFERE WITH THE DRAWING

Now *isometric* comes from *iso* which means *equal* and *metric* which means *measure*, so isometric means *equal measure* and the three lines used in isometric perspective are at equal distances from each other. The lines which cross the vertical lines on isometric cross-section paper are 30 degrees from the base, or horizontal line and the vertical line is, of course, 90 degrees from the horizontal
as shown in Fig. 23. Having everything at hand suppose you try to draw a square [27]
frame. Begin by making the first upright and you will see by looking at Fig. 23 that all you have to do is to draw three vertical lines and join the top and bottom by marking over the 30 degree lines. This done draw three more uprights in the same way and when you have these on paper it is easy to put beams on top or struts between them as shown at Fig. 24.

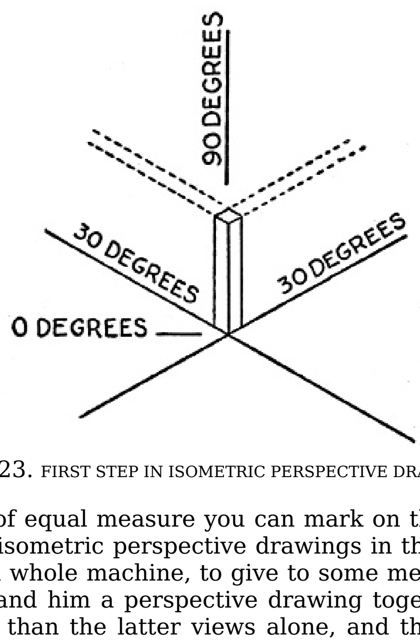



FIG. 23. FIRST STEP IN ISOMETRIC PERSPECTIVE DRAWING

As all the lines are of equal measure you can mark on the exact dimensions as [28]
shown in many of the isometric perspective drawings in this book. For a drawing of some device, or of a whole machine, to give to some mechanic to make for you the better way is to hand him a perspective drawing together with the top, side and end views, rather than the latter views alone, and then he will not need to

figure out how they are put together.

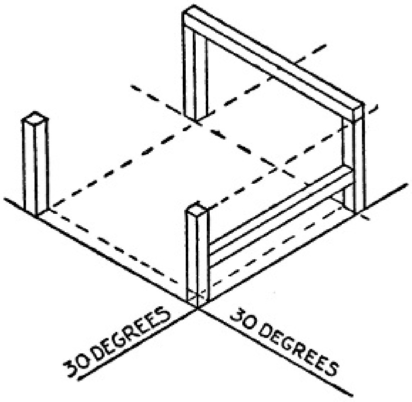



FIG. 24. THE NEXT STEP IN ISOMETRIC PERSPECTIVE DRAWING

To show to a better advantage how isometric perspective works out look at Fig. 25 and you will see how the bearings of a crankshaft of a four cylinder gas engine stand out in a vertical line, up and down and in a horizontal line right and left as though they were real and made in three dimensions.

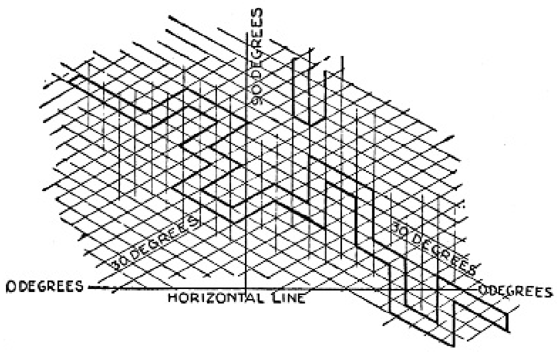



FIG. 25. A CRANK SHAFT DRAWN ON ISOMETRIC PAPER

**How to Make Isometric Paper.—**To make isometric perspective drawings you can get along without the cross-section paper described above though this is [29]
the easiest and most accurate way to get results.

But you can make these drawings on any kind of paper if you know how to use a *protractor* and measure of 30 degrees. To do it right you should have some drawing tools and if you are an inventor you should have them anyway.

**Drawing Tools You Need.—**For making drawings of any kind you should by all means have a *drawing-board* as shown at A in Fig. 26. As a drawing board must be perfectly square and made so that it cannot warp it is better to buy one of a dealer in drawing materials.

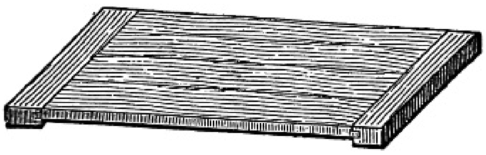


FIG. 26A. A DRAWING BOARD

A good board is built up of thoroughly seasoned strips of white pine glued together and fitted with end ledges; a small board say 12 by 17 inches on the sides can be bought for 50 cents or a little more and it will serve you well. A 12 inch *triangular boxwood architect’s scale* is shown at B in Fig. 26 and is much handier to use than a common rule.

FIG. 26B. A TRIANGULAR SCALE

A beginner’s set of drawing instruments consisting of *compasses*, with pen and [30]
pencil points, a *ruling* pen and a box of leads all in a nice pocket case, as shown at C, Fig. 26, can be bought for $1.25 and these compasses are easier to handle than the one shown in Fig. 14.

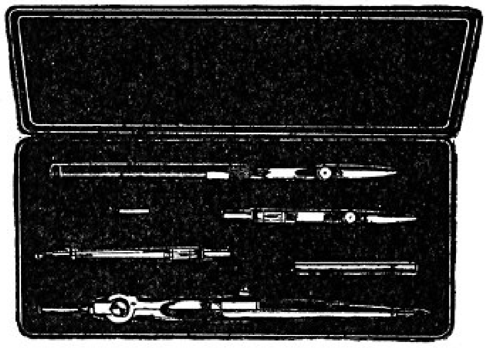


Fig. 26c. A SET OF INEXPENSIVE DRAWING INSTRUMENTS

But the chief instrument you need is a *protractor*, as shown at D, Fig. 26. This is a *semicircle* of brass, or of German silver, 3¾ or 4½ inches in diameter and costs 10 cents or 40 cents, according to the size and metal it is made of.

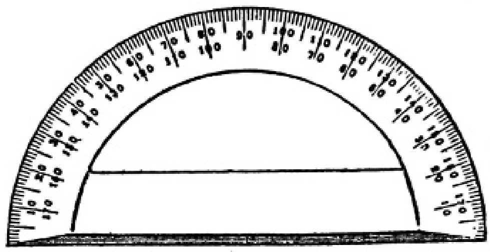


Fig. 26d. A PROTRACTOR FOR MEASURING CIRCLES AND ANGLES BY DEGREES

A protractor, as you may or may not know, is used to lay off *angles* and to [31] measure *angles* in *degrees*. The curved part or scale of the protractor is divided into 180 degrees since there are 360 degrees in a circle. The figures start at both corners with 0 so that an angle of any number of degrees right or left can be marked off. Now the lines formed by marking off angles of 30 degrees are the only ones you will have to make for isometric perspective. To do this fasten a sheet of paper to your drawing board with thumb tacks at each corner and draw a straight line across the paper near the bottom. Put your protractor on the edge of the paper and the pencil line exactly as shown in Fig. 27; lay your rule so that its edge crosses the straight part of the protractor at the middle, marked A in the drawing and also on the line of the scale of the protractor marked 30 degrees and then draw a line on the paper along the edge of your rule.

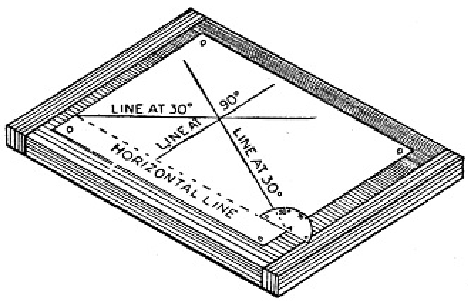



Fig. 27. THE POSITION OF THE PROTRACTOR ON PAPER

This done place the protractor on the opposite and left hand edge of the paper and the horizontal line and lay your rule with its edge crossing the middle of the [32] straight part of the protractor as before and on the 30 degree line of the scale and so that when you draw the line it will cross the other 30 degree line as shown in Fig. 27.

If now you draw another line at 90 degrees, that is vertically, between the two crossed lines, also as shown in Fig. 27, each of the three lines will be exactly the same distance apart in degrees. You can go ahead now and draw lines ⅛ inch apart parallel with each of the three lines and you will have a sheet of isometric cross section paper of your own making.

**How to Draw Isometric Ellipses.—***An Easy, Rough Way.*—There is just one more little thing you should know about making isometric perspectives and that is how to draw disks, wheels and anything else that is circular in form so that they will look right and be right.

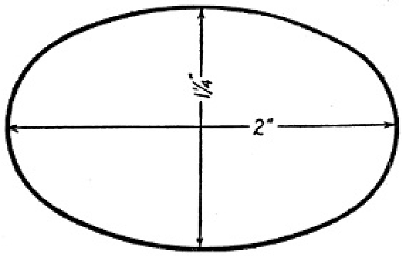



FIG. 28A. THE PROPORTION OF AN ISOMETRIC ELLIPSE

In isometric perspective everything that is round in reality is drawn in the shape of an *ellipse*, that is a closed curve that is longer than it is wide as shown at A in Fig. 28; there are different shaped ellipses but there is only one used for [33] isometric drawing and this is always in the ratio of 1¼ to 2; that is if an ellipse is 2 inches long it will be 1¼ inches wide; an ellipse 4 inches long will be 2½ inches wide and so on.

An easy, though rough way to draw an isometric ellipse is to make a line as long as the diameter of the disk or wheel you intend to represent; draw another line which is the width of the ellipse through the center and at right angles across it, see A again and then draw the curved line around the end of them free hand.

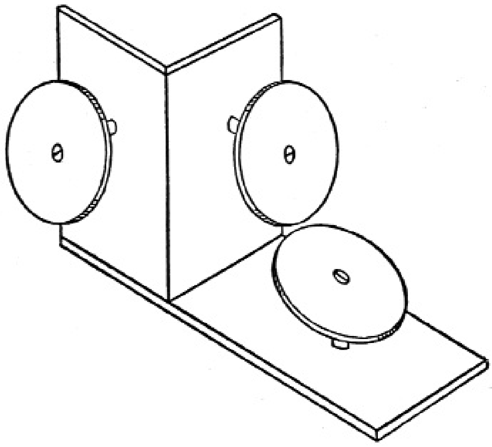


FIG. 28B. HOW ELLIPSES STAND OUT IN RELIEF

How these ellipses are made to appear as if they were set either in a vertical or a horizontal position and at right angles to each other is shown at B in Fig. 28. The *axis*, that is the spindle, or shaft on which the disk, or wheel, is mounted, must always follow the 30 degree line running at right angles to the edge of the [34] board or whatever it is supposed to be fastened to or goes through; and the thickness of the disk or wheel is always shown on the same sides as the thickness of the board or other part on which it is mounted, all of which is brought out clearly at B in Fig. 28.

**How to Draw an Isometric Ellipse.—***A Harder but More Accurate Way.—* Begin by drawing a straight line as long as you want the longest axis of your ellipse to be, as shown at A B, Fig. 29. Divide this line into four equal parts. Now take your compasses and with the needle at the center of the line O draw a circle having the line as its diameter.

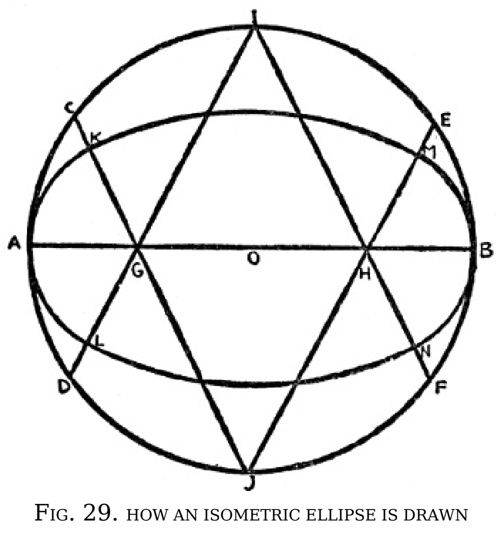



FIG. 29. HOW AN ISOMETRIC ELLIPSE IS DRAWN

Next start at A with your dividers and divide the whole circle into ten equal parts and then take your rule and draw a line from the point C on the circle through the point G on the diameter and *produce*, or extend it to the bottom of [35] the circle; draw a line from D through G and extend it to the top of the circle; draw a line from E through H and extend it to the bottom of the circle when it will intersect the line C G at the point J; and finally draw a line from F through H to the top of the circle which will intersect the line D G at I.

Take your compasses and using G as a center draw the arc K A L; then using H as a center draw the opposite arc M B N; using the point J as a center, draw the arc K M so that its ends will meet the upper ones of the end arcs perfectly; using the point I as a center draw the fourth and last arc L N when the ellipse is completed.

When making isometric ellipses much care must be taken to make all the points [36] and draw all the lines with the greatest accuracy as the slightest error will distort the whole thing.

**How to Shade Drawings.—**Besides the few hints for shading perspective drawings which I have given above there are certain ways to shade cross-sections and elevations to show whether it is made of metal, glass, wood, liquid, cork, carbon, insulation or other materials. There are also different kinds of shading to show fine and coarse fabrics and the various colors.

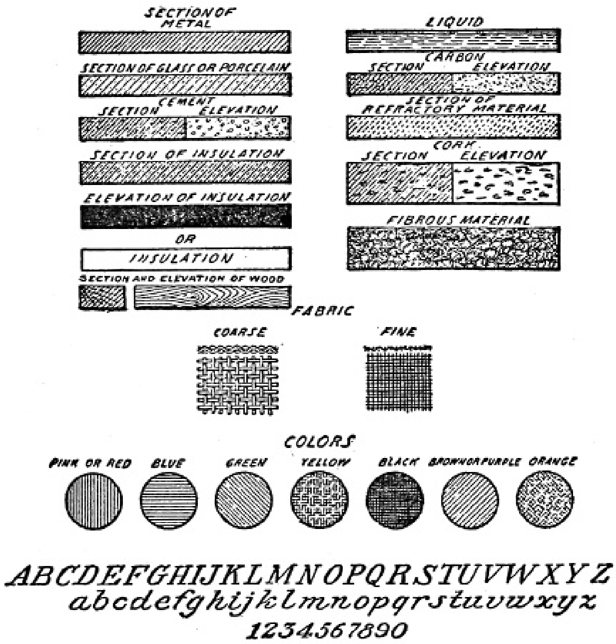



FIG. 30. A SHADING AND LETTERING CHART FOR DRAWINGS

The patent office has prepared a chart showing the shading that should be used to represent the different materials and colors and these are reproduced in Fig. 30. The letters of the alphabet both *upper* and *lower case*, as the capitals and little letters are called, which are used by mechanical draftsmen are also shown in Fig. 30. As these letters and figures are clear, easy to make and are preferred by the patent office they are good ones for you to use.

**How to Make Electrical Symbols.—**In making drawings, either for yourself or for the patent office, of electrical apparatus to show how it is connected up you do not need to draw out a plan view or a perspective of each part but you can make what are called *symbols*.

Symbols are simply a few lines or signs that stand for or represent a certain [37] piece of apparatus; as an illustration suppose you want to show a dry cell, all you need to do is to make a couple of parallel lines, one shorter and heavier than the other like this:

and if you want to show a battery you make as many pairs of parallel lines as there are cells in this fashion:

And just so with every separate piece of electrical apparatus, and all of them are [38] shown at A and B in Fig. 31.

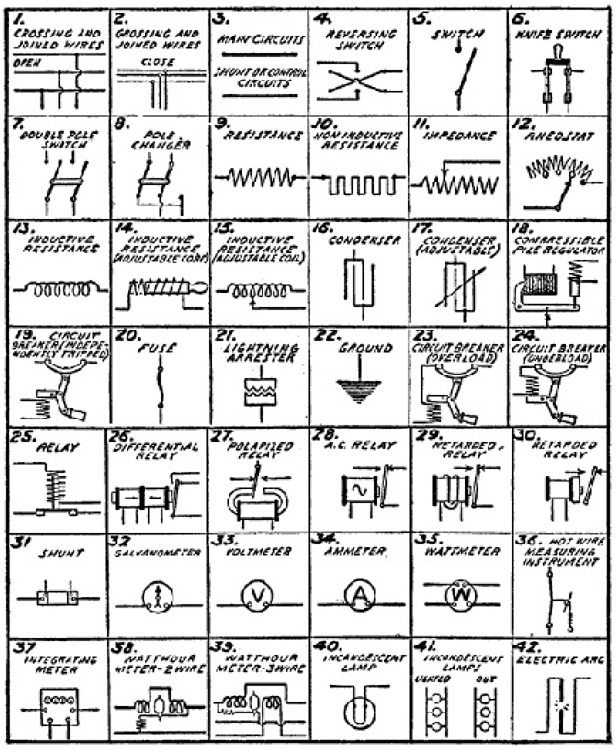



FIG. 31A. A CHART OF ELECTRICAL SYMBOLS

Large illustration

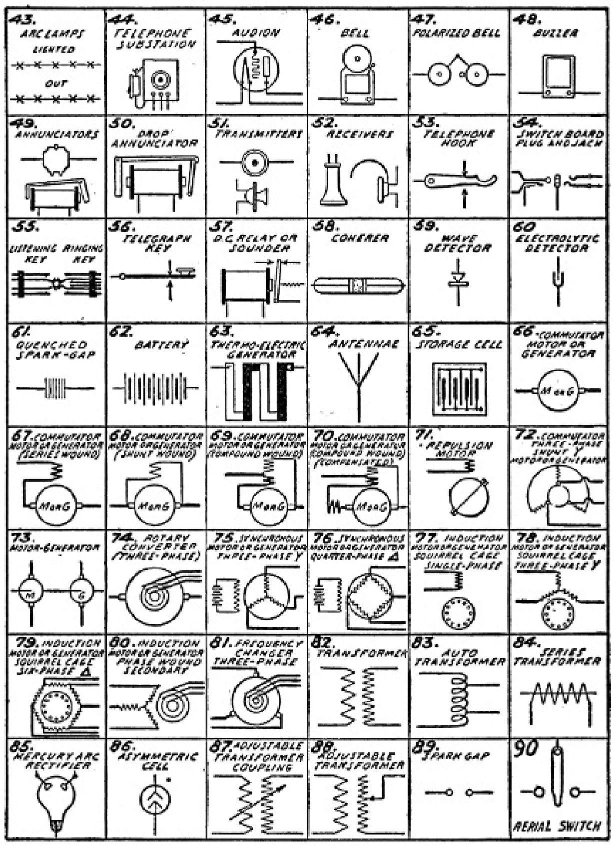



FIG. 31B. A CHART OF ELECTRICAL SYMBOLS

Large illustration

[39]

**How to Read Electrical Diagrams.—**From the plates of symbols given at A and B in Fig. 31, you will see that the symbol for a battery is a pair of parallel lines as shown above, that the symbol for a motor is made in this fashion:

and that a switch is made like this:

now if you want to show a battery, a motor and a switch wired together all you have to do is to join the symbols with lines as shown at C in Fig. 31 and you will have what is called a diagram.

You can *read* a diagram, that is understand how it is connected up, in an instant for you can see at a glance how the wires run. Because the wiring is shown so simply and clearly diagrams of this kind are usually called *wiring diagrams*.

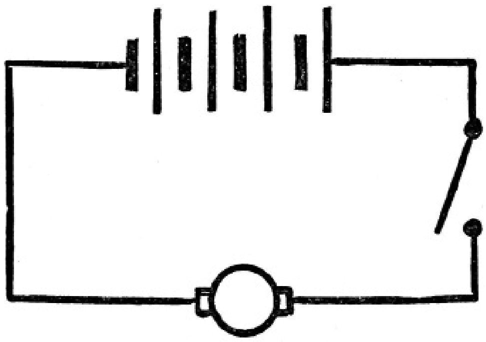


FIG. 31C. A SIMPLE WIRING DIAGRAM

In drawing wiring diagrams try to place each symbol in such a position that the connecting lines which represent the wires cross each other as seldom as possible, otherwise your diagram will be confused and it will be hard to follow out the circuits.

[40]

**Some Aids to Drawing.—**The following aid to drawing and designing was published in the *English Mechanic* and you will find it very helpful if your invention has to do with an automobile, aeroplane, or any large machine which is used or actuated by a person.

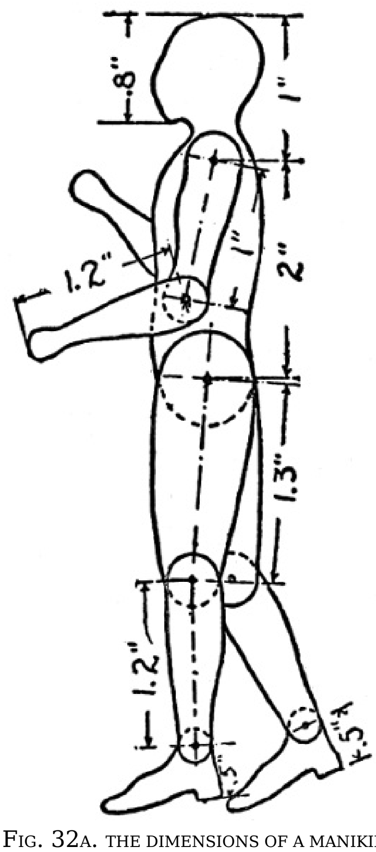



FIG. 32A. THE DIMENSIONS OF A MANIKIN

Make a manikin, that is a little jointed figure of a man as shown at A in Fig. 32. The figure can be made to any scale but 1 inch to the foot which is $\frac{1}{6}$ full size is a good ratio to make it but it must of course be made to the same scale as the machine you are drawing.

To get the right proportions rule a sheet of paper a couple of inches wide and about 8 inches long so that the divisions will be $^1/_{12}$ inch square and draw on this the different parts of the manikin as shown at B in Fig. 32. Now since every $^1/_{12}$ inch on the paper is equal to 1 inch for a man 6 feet tall your manikin will be 6 inches high when it is jointed and complete. [41]

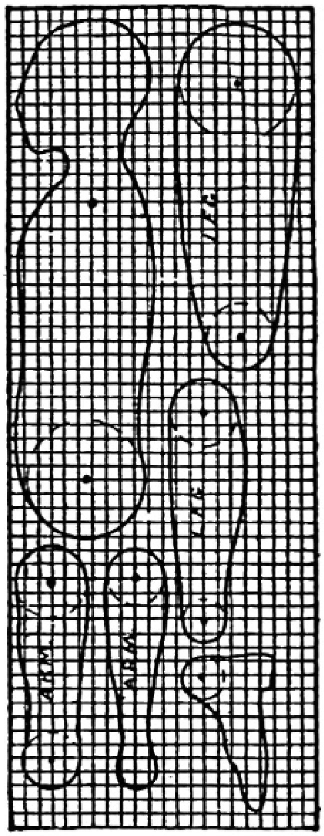


FIG. 32B. THE PROPORTIONS OF A MANIKIN DRAWN ON CROSS-SECTION PAPER

The figure can be made of cardboard if it is to be used only a few times but thin wood, celluloid or hard rubber, or sheet tin, brass or copper will make a much more substantial one. Whatever the material that is used the edges of each part should be filed smooth; and when you rivet the parts together to make the joints the latter should work smooth and yet stiff enough so that the parts will stay in [42]
whatever position you place them.

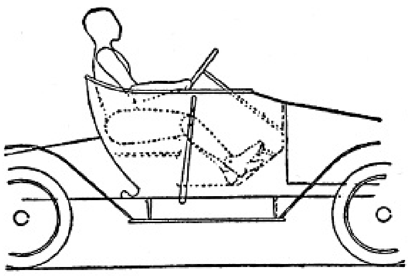


FIG. 32C. A TRIAL POSITION OF THE MANIKIN

When you lay the manikin on your drawing you can see whether or not the levers are in the right places as shown at C and D in Fig. 32.

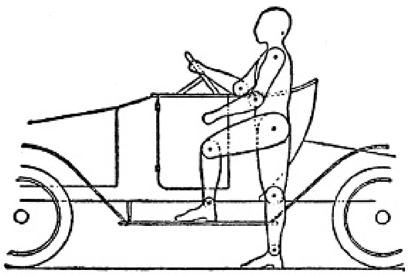


FIG. 32D. ANOTHER TRIAL POSITION OF THE MANIKIN

**Making Cardboard Models.—**In drawing out your invention you will often find that you can't get the image you have in your mind's eye down on paper.

There may be the movement of a lever, the turning of a wheel or the motion of
a cam that you cannot quite see through and try as you will to work it out on [43]
paper the thing refuses to materialize. Under such conditions it would be a great waste of time and money to set about building a real model but there is an easy way out of the difficulty and that is to make a cardboard model of the device.

Just as an illustration take the case of an aeroplane. Say that your big idea is a scheme for controlling the *elevating planes* and the *direction rudder*; you have clearly in mind the use of an elevating plane on each side of the rudder and yet when you try to draw it out these two parts won’t fit together at all as you expected them to do.

When you reach this point get a sheet of heavy cardboard, shears, bottle of liquid glue, pins, matches or toothpicks, some thin wire, a few corks and a sharp knife.

Out of these materials you can build up the *fuselage*, as the body of the aeroplane is called; next you can fasten on the rudder and then the elevation planes; and when you have the tail-planes put together with real materials and actual shapes and sizes they will stand out in bold relief and you will have no trouble in making your drawings from the cardboard model.

Or suppose you have an idea for a gyro-motor such as are used for driving aeroplanes. Now in this motor the shaft to which the pistons are fastened stands still and the cylinders in which the pistons move revolve. It is rather a curious motion and not easy for a fellow who is not posted on mechanics to grasp offhand.

What’s the thing to do? Why, make a cardboard model of the mechanism using pins for the shafts and you will have a model that will look like Fig. 33, and when you turn the cardboard disk with the cylinders marked on it you will see at once exactly how the motor works. [44]

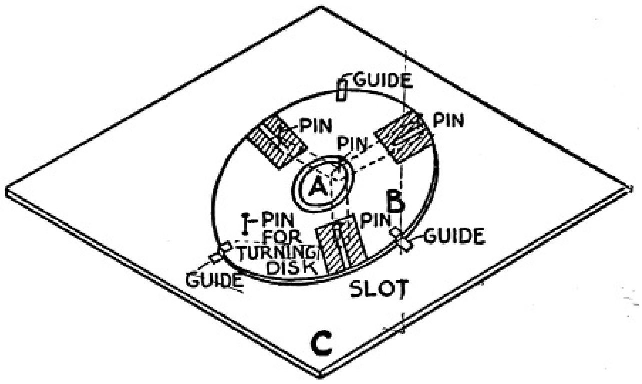



FIG. 33. A CARDBOARD MODEL OF A GYRO ENGINE

And so it is with many other contrivances; when you come to any part that doesn’t seem to fit or is not clear, make a cardboard model and your troubles will vanish as dew-drops in the morning’s sun.

---

[45]

# CHAPTER III

## THE STATE OF THE ART

Taking it for granted, now, that you have drawn out your invention on paper and have made cardboard models of the more difficult parts so that you can see about what your device or machine will look like and how it will work your next move is to look up the *state of the art*.

**What is Meant by State of the Art.—**The state of the art means everything that has been published either in books, papers, or in patents about anything that has been discovered or invented, which has a bearing on your invention.

As an instance the *state of the art* of the *dynamo electric machine*, or *dynamo* as it is called for short, goes clear back to 1833 when Faraday made the experiment of passing a wire across the pole of a magnet and found that a current of electricity was set up in it—that is in the wire. Since that time hundreds of patents have been taken out and thousands of articles have been written about dynamos.

All of this information, or *data* as it is called, goes to make up the state of the art in the class of dynamos and all of the patents can be had and many of the articles too if you know how to go about it to find them and one of the purposes of this chapter is to tell you how to do it. [46]

**Use of the State of the Art.—**You can easily understand that with all the thought that has been given to, and the experimental work that has been put on, dynamos to the end of bettering them it is a pretty hard thing to make an improvement that has not been made before, though it is still quite possible to do so.

Suppose, then, you had thought of and worked out on paper some improvement on the dynamo which you believed to be new and original and of great value. Certainly since you know that inventors like Edison, Brush, Weston, Thompson, Tesla, and a hundred other men almost as big, had applied themselves with diligence to dynamo problems during the last 40 years you would not care to go very far in spending your time or your money working on it until you learned whether or not some one before you had thought of and used the same *principle*.

Yet hundreds of beginners in the field of inventing work along in the dark because they do not know the state of the art, and always to their sorrow. So don't be one of them.

**How to Learn the State of the Art.—**For the reasons I have given above you will see that it is bad practice to go beyond the point of working out your invention on paper before you know whether it is really new or not for though it may be entirely original with you, if it has been thought of and read before some learned body of scientists, or printed in some musty trade paper prior to the time [47] you conceived the idea you haven't the slightest claim to it, nor is it of the least value to you.

And so after you have thought out your invention and have made drawings of it the next step *is not* to apply for a patent as most patent attorneys will advise to do, or to have a model made as many model makers will tell you to do but *to look up the state of the art* and see where you are *at*.

**Having a Patent Attorney Look it Up.—**The easiest and quickest way to learn roughly the state of the art is to have a *preliminary search*, as it is called, made by a *patent attorney*, which means that he will look through the files of patents that have been granted by the *United States Patent Office* to other inventors for devices or machines of the kind you are working on.

To do this you must, of course, *retain* a patent attorney, that is employ him, and turn the drawings and written description of your invention over to him. Every patent attorney outside of Washington, where the patent office is located, has a *correspondent* or an associate, that is another patent attorney, who lives there and who acts for him when necessary.

This latter patent attorney will take your drawings and description to the library of the patent office, look over the files of patents there and pick out those which seem to him are most nearly like your invention.

He will get copies of these patents, send them to your patent attorney who will in turn hand them to you with your original drawings and you can then go over [48] them and compare them and judge for yourself whether you have a really new invention or if it burned in the brain of some other inventor before you ever dreamed of it.

From the above you might infer that it would be a good scheme to employ a patent attorney who lives in Washington; but on the contrary it is better to have a patent attorney in your own city transact this business for you, if one is to be had, for then you can talk with him and you will learn many things you couldn't begin to find out through correspondence.

Many advertising patent attorneys agree to make what they are pleased to call a *free search* for you—and do it while you wait, so to speak. A free search, or *desk search*, as it is dubbed by those who don't make them, is of no value whatever for it is the snap-shot opinion, or rather a notion, of a patent attorney who is drumming up business by un-business like methods.

To show how absurd an opinion of this kind is just consider that there are 43 *divisions* of inventions in the patent office; each division, is split up into anywhere from a dozen to nearly 200 *classes* and that in some of these classes as many as 12,000 patents have been granted as in the case of the sewing machine.

And when you ask a patent attorney of this ilk to make a free search for you he will write back a letter in this tone of voice: I have very carefully considered your *sketch*, etc., etc. The first payment of fees necessary to start your case is $20 and upon receipt of this amount I will be very glad to carry the case forward, etc., etc. [49]

All patent attorneys who advertise that they will make a search for you free of charge will also make what they call a *special search* for which they charge $5.00, and any other patent attorney will make one for the same price and which is, after all is said and done, only a *preliminary search*.

You can buy a copy of any patent that has been *issued* by sending 5 cents in coin—the government won't take its own stamps—to the *Commissioner of Patents, Washington, D. C.*, that is if you know the number and date of it and the name of the inventor to whom it was granted. The patent attorney who makes the preliminary search will send you several copies of the patents nearest like your drawing without extra charge as these are, or should be, included in your $5.00 fee.

When you get the copies of these patents go over each one carefully and see how nearly the pictures are like yours; then read the description of the invention, or *specification* as it is called, and compare it with your own statement, and, finally study the *claims* at the end of the specification and pick them to pieces for in these are to be found what has really been allowed to the inventor by the patent office.

The patents found by the patent attorney in making a preliminary search of the files and which are sent to you does not by any means represent the whole state of the art, but they serve a useful purpose as a starter. The reason it is not [50] complete is because the patents are usually selected by patent attorneys in virtue of their similarity to the drawings you have submitted to him. Sometimes, to be sure, he reads what the specification says and if he is a real good patent attorney he will sift out a few of the claims, though this is usually due to his patent training rather than to any conscientious desire on his part to get at all the facts in the case.

But when you have applied for a patent on your alleged new and useful improvement and it is being scrutinized by the *examiner* in the patent office, he will look up the state of the art in all its devious *ramifications* for this is what he is paid to do by the people of the United States, though he thinks it is the officials in Washington who employ him. At any rate he has plenty of time to do it in and ample assistance to do it with.

Nor does he merely take a glance at the drawings, specifications and claims of your patent application and compare them casually with others that have been granted along the same line of endeavor, but, instead, when enough pressure is brought to bear, he will look up everything that has ever been published in all languages, including the barbaric *ro*,[1] since Adam was a boy.

At other times and for no reason at all, or so it seems, he will of a verity go to sleep on the job in his sub-cellar and let an application slip through his room in a [51] few months, while he will spend years on another application of the same kind. Of course if you are the fortunate one you will be glad to get a patent granted so easily; your patent attorney is glad because he has your money in his pocket and the examiner is glad because he has made a friend of his glad.

To have everybody glad is a nice thing, you will allow, but don’t crow too soon for there is a hole in the average patent big enough to drive a horse and wagon through. If your patent is for an invention of genuine merit you will not be alone very long in the field and should you commence to make anything that looks like real money out of it you will find some other genius with an invention and a patent, as like yours as the other Siamese twin and if you don’t sue him he will sue you and then you can fight it out in the courts.

Even as right is always on the side of the army with the heaviest artillery, if there are enough shells, so, too, justice is always on the side of the inventor who has the smoothest patent attorney and the cleverest experts if they have enough ammunition in the way of some claims. While it requires skill to draw up good claims they can in any case be made better where the state of the art is known by yourself and your patent attorney.

**How to Look It Up Yourself.—**Whatever the nature of the invention you are working on you should read up its history from its earliest beginnings and in this [52] age of papers, books and public libraries this is an easy, entertaining and profitable thing to do.

As an illustration take the art of flying and let’s suppose you are working on a new *wing*, or *main-plane*, for an aëroplane; if you will go over the list of books sold by book publishers, or consult the catalogue of a public library you will find books on flying, or *aviation* as it is called, that will give you a full account of the development of flying machines; and if you will get the right book it will picture and describe all the forms of wings that have been invented and patented up to the time the book went to press. Then there are weekly and monthly papers published which are devoted entirely to the theory and practice of flying and by reading these you will be able to keep right up to the *entering edge* of the art.

Now what I have said about flying is just as true of whatever else you may happen to be working on, for books and papers are printed and published about nearly every subject you can think of, from aviation to wireless telegraphy; by reading up on the subject of and allied to your invention you will soon have the history of it by heart and this makes up a large part of the state of the art.

Another and fortunate thing when you look up the state of the art a lot of other ideas will surge helter-skelter through your mind and if you are careful to write them down many of them will be of much value to you in the furtherance of your invention.

If you live in a large city it is an easy matter to look up the patents that have [53] been granted for inventions in your class, for you will find an *Index of the Patent Office* in the public library which gives the number and date of the patent you want and the *patentee’s name*. The *Index* is published every year by the Unites States patent office and it gives the alphabetical list of the patentees and of the inventors to whom patents were granted for that year.

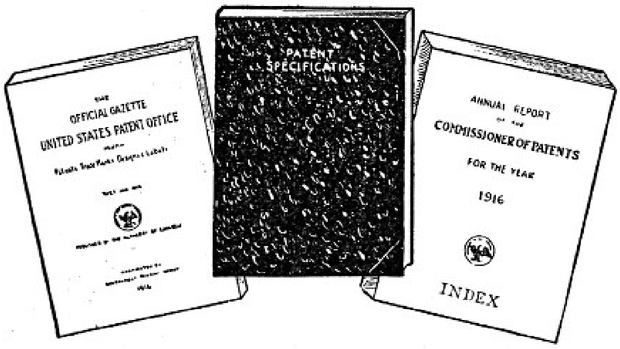



FIG. 34. THE OFFICIAL GAZETTE
FIG. 35. PATENT SPECIFICATIONS
FIG. 36. INDEX TO PATENTS

Having found the patent you want to look into, get the *Official Gazette* of the patent office for the same year and by looking up the number, or patentee, or invention, or all of them, you can easily locate an *excerpt* of the patent and then you can take a look at the drawing and read the principal claims.

The *Official Gazette* is published every week by the patent office and it contains a picture and a brief description of each patent issued for that week, together [54]
with the number and date of the patent, the name of the patentee and of the invention.

Should you require more information about a patent than is given in the *Gazette* you can look up a copy of the patent, or *full specification* as it is called, and these are bound in handsome volumes of 100 patents each, or at least, this is the practice of the New York Public Library.

In every library that has a *patent section*, that is a part devoted to patents, there is a librarian in charge who will either find any patent you want or who will show you how to use the *Index*, *Official Gazette* and the volumes of the *full specifications*.

The patent attorneys in Washington have things much easier as all of the patents are bound in books according to the class they are in and they only need to look over the volumes of a given class to choose those they want.

When you have learned everything you can from books, papers and copies of patents already granted about the subject you are interested in you will have a pretty clear idea of the state of the art and whether you are working in a virgin field or one that has been sown with the same kind of inventions by others.

But there is another and most important part of the state of the art which neither you nor your patent attorneys can find out about until after you have filed your application for a patent; this is the information contained in the applications for patents by other inventors before your application was filed.

Should another application *disclose* either in whole or in part an invention like, [55]
or nearly like, yours, or rather that your invention is like, or nearly like, some one's else, the patent examiner declares what is called an *interference*, of which more will be said in another chapter, and this gives the patent attorneys on both sides another chance to rake in a few more fees.

**What to Do When You Find There Are No Other Improvements Like Yours.—**After you have looked up, or have had looked up, the state of the art as carefully as possible, and you are satisfied that your invention, or improvement, is different from everything else you have been able to find, you should by all means go ahead and make such experiments, or build a working model, as the case may be, in order that you may know that all you have thought about it is really true.

As soon as your experiments are completed or your model is finished so that you know exactly what you want to *claim* as being strictly new and novel and original with you, then you are in shape to hire a patent attorney to draw up your patent application and file it and don't do the latter a moment before.

A patent application based largely on what you *guess*, is a patent when granted without value for it can no more cover the exact facts in the case when these are finally worked out than a description one might write about an imaginary trip to Europe would be likely to fit the true details of a real trip which he would make sometime thereafter.

**When You Find There is a Resemblance.—**Very often you will find after you [56]
have looked up the state of the art that some other inventor has patented a device that seems on the face of it quite like yours and yet when you examine them critically, compare them closely and bring thought to bear upon them you will be able to distinguish a difference and often in several respects.

Sometimes this difference, though it seems to be small, is a mighty one when it comes to producing results as for instance when Elias Howe used a needle with the eye near its point instead of in its head and so made the sewing machine a commercial success. And yet a patent examiner of to-day would not be likely to see any difference in a needle with an eye in its head and one with an eye near its point, that is, if he had never seen either one before.

If you have made a machine to do a certain thing and you find that another machine has been invented that does the same thing and in the same way you may be able to change the mechanical movements, or electrical devices, until you are able to get the same or a better result by other and better means. It is all very easy to tell you to do this but in practice it is often a mighty hard thing to accomplish.

The Bell telephone is an example of such difficulties, for while both transmitters and receivers can be made which work on principles quite different from those now in use the results are not nearly as good and hence the inventions have no practical value.

**When Others Are Exactly Like Yours.—**But when you find that your great idea has been thought of and worked out and patented by some other inventor ahead of you and that both the cause and effect which you and he arrived at are the same, then the best thing to do is to drop it like a hot potato and invent something else. [57]

Note.—The Patent Office publishes a *Manual of Classification*, price $1, which lists all of the sub-divisions of each class. Take as an illustration *Explosives*, which is *Class 53*. This is subdivided into six such classes, namely: (1) Blasting Powder; (2) Fulminates; (3) Nitro Compounds; (4) Gun Powder; (5) Matches; (6) Pyrotechnic Compounds.

---

[58]

# CHAPTER IV

# HOW TO EXPERIMENT

The kind of experimenting you will do will, of course, depend altogether on the nature of the invention on which you are working.

But, as good fortune would have it if you are not mechanically inclined you are not apt to hit upon a mechanical invention. And if you know nothing of electricity, you are not likely to think out an improved electrical device.

But this much is certain if you are going to experiment the right way you must know something about the right way to experiment. No one should expect to work out to a successful conclusion a new machine or apply a new improvement to an old machine if he knows nothing of the *first principles of mechanics* or *about mechanical movements*, and by rights he ought to have some knowledge of *machine design*.

And the above statement is just as true of electrical inventions. A worker who does not know the difference between a binding post and an alternating current need not expect to progress very far with an invention of, say, an electric block signal system—unless he calls in an expert to help him; but what he should do is to study the principles of electricity and magnetism, learn the various currents [59]
that can be used and what apparatus and instruments are needed for utilizing these currents.

The same thing applies to inventions in chemistry in that to work intelligently you must know about the properties of substances, chemical change and acids, bases and salts. And with electro-chemistry both a knowledge of chemistry and electricity are needed.

It is easy to see that it would not be possible in the limited space I have here to say more than a word or two about the subjects of mechanics, electricity, chemistry and electro-chemistry when each requires a whole chapter to explain it even in a rough way and a whole book to explain it thoroughly. But there are a few things I can tell you about them that will put you on the right track and then I shall give you the names of some books that will be of great service to you when you are in need of them, and with your help we’ll make a real inventor of you.

**How to Experiment with Machines.—**Any one who possesses the slightest bent for mechanics can work out improvements on devices like egg-beaters and monkey-wrenches and feel their way as they go along.

But when it comes to designing and building real machines where numerous levers, gears, and springs are combined to make a working unit you should by all means read up on the subjects of *work, energy and power*, learn about the *six mechanical powers*—and the action of machines in general. The following definitions will give you an idea about all of them.

[60]

**Work, Energy and Power.—**A wheel will not turn of its own accord but if it is moved round by some *force* applied to it such as the hand, a coiled spring or a motor, *work* is done. In fact whenever a thing is made to change its position work is done.

The power to do work is caused by *energy*; energy is developed when some force is applied and can be stored up in bodies as when a ball is thrown. When the energy stops acting, or is used up, there can no longer be any work done. Energy can be *transferred* from one body to another, as from a clock-spring to a wheel, or from one wheel to another wheel; and energy can be *transformed*, as the chemical energy of a battery into the rotary energy of a motor or from steam into mechanical motion.

The *unit of work* is the *foot-pound* and this is the work done to raise *one pound one foot high*. The *rate* of doing work is the *horse power* and a horse power is equal to lifting 550 foot-pounds in a second, or 33,000 foot-pounds in a minute.

Energy may be either *potential* or *kinetic*; *potential energy* means energy that is stored up and with nothing to act on, and for this reason it is called *energy of position*. The electric charge of a Leyden jar is potential energy but the moment it is released it makes a spark and becomes *kinetic energy* or *energy of motion*. Potential energy can be changed into kinetic energy and kinetic energy back again into potential energy with amazing freedom. Energy has a definite relation
to *velocity* which means that when the speed of a moving body is increased its [61]
power to do work is also increased.

Like matter, energy cannot be destroyed, and so all of it taken together is called a *constant quantity*. When the energy stored up in a spring, or a battery, has been used the energy is not destroyed, though it may be very hard to find out where it has gone, but you may know that it has vanished in heat and in other forms of energy.

**Work Against Friction.—**The chief resistance which machines have to overcome is caused by *friction*. Since there is no such thing as a perfectly smooth surface friction is always present in machines and much energy must be spent in overcoming it. The energy wasted by friction is not destroyed but is transformed into another kind of energy and that is heat. When a marble is rolled over the surface of a table there is less friction between the two than when the marble slides across the table. Hence with *ball bearings* there is less friction than with *cone bearings*. (See Appendix I.)

**Forms of Energy.—**There are nine forms of energy that you can make use of in your experiments and in your inventions, and these are:

| | | |
|---|---|---|
| Energy of Masses | Bodies in Motion—kinetic. | |
| | Bodies under Stress (like a coiled spring). | Potential. |
| | Bodies attracted by Gravitation. | Potential. |
| | Sound—both kinetic and potential. | |
| Energy of Molecules and Atoms | Heat. | |
| | Molecular and Atomic Energy. | |
| | Chemical Action. | |
| Energy of Ether | Electric and Magnetic Actions. [62] | |
| | Light and Invisible Radiation. | |

**Machines and the Principles of Machinery.—**A *machine* is a contrivance of mechanical parts by which energy is transferred from one part to another. Beside the amount of energy required for doing useful work there must be an extra amount for overcoming the friction. Remember that no machine can either create energy or increase it, and, as you have seen, every machine wastes some energy in friction; this being true it must be clear then that it is impossible to make a machine which when once set in motion would continue to run forever, or at least until its parts were worn out. So don't waste *your energy* in trying to invent a *perpetual motion* machine.

**The Uses of Machines.—**These are many and varied from a commercial point of view in that they are designed to do better, faster or cheaper work and sometimes all of these good qualities are found in a single machine.

From a mechanical point of view, though, a machine is used to

(1) Change one form of energy into another form, as steam into electricity.

(2) To make a slow moving, but powerful force produce a high speed or velocity, as in a sewing machine.

(3) To change a small, fast moving force into a powerful force, as in the action of a crowbar.

(4) To change the direction of a force so that the power can be applied where and when it is needed, and [63]

(5) To make use of whatever force is at hand as the strength of animals, wind, water, steam, gas and electricity.

**The Six Mechanical Powers.—**As a matter of fact there are really only two of these, namely the *lever* and the *inclined plane*, the other four, that is the *wheel* and *axle*, the *pulley*, the *wedge* and the *screw* being simply modified forms of the first two.

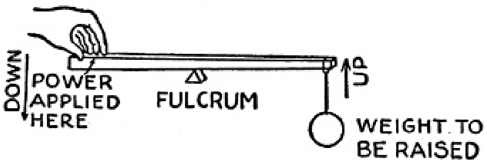



Fig. 37a. a lever of the first class

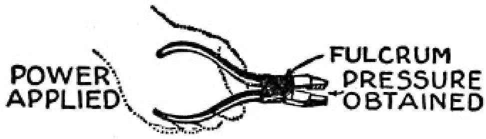



Fig. 37b. a pair of pliers

The *lever* is a rigid bar resting on, and which can be moved about a fixed point, called the *fulcrum*. There are three classes of levers and these are: [64]

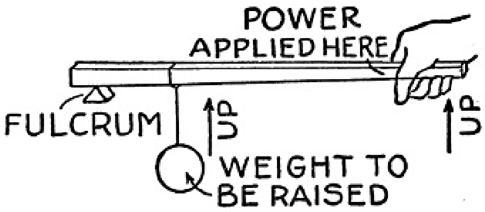



Fig. 38a. a lever of the second class

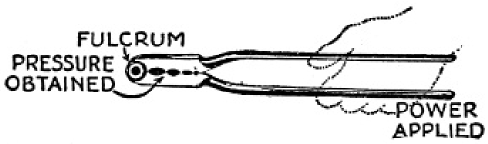



Fig. 38b. a pair of wire splicing clamps

(1) Where the fulcrum is placed between the load and the power which moves it, as shown at A, Fig. 37; a pair of shears, pliers, a balance and a crowbar are levers of the first-class, see B, Fig, 37.

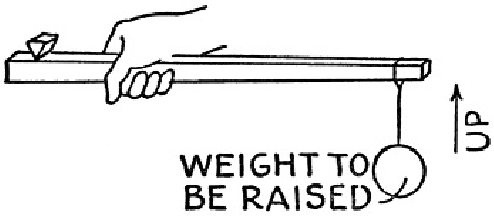



Fig. 39a. a lever of the third class

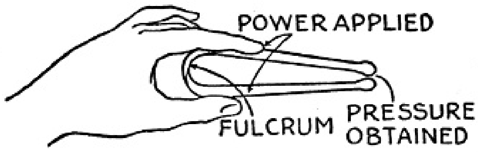



Fig. 39b. a pair of sugar tongs

(2) Where the load is applied between the power and the fulcrum, as shown at A, Fig. 38; a lemon squeezer and wire splicing clamps are examples of this class; see B, Fig. 38, and

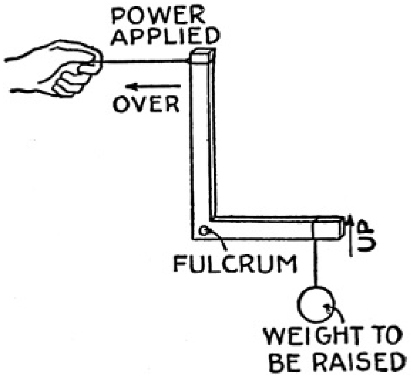



FIG. 40. A BENT LEVER

(3) Where the power is applied between the load and the fulcrum as shown at A, Fig. 39; the foot treadle of a jig saw and sugar tongs are levers of this class. See B, Fig. 39. Then there is the *bent lever*, as shown in Fig. 40, where the power and load do not act parallel with each other, and the *compound lever* which takes [65] the place of a single long lever as shown in Fig. 41, and which is used in large platform-scales.

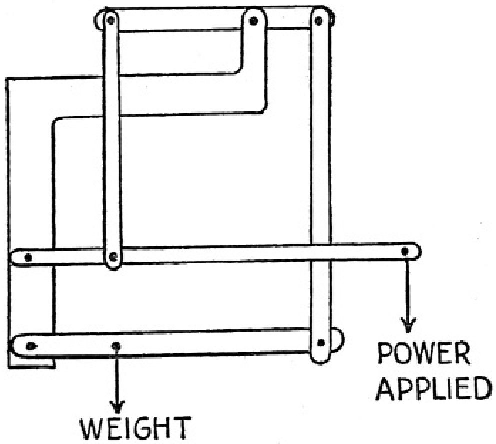



FIG. 41. A COMPOUND LEVER

The *wheel* and *axle* is really a form of lever and fulcrum. The axle provides a continuous fulcrum as shown in Fig. 42. Trains of wheel work, such as are used in clocks and other mechanical devices, are used to change a slow moving powerful [66] force into a high speed, or velocity, or the other way about. Fig. 43 shows a train of wheel work.

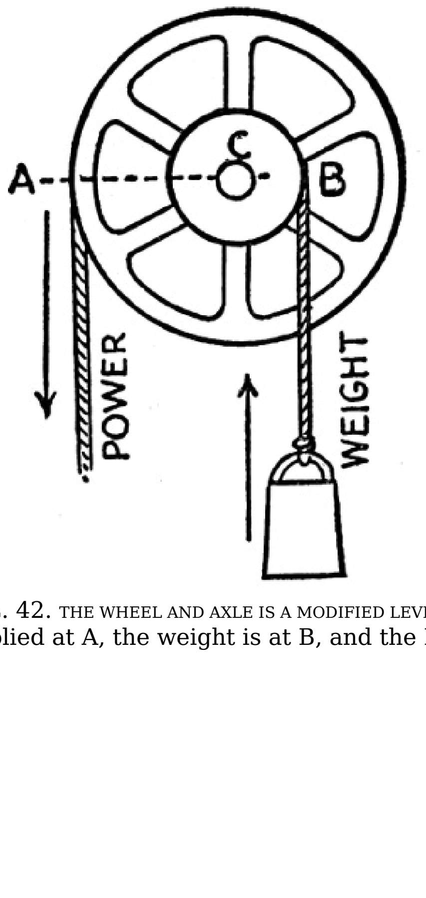



FIG. 42. THE WHEEL AND AXLE IS A MODIFIED LEVER
The power is applied at A, the weight is at B, and the Fulcrum is at C.

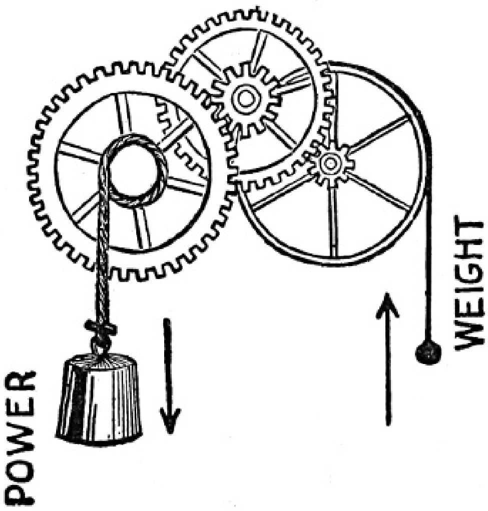



Fig. 43. A TRAIN OF WHEELS OR WHEEL WORK

The *pulley* is a wheel with a cord, rope or belt running round it as shown in Fig. 44. It is used to transmit power and also to change the direction of it. A pulley can be either fixed or movable. A *compound pulley* makes it possible to raise a heavy weight with a very small force, not by increasing the energy, but by transposing *velocity* into *power*. [67]

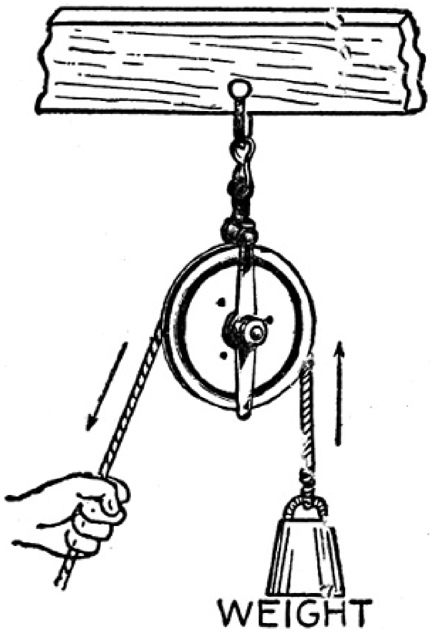



Fig. 44. A FIXED PULLEY

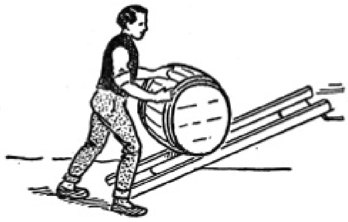



Fig. 45a. AN INCLINED PLANE
Fig. 45b. ONE OF THE USES OF AN INCLINED PLANE

The *inclined plane* is any hard smooth surface set at a slant to the force to be overcome. A barrel can be rolled up an inclined plane against the force of gravity, as shown in Fig. 45, while it could not be lifted straight up to the same height. [68]

The *wedge* is simply an inclined plane on a small scale. It is useful where a great force must be exerted through a small distance, as in splitting a stick of wood, as shown in Fig. 46.

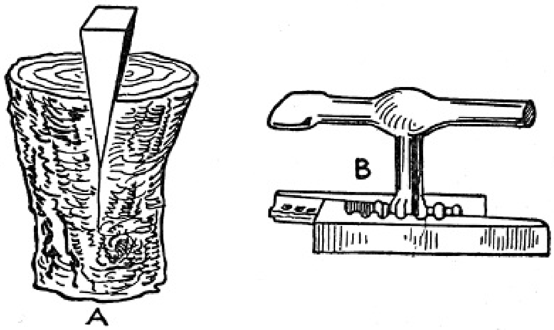



FIG. 46A. A SIMPLE WEDGE
FIG. 46B. TWO WEDGES FORM A PRINTER'S QUOIN

A *screw* is also a modified form of an inclined plane. By means of a screw great pressures can be exerted in a small space and here again a powerful force is had with a corresponding loss of velocity. It is shown in Fig. 47.

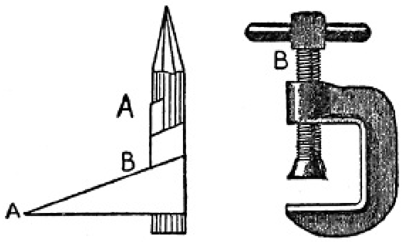



FIG. 47A. THE THEORY OF A SCREW
FIG. 47B. A SCREW CLAMP

[69]

**Compound Machines.—**Any of the above six simple machines can be combined with any or all of the others and every machine that has ever been invented for any purpose is made up of a combination of these six mechanical powers.

Since the beginning of invention there has been made by combining these six mechanical powers in different ways, a large number of simple machines called *mechanical movements*; and there has not been a single new mechanical movement invented in many years.

Hence when you begin to work on your machine don't waste time and energy trying to devise the mechanical movement you need, or what is still more foolish attempting to invent a new mechanical movement but look at the pictures in Fig. 48 which gives over 60 of the most useful mechanical movements. If you cannot find one among them that will do the work then look for it in Gardner D. Hiscock's book of *Mechanical Movements* which gives them all.

**Books.—**And it would be a good idea for you to read one of the following books which you can, most likely, get at any library:

*Elementary Physics*: Elroy M. Avery.
*Elements of Physics*: Edwin J. Houston.
*Elements of Physics*: George H. Hoadley.
*College Physics*: A. L. Kimball.

The first-named books go deeply enough into the subject of physics for all ordinary purposes while the last named is very thorough and has a lot of *math* in it; and all of them treat of liquids, air, electricity and magnetism, sound, heat and light. In whatever field you are working a general knowledge of physics will give you the key to a new and a mighty interesting world.

[70]

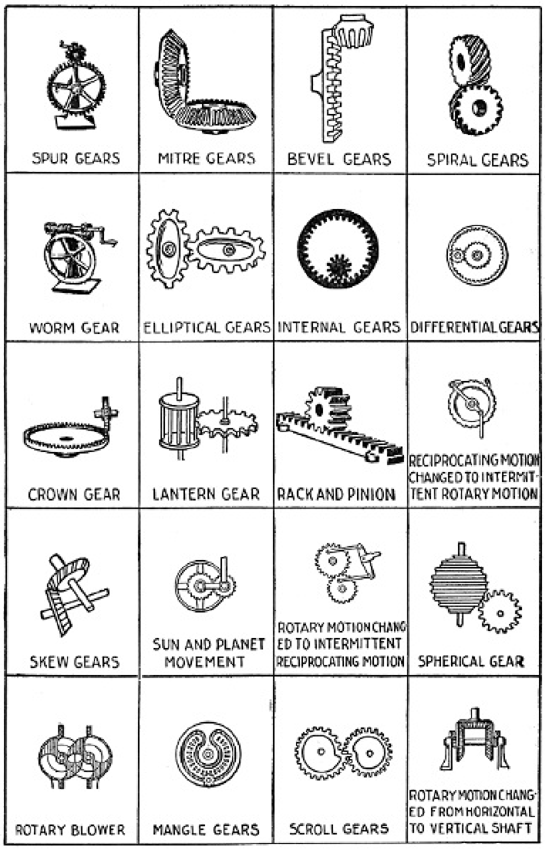



Fig. 48a. some useful mechanical movements

Large illustration

[71]

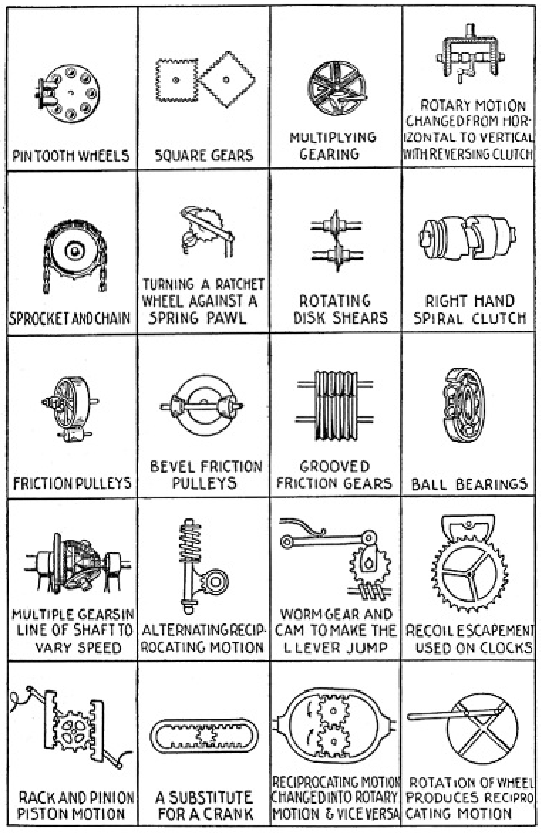



Fig. 48b. useful mechanical movements

Large illustration

[72]

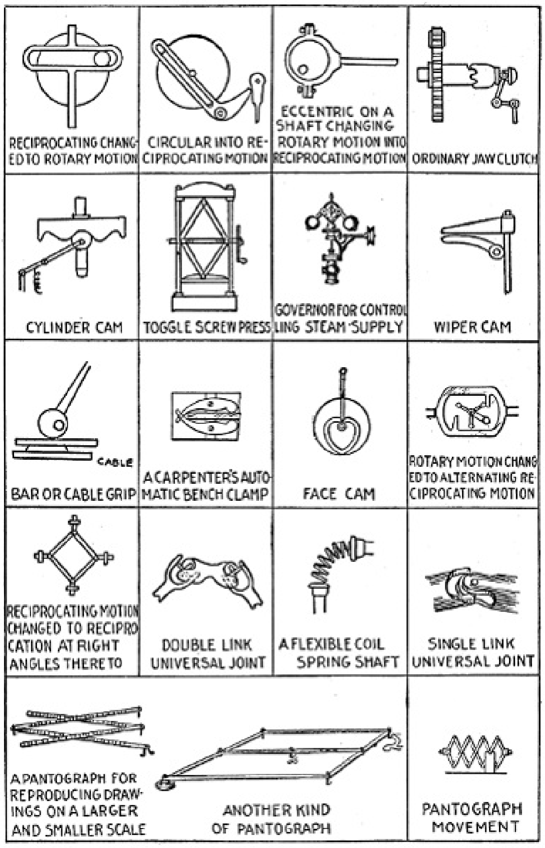



FIG. 48C. USEFUL MECHANICAL MOVEMENTS

Large illustration

[73]

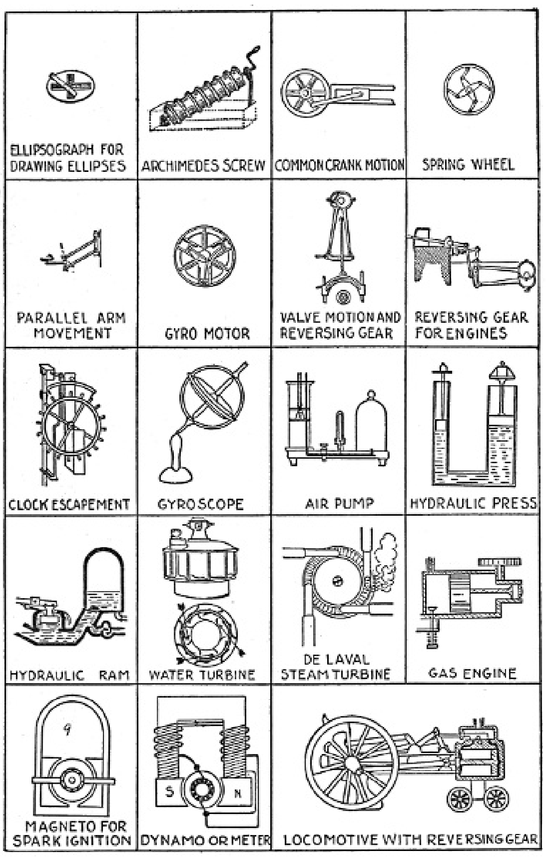



FIG. 48D. USEFUL MECHANICAL MOVEMENTS

Large illustration

With the first principles of mechanics well in mind and the mechanical movements I have given, you can go on with your experiments in a safe and sensible way. [74]

**How to Experiment with Electricity.—***Electricity* is very much like mechanics in that any one can put up an electric bell or screw in a plug-fuse but to experiment and build an apparatus in which electricity and magnetism are the powers used you must know how electricity is generated, how magnetism is produced, the different forms of electricity that are available and finally the kinds of apparatus best suited for the work that is required of them.

**Forms of Electricity.**—Though there is only one kind of electricity it can be divided into four classes, or forms, and these are:

(1) Electricity at rest, or *static electricity*, that is electricity stored up but not active as in a charged Leyden jar.

(2) Electricity in locomotion, or *current electricity*, in which electricity flows along wires, through solutions and other conductors when it is able to do work.

(3) Electricity in rotation, or *magnetism* in which electric whirls produce attraction and repulsion, and:

(4) Electricity in vibration, or *radiation* in which electric charges moving to and [75]
fro millions of times a second set up waves in the *ether* which our eyes can see and which we call *light*. Then there are waves much too short for the eye to see and these are called *ultra-violet* waves; there are waves too long for the eye to see and these are the *infra-red* waves which we can feel for they are *heat* waves, and finally there are very long waves set up in the ether by surging *high frequency* currents in wires and these are called *electric* or wireless waves.[2]

**Static Electricity.**—You can think of electricity as being a fluid, like water, for it has both *quantity* and *pressure*, and in many ways it acts like a fluid.

If you filled a tank, raised above the ground, with water, the latter would be at rest, but it would be under pressure too and the moment a hole was bored in any part of the tank below the level of the water it would squirt out; in other words the *potential water* would be changed into *kinetic* water or water in locomotion. If, now, you charge a *Leyden jar*, or a *condenser*, with electricity it will be at rest until you bring the alternate coatings of tin-foil closely together when a spark will result and a current will flow.

Static electricity is generated by *friction* and by *induction*, but the electricity so produced is very small in quantity and very high in pressure. A Leyden jar, or other condenser can be charged, though, with a low pressure current of electricity, as in a *spark coil*.

[76]

**Current Electricity.**—Whenever electricity flows in a wire, or other conductor, it acts like water flowing through a pipe and it is then called *current electricity*. The two most common ways to generate a current of electricity is by means of a *chemical battery* and by a *dynamo electric machine*.

A current of electricity may have a small *current strength*, as its quantity is called, and a high *voltage*, as its pressure is called, like the discharge of a Leyden jar, or it may have a large current strength and a low voltage, as a current generated by a battery.

A *direct current*, see Fig. 49, is a current which flows steadily in one direction and this can be generated by a battery or a dynamo. An *interrupted current*, see Fig. 50, is a current that is *made* and *broken* a number of times a minute and this is usually done by a *vibrator*, or *interruptor* as it is often called. A *pulsating current*, see Fig. 51, is one whose current strength is varied. One way to produce a pulsating current is to talk into a *telephone transmitter* which is connected with a battery.

FIG. 49. A STEADY DIRECT CURRENT

FIG. 50. AN INTERRUPTED DIRECT CURRENT

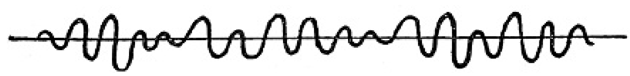


FIG. 51. A PULSATING DIRECT CURRENT

An *alternating current*, see Fig. 52, is one which flows first in one direction and [77]
then in the other direction. A *magneto-electric machine* and an *alternating current generator* are the means for generating this form of current. Alternating current can be produced from a direct current by using an *induction coil*, or *spark coil* as it is called. But a steady direct current can be obtained from an alternating current only by coupling an *alternating current motor* to a *direct current* dynamo.

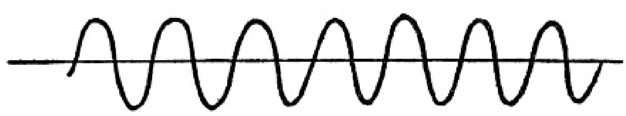


FIG. 52. AN ALTERNATING CURRENT

The pressure, or voltage, of an alternating current can be *stepped up* or *stepped down*, that is, raised or lowered, by means of a *transformer*, which is the simplest form of induction coil. The current strength varies proportionately with the charges in pressure so that there can never be any increase in the total amount of energy but there is always a loss of energy due to heating and other causes. The moral again is that an electrically driven perpetual motion machine is [78] a delusion and a snare. Alternating current can be changed into *interrupted direct current*, see Fig. 53, by an *electrolytic rectifier* or a *mercury vapor tube*.

FIG. 53. ALTERNATING CURRENT CHANGED INTO AN INTERRUPTED DIRECT CURRENT

A *high tension current* is an alternating current of sufficient pressure to make a *jump-spark*; it can be produced by a *high-tension magneto*, or a *spark coil*. An alternating current is generally considered one that changes its direction less than 100,000 times a second; when it changes its direction 100,000 times or more a second it is called an *oscillating current*, see Fig. 54, or a *high frequency current*, and this is the form of current that is used for sending out *wireless waves*.

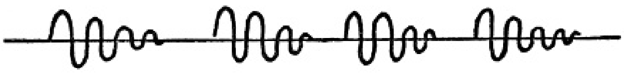


FIG. 54. A PERIODIC OSCILLATING CURRENT

The only known way to set up oscillating currents of really high frequency is by discharging the stored up electricity of a condenser, or its equivalent, through a circuit of small resistance by means of a spark, or an arc. The latter sets up sustained oscillations as shown in Fig. 55. *High frequency alternators* (machines) have been built which generate alternating currents of over 100,000 *cycles* per second.

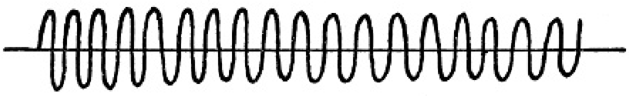


FIG. 55. A SUSTAINED OSCILLATING CURRENT

**Magnetism.—**A bar of steel can be made magnetic by rubbing it on a *permanent steel magnet* or on an *electromagnet*, or winding a number of turns of [79] wire around it and passing a current through the wire.

If a bar of soft iron is placed in a coil of wire and a current is made to flow round it the iron will become a magnet but remains so only while the current is flowing, and this forms an *electromagnet*. An electromagnet works best on a direct current but an alternating current can also be used to energize it.

A coil of wire with an *air core*, that is without either an iron or a steel core, becomes a magnet when a current is made to flow through it. If, now, one end of a bar of soft iron is slipped into the hole in the coil of wire and the current is turned on the iron bar, or core, will be drawn into it. This kind of a magnet is called a *plunger electromagnet*, or *solenoid*.

**Radiation.—**Whenever you light a match, or make a light by any other means, electric charges on the molecules of the substance which is heated vibrate violently to and fro and the minute surgings of the electric charges set up *electro-magnetic* waves in the *ether* which the eye can see and the brain can sense and this is what we call *light*.

When some substances are intensely heated, as for instance, the *carbons* of an *arc lamp*, waves are also sent out which are too short for the eye to see but which will nevertheless affect a photographic plate. These are called *ultra-violet waves*. The *infra-red* waves are too long for the eye to see but the nerves of our bodies sense them as heat.

[80]

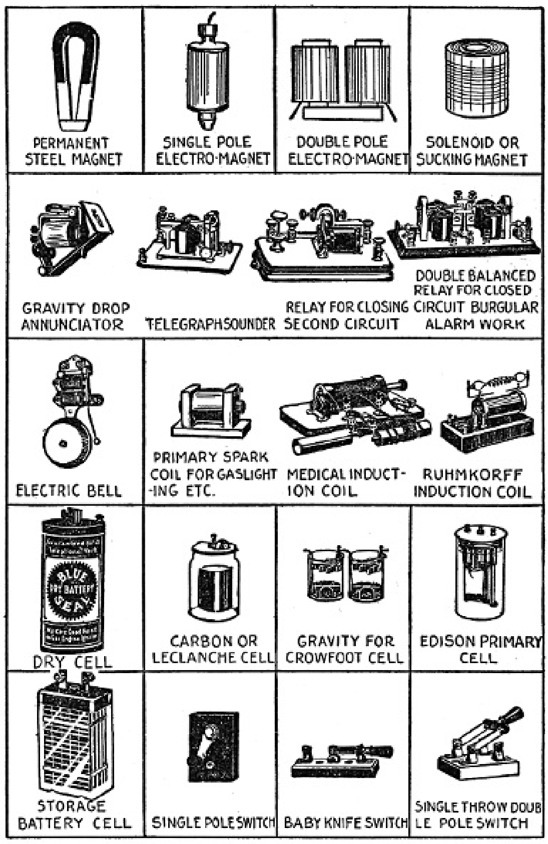



FIG. 56A. SOME USEFUL ELECTRO-MECHANICAL DEVICES

Large illustration

[81]

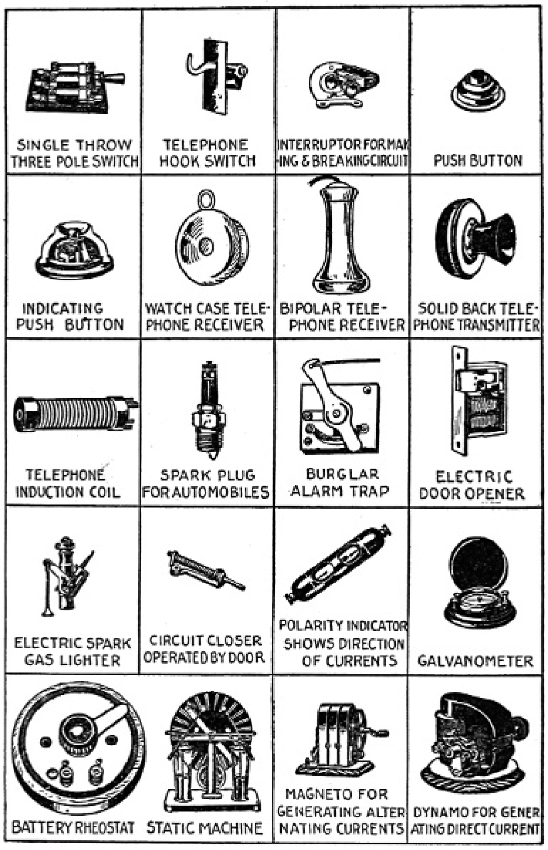



FIG. 56B. SOME USEFUL ELECTRO-MECHANICAL DEVICES

Large illustration

In conclusion take this bit of advice: don't try to invent a new kind of electric current and don't try to devise a new *electro-mechanical movement* for in either case you will waste your time. Every form of current and every kind of electro-mechanical device you will need for any machine which you may invent are at hand and ready for use. Fig. 56 shows a number of electro-mechanical devices and these will aid you in getting the result you want. [82]

**Books.—**The books on physics listed on page 69 go deeply enough into the subject of static and current electricity and magnetism for all ordinary purposes of invention, but if you are interested in *wireless* and *high frequency electricity* then I would suggest that you read the following books:

*The Book of Wireless.* A. F. Collins.
*Manual of Wireless Telegraphy.* A. F. Collins.
*Wireless Telegraphy and High Frequency Electricity.* H. LaV. Twining.
*Electric Wave Telegraphy.* J. A. Fleming.

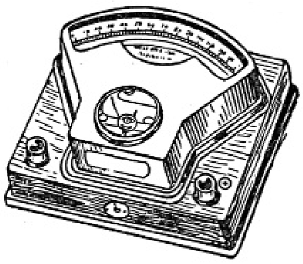



FIG. 57. AN AMMETER FOR MEASURING CURRENT
FIG. 58. A VOLTMETER FOR MEASURING PRESSURE

**Your Electrical Equipment.—**Should your invention call for experiments in electricity, especially where the amount of current used is a factor, you should provide yourself with a good *ammeter*, as shown in Fig. 57, for measuring the current in *amperes*, and a *volt meter*, as shown in Fig. 58, for measuring the pressure, or *voltage*, in *volts*. (See Appendix O.) [83]

Where the resistance in *ohms* of a wire, or a circuit of any kind must be known a *combined bridge and resistance box* is the best way to make accurate measurements. Resistance boxes measuring from .001 ohm to 17.600 ohms can be bought of the L. E. Knott Apparatus Co., Boston, Mass., for about $18.00. It is shown in Fig. 59.

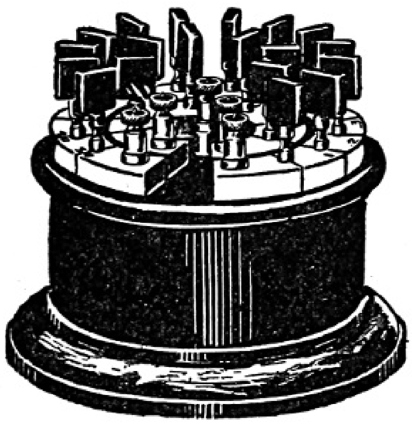


FIG. 59. A RESISTANCE BOX FOR MEASURING THE RESISTANCE OF WIRES

A large number of electrical devices call for winding wire on cores, spools, coils, etc. Nearly all windings can be done on a lathe but if a lathe is not among your treasured possessions you can make a *winder* which will serve all ordinary purposes. The drawings shown at A and B, Fig. 60, give all the details of construction and you can make one chiefly of wood of whatever size your winding calls for. [84]

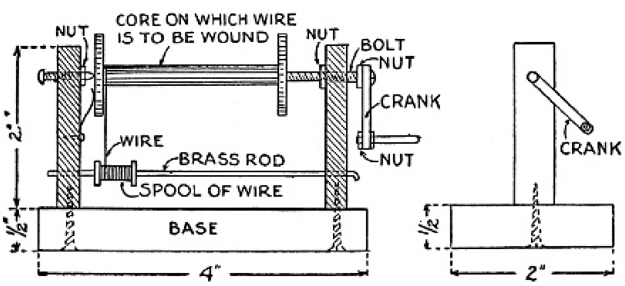



FIG. 60. AN EASILY MADE WINDING DEVICE
A. A side view
B. An end view

**How to Experiment with Chemistry.—**It is a pleasant pastime to make chemical experiments after a known formula but it is quite a different and a difficult thing to try to invent some new chemical compound when you know little or nothing of chemistry.

If your invention calls for some *chemical combination* or *decomposition* or *double decomposition*—these are the three kinds of chemical action—get an elementary book on chemistry and study it until you really know it and then you will have a bed-rock foundation on which to build up your invention.

You may say it is all very well to read a book on chemistry and learn all about it but it’s a mighty hard thing to do without a teacher. My answer is if you are not interested in chemistry, you will certainly find the study of it up-hill work and very tedious.

But if you are working on an invention like, say, *synthetic gems*, that is making [85]
real rubies and sapphires and emeralds in an oxy-hydrogen furnace, see Fig. 61, you will not only study but you will study harder than you have ever studied before if you believe it will help you to find the solution of the gem problem. It is under these conditions that work-study becomes play-study and you will be fascinated with it and it will then prove pleasant as well as profitable.

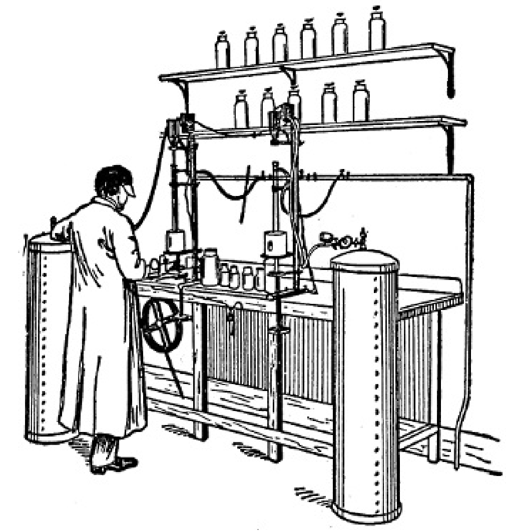
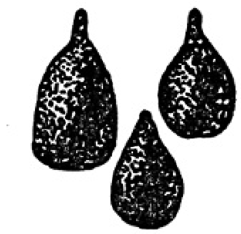


FIG. 61A. MAKING A REAL RUBY BY CHEMISTRY



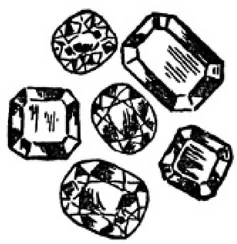


FIG. 61B. RUBY BOULES AS THEY COME FROM THE FURNACE
FIG. 61C. SYNTHETIC RUBIES AFTER THEY ARE CUT

[86]

**Your Chemical Equipment.—**The chemical apparatus you will require depends entirely on the class of work you are doing but for all ordinary chemical experiments the following apparatus will be found useful: (1) a nest of beakers; (2) a jeweler’s blowpipe; (3) one-half dozen wide mouth flint bottles; (4) a Bunsen burner with regulator, that is if you have gas, or (5) an alcohol lamp; (6) a glass U tube; (7) a nest of Hessian crucibles; (8) a nest of porcelain crucibles; (9) an evaporating dish; (10) a lead dish; (11) a couple of glass funnels; (12) a glass bottle with a two hole stopper; (13) half a pound of glass tubing; (14) a porcelain mortar and pestle; (15) a plain glass retort; (16) a stoppered retort; (17) 3 or 4 feet of ¼ inch rubber tubing; (18) a sand bath; (19) a dozen test tubes; (20) a test-tube stand; (21) a test-tube clamp; (22) a test-tube brush; (23) an iron retort tripod; (24) one-half dozen watch glasses; (25) a water bath; (26) some wire clamp supports; (27) a couple of platinum plates; (28) an air bath; (29) a burette; (30) a pinch-cock, and (31) a brass scale with weights. See Fig. 62.

All of the above apparatus can be bought of any dealer in chemical or school apparatus for ten or twelve dollars. For advanced work you will need other apparatus but whatever your requirements may be you can either buy the apparatus ready made or have it made to order.

As to chemicals these will likewise depend on the nature of your experiments.
Send to Eimer and Amend, 205 Third avenue, New York City, for a catalogue and [87]
price list of chemicals and chemical apparatus as they sell everything used by chemists and electrochemists.

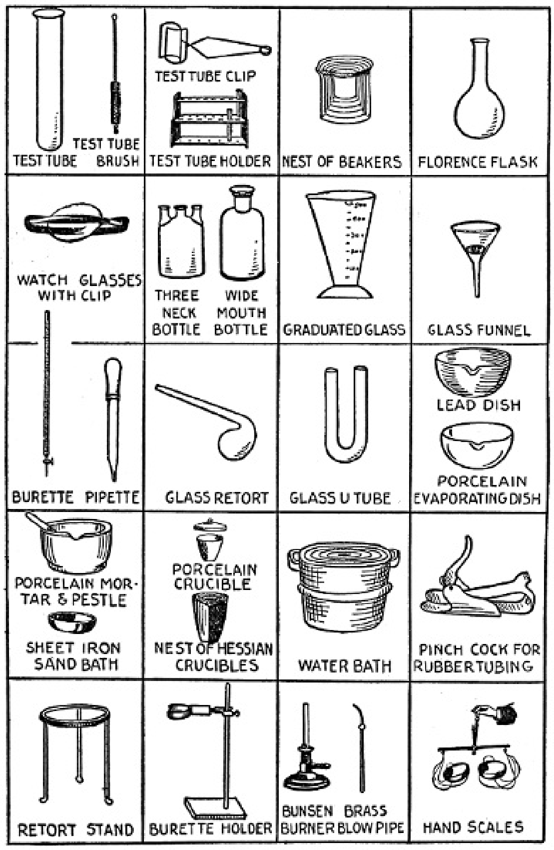



FIG. 62. SOME USEFUL CHEMICAL APPARATUS

Large illustration

**Books.—**The following books with the exception of the last one are good elementary treatises on chemistry: [88]

1.—*Elementary Chemistry.* Smith.
2.—*First Principles of Chemistry.* Brownlee.
3.—*Chemistry.* Remsen.
4.—*Complete Chemistry.* Avery.

**How to Experiment with Electro-Chemistry.—**In working out electro-chemical inventions you require a knowledge of both electricity and chemistry for it is the electric current that produces the chemical change either directly or indirectly.

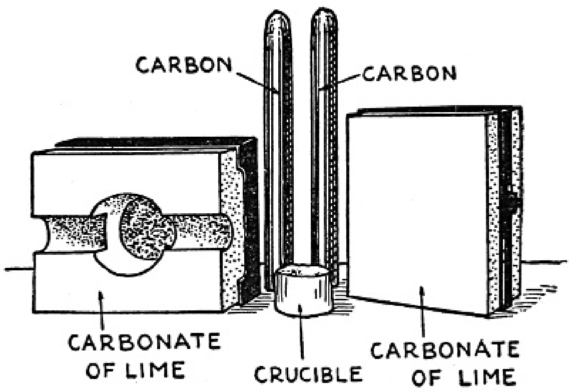



FIG. 63A. AN ELECTRIC FURNACE, SHOWING THE DIFFERENT PARTS

An electric battery of any kind is electro-chemical in action and so is *electroplating* and *electrotyping* but these are old inventions. The production of [89] *ozone* and *nitric acid* from the air by the action of an electric spark; of coal tar colors by *electrolysis*; the *electrolytic* refining of copper and the electrolytic production of aluminum are electro-chemical inventions in which the action of the electric current is direct. And they are inventions of great importance and of recent date.

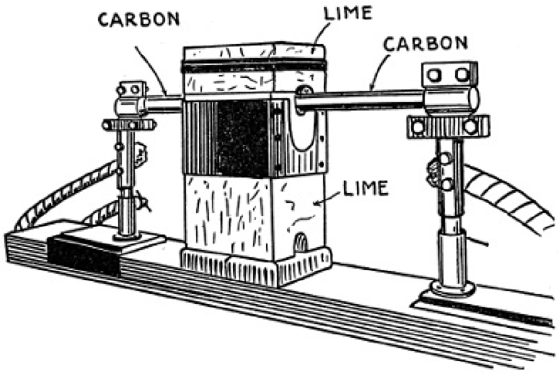



FIG. 63B. AN ELECTRIC FURNACE IN OPERATION

Then there are a large number of indirect electro-chemical processes in which the electric current is used to produce heat as in the electric furnace. Genuine diamonds, though too small and too costly to have any commercial value, have been made in the electric furnace, shown in Fig. 63. *Calcium carbide* for making acetylene gas; *carborundum*, an abrasive that is better than emery; *electric smelting* and the *reduction* of *iron ore* with carbon are all new electric furnace inventions of great value, and there are many others. [90]

BOOK.

*The Elements of Electro-Chemistry Treated Experimentally.* By Lüpke.

[91]

# CHAPTER V

## MAKING A MODEL

At the end of the chapter on drawing I explained how you could make models of mechanical movements of cardboard. And you will remember that the purpose of these simple models is to clear up points that are hazy when you are working out your invention on paper.

**Kinds of Models.—**Now besides cardboard models there are some other kinds, the chief ones being (1) *rough models*; (2) *scale models* and (3) *working models*, and each of these kinds is useful in its own way. The kind you should make, or have made, will depend on the bulge of your pocketbook as well as on the nature of your invention as you will presently see.

There was a time when the United States patent office required a model of every invention for which a patent application was made; as a result the noble patent office finally became a museum filled with antique models instead of an office in which business was transacted for and with inventors.

The government officials then concluded that the *patent examiners* didn't really need to see the models anyway and then and there they ordered that a patent application only need be sent to the patent office—with one exception; this exception is made when a would-be inventor applies for a patent on a perpetual motion machine and then he is asked for a *working model* and if this is not forthcoming—and of course it never is—no further attention is paid to him or to his application. [92]

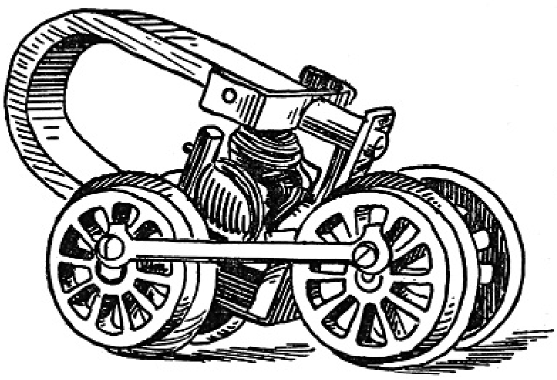


FIG. 64. A ROUGH MODEL OF AN ELECTRIC MOTOR DRIVE FOR A LOCOMOTIVE

**Rough Models.—**After you have made the drawings and experiments which your invention calls for and both have worked out to your satisfaction you will then have a burning desire to see the result of your efforts in a more substantial form.

Some machines in which there are only a few moving parts need not be built up very carefully, or to exact scale or even of the materials the marketable product is [93]
to have in it. Very often a model can be made of wood and scrap metals that will do and show everything that you want it to. See Fig. 64.

Should you have to employ a patent attorney who lives at a distance from you, say one who has an office in Chicago, Philadelphia or Boston, a rough model of your invention will be of great help to him for it will give him an insight into its workings and its possibilities that he is not apt to get from studying your drawings and description unless you are a good mechanical draftsman and he is above the average in his profession.

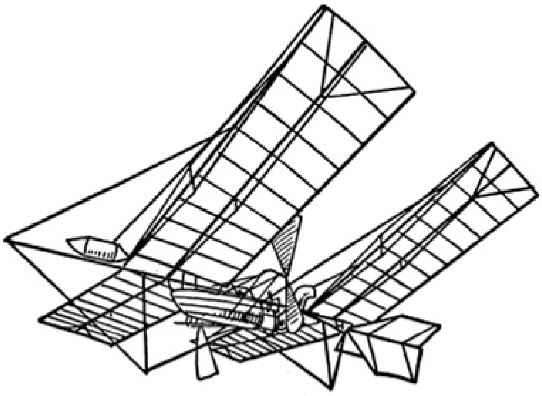


FIG. 65. A SCALE MODEL OF AN AEROPLANE

**Scale Models.—**Scale models are usually miniatures of the full sized machine, that is every part of the scale model is reduced in proportion from the dimensions [94]
of the big machine, say 1 inch to the foot or whatever you want to make it.

Like rough models scale models need not be actual working models, indeed in many cases it is very hard if not impossible to make a scale model which will run or work like a full sized machine, unless the model is made very large, as for instance model aeroplanes fitted with motors of any other kind than those made of rubber strands. Fig. 65 shows a scale model of an aeroplane.

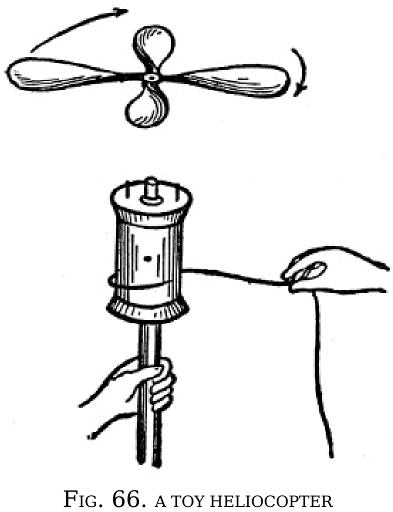


FIG. 66. A TOY HELIOCOPTER

Then again sometimes a scale model will work to perfection and when a full sized machine is built it will not work at all as in the case of the *heliocopter*, that is, a flying machine having a screw with blades like a propeller and which when it is rapidly spun by means of a string like a top will rise in the air to a height and sail away to a distance of a hundred feet or more. Fig. 66 shows a toy *heliocopter*, [95]
or aerial top as it is called. Many attempts have been made to build full sized flying machines on the principle of the toy heliocopter but so far none of them have been able to get off of the ground.

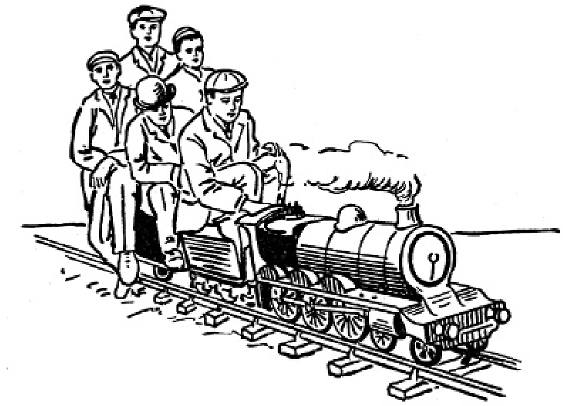


FIG. 67. A WORKING MODEL OF A BRITISH EXPRESS LOCOMOTIVE

Then again there are many machines that can be made of any size and which will work equally well. Fig. 67 is a scale model of a British express locomotive. It is 4 feet long and an exact scale model which can be fired up with coal and it will make a speed of 10 miles an hour.

A scale model of your invention, if it is a machine, or an electrical apparatus, when built by an expert model maker, makes a mighty pretty display and will never fail to attract attention wherever it may be shown.

[96]

**Working Models.—**A working model may be a scale model as you have seen or it may be a full sized machine or of any size between these limits.

When you have your invention past the drawing board and up to the shop bench by all means make a working model of it and if possible make it full size. This kind of a model is the proof you want that your invention will work when it is put to the test and by making a working model you will find lots of changes little and big that are needed and which when made will improve its operation wonderfully.

And however carefully you have worked out your invention on paper you will find that when you come to make a model, or have one made, you will have to change it not once but many times, that is if it is a machine in which a number of parts are made use of and you may have to re-design it and re-construct it several times.

For this reason it is a waste of money to build a fine appearing and costly model in the beginning but what you should do is to make one that will work without regard to its looks so that you can experiment with it, overhaul it, tear it down, build it up again and so on until you are satisfied with it and the results it produces, if such a thing is possible, before you even begin to talk to a patent attorney about applying for a patent on it.

Nearly every *tyro* inventor seems to believe that the only way to keep honest folks from stealing his invention is to apply for a patent on it immediately. You will [97] remember I pointed out in the first chapter how to protect your first idea by signatures and *affidavits* and protection of this kind is just as good, and in my opinion just as safe, and in every way better than to rush off and apply for a patent and—though of course money is of no object—it is cheaper by at least $35.00.

Again as I stated in the preceding chapter if you apply for a patent before you have made a working model of it you will find when you finally get your model finished it will be so at variance with what you have written in your specification and claims that you will hardly be able to recognize it as being the same invention; and besides there will be the trouble and the expense of changing your drawings and specification and claims.

On the other hand when you have finished your model to the point where it will do the work you want it to do you are in a position then to make a new and accurate set of drawings, to write a clear description of how the machine works and to draw up your claims with the certainty of knowing just what you have and what you want to ask for—in a word you are ready to do business with the patent office.

**Ways to Make a Model.—**The way in which you get your model made depends on several things and over these you will have little or no control.

There are two ways for you to get a model made of your invention and these are (1) to make it yourself and (2) to have a model maker make it for you.

These two general ways may be further divided into several sub-ways and [98] among these are (a) for you to have your own workshop, or laboratory and hire machinists, or electricians, or chemists, and have them do the work under your direction; (b) for you to give a model maker the job and have him, or his men, do it under your supervision and (c) for you to have separate parts of it made by various model makers and then assemble them in your own shop.

If you are a little skilled in the use of tools there isn't anything I know of that will give you greater pleasure than to make each part of your model with your own hands in your own shop and watch it grow day by day until it becomes in truth the very apple of your eye. At least that is the way I feel about it. Moreover it gives you a sense of security you cannot have when the work is in some one's else hands.

In making a machine from your own ideas and plans no one can do the work so well as yourself provided you can do the work at all and besides it is cheaper and far more satisfactory.

Should you have a fat pocket-book and at the same time a taste for inventing and the sciences—these elements seldom go hand in mind—but if they should get close together in your case I say, the right way to make a model is to hire skilled men to do the work while you do the thinking and the assembling in your private lab. By this process your model will go forward rapidly and the work will be done in the best fashion.

Before employing any one to work on your invention have him sign this [99]
agreement:

EMPLOYEE'S PATENT AGREEMENT

The undersigned, in consideration of his employment by Charles Basset, inventor, and in further consideration of the salary received by him for such employment, hereby agrees that all inventions and discoveries pertaining to the business of the said Charles Basset which may be made by him while in his employ shall become the property of the said Charles Basset.

And further, he also agrees to assign to the said Charles Basset all applications made by him for *letters patent* of the United States and elsewhere and all *letters patent* that may be granted to him, covering such inventions and discoveries without further compensation, and

That he will promptly, on conception of any patentable idea or invention, disclose the same to the said Charles Basset and on his request so to do will make application for *letters patent* covering such inventions and discoveries;

And further, that he will execute all other papers whatsoever that may be necessary to transfer to and rest in the said Charles Basset all the right, title and interest in and to such inventions and discoveries, it being understood and agreed that all expense incident to the securing of any *letters patent* or application for patent shall be borne by the said Charles Basset.

(Signed) Henri Fabre.

*Boston, Mass.,*
*May 26, 1916.*

—*Brennan's Handbook.*

The plan of having a model maker do all of the work under your direction may
not appeal very strongly to you but after all, if you lack the skill and the [100]
equipment needed for making your model, it is a pretty good scheme.

Every large model making establishment has separate rooms fitted up where each inventor can work on his own machine and this gives you the privacy you demand and besides whenever you want a part made or changed you have a skilled mechanic at your beck and call and a shop equipped with the finest machine tools for him to use.

Nor need you be afraid that your invention will be *appropriated*, which is a high-toned name for theft, by either the model maker or his employers to whom you have entrusted your drawings, and for the following reasons:

(1) Because any hint of such a thing as theft would ruin his business for all time; (2) because 99 per cent. of all inventions fail to make money for any one of 99 reasons and (3) because the model maker grows rich making models for inventors while the latter mostly go broke; and as far as the employees are concerned we must grant that they are as honest, or even more so, than the average run of suffering humanity.

Neither are inventions apt to be stolen by patent attorneys for the reasons cited above but after you have worked out your invention, built a model and obtained a patent you are then in great danger of being separated from the fruits of your genius and perseverance by the professional promoter who makes it his business
to finance the invention and at the same time to feather his own nest; but more [101]
about him a little later.

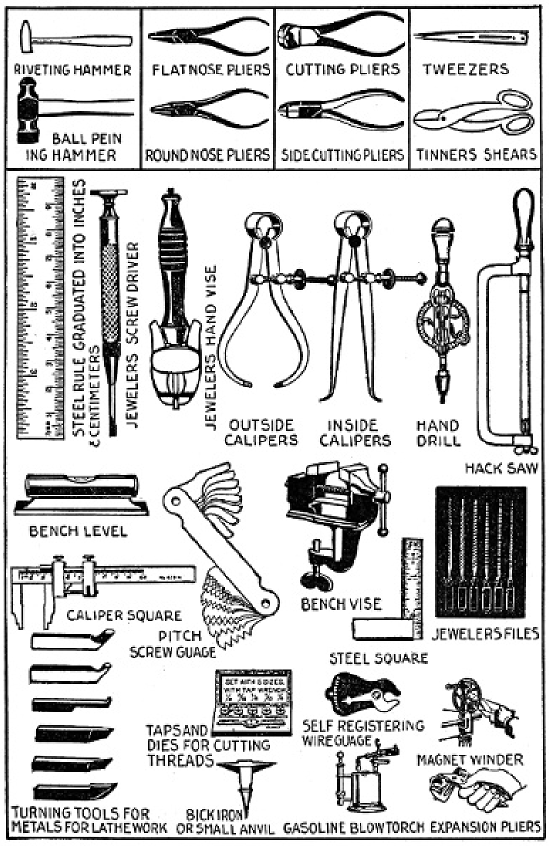



FIG. 68. SOME USEFUL JEWELERS' AND MACHINISTS' TOOLS

Large illustration

A good way to safeguard yourself at the hands of model makers, if you have any doubts about them, is to give different model makers different parts to make and then assemble them yourself. While it takes considerably longer to build up a model in this secret way still there is a lot of satisfaction in this method of procedure. [102]

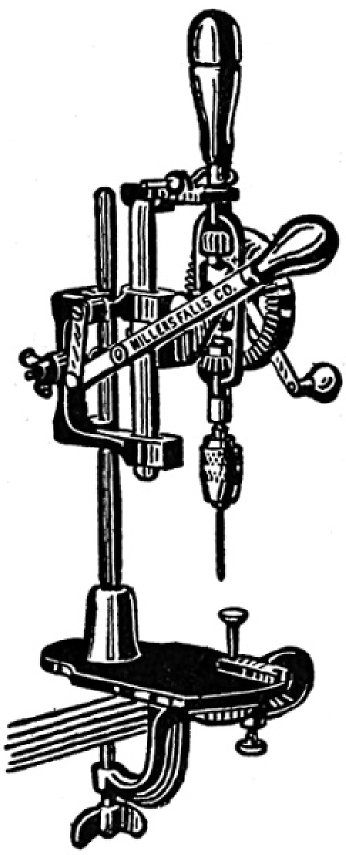



FIG. 69. A SMALL HAND DRILL PRESS

**The Tools You Need.—**To make a model of any description you need the usual tools that are the handservants of every jeweler and machinist, see Fig. 68, and [103] you ought to have a small *drill press*, see Fig. 69, and a *screw cutting lathe*, as shown in Fig. 70, if you can afford these machines.

There are two or three tools that nearly everybody knows about and yet which very few folks know enough about to use them. One of these tools is the *vernier* and another is the *micrometer* and both are used for *precision* measurements.

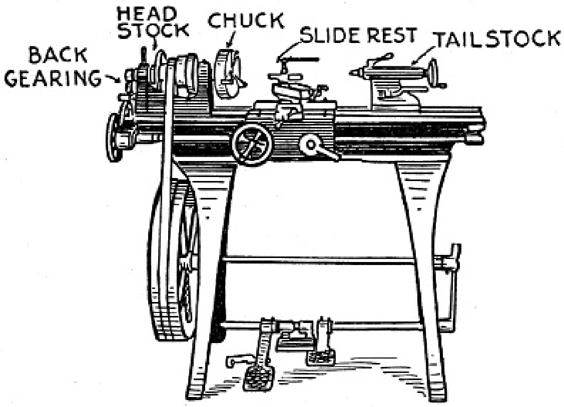



FIG. 70. A FOOT POWER SCREW-CUTTING LATHE

*The vernier* is not, strictly speaking, a tool in itself but it is a device that is applied to *scales* which makes it possible to measure small fractions of an inch much more easily and accurately than can be obtained with the scale alone. The vernier is also used on calipers, micrometers and other tools and instruments.

The vernier is a short scale which is fitted to and slides along the edge of a fixed scale as shown in Fig. 71. The fixed scale is divided into 10ths of an inch and [104]
the vernier, which is $^{9}/_{10}$ inch long, is divided into 10 spaces.

Suppose now when you measure a part of your model that you move the vernier over to the right so that the first mark of the vernier and the first mark of the fixed scale are exactly in a line with each other, then the vernier will have moved just $^{1}/_{10}$ of a scale division which is $^{1}/_{100}$ of an inch.

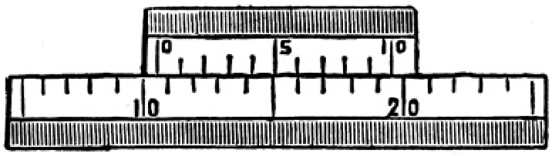



FIG. 71. A VERNIER FOR ACCURATE MEASUREMENT

If the record marks of the vernier and of the fixed scale are exactly even then the vernier will have moved $^{2}/_{10}$ of a scale division or $^{2}/_{100}$ or $^{1}/_{50}$ of an inch, and so on. The fraction of the $^{1}/_{10}$ inch that is obtained with the vernier is added to the number of inches and the fractions of an inch of the part which is measured. The vernier gets its name from Pierre Vernier who invented it in 1631.

*The micrometer* is a tool, or instrument, which will measure accurately from 0 to 1 inch in thousandths of an inch. It is one of the most useful measuring devices that has ever been invented and if you are to build a model accurately you cannot get along without one. It is shown in Fig. 72.

There are five parts to a micrometer and these are (a) the *frame*; (b) the *anvil*; (c) the *spindle*; (d) the *sleeve* and (e) the *thimble*. The frame is held in the left [105]
hand, the object to be measured being placed between the anvil and the spindle; the thimble is turned by the thumb and finger of your right hand and the spindle, which is fastened to the thimble, turns with it and moves through the nut in the frame until the end of the spindle touches the object to be measured.

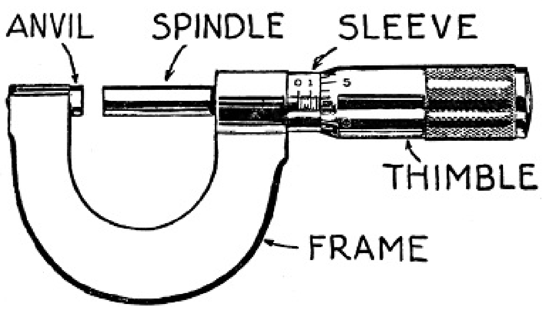



FIG. 72. A MICROMETER FOR MEASURING THOUSANDTHS OF AN INCH

The measurement of the object is shown by the vertical lines on the spindle and the horizontal lines on the thimble and both of which are numbered. They are really a form of vernier.

To *read* the micrometer, that is to find the measurement of an object, you have only to multiply the number of vertical divisions which you can see on the sleeve by 25 and to this add the number of divisions on the bevel of the thimble from the 0 line to the line which coincides with it, that is, comes even with the long horizontal line on the sleeve. It is easy to learn to read a micrometer by taking one in your hands, making a few measurements and following the above [106] instructions.

The *wire gage* is a circular piece of flat steel a little larger than a silver dollar and it is used to find the numbers of, and to measure the sizes of, wires. There are 32 slots cut in the edge each ending in a hole and numbered from 5 to 36 as shown in Fig. 73.

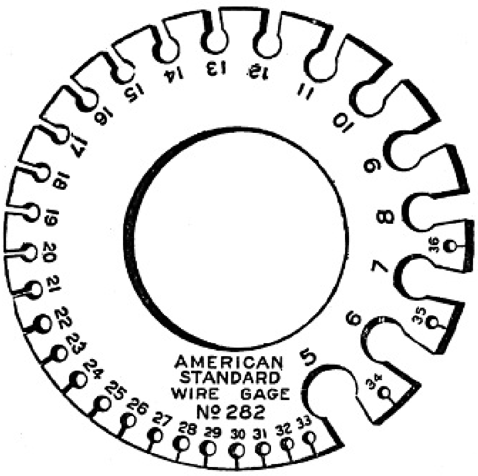



FIG. 73. A STANDARD WIRE GAGE

To find the number of a certain sized wire slip the latter into the slots until you find one into which it will just pass snugly and the number of the slot will be the number of the wire. On the reverse side of the gage will be found the sizes of the wire in decimal fractions of an inch.

[107]

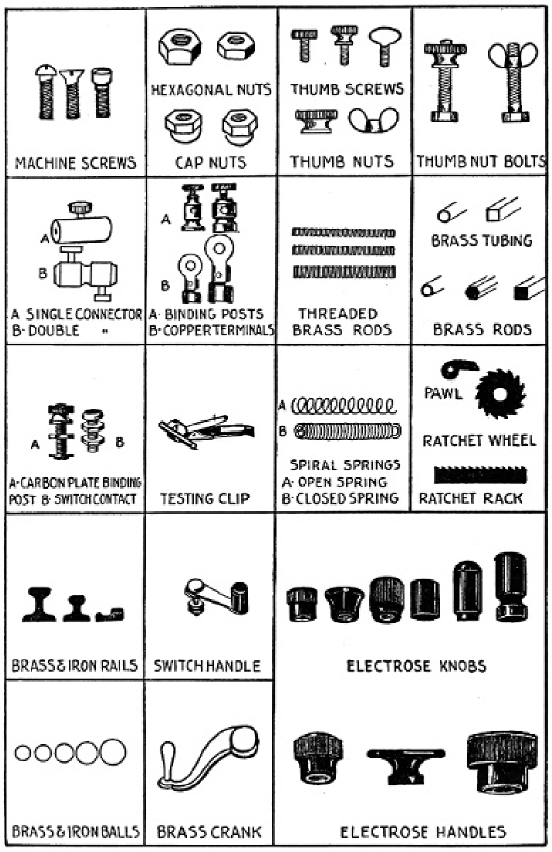



FIG. 74. SOME USEFUL STOCK MATERIALS MADE BY AUTOMATIC MACHINERY
Large illustration

There are a number of different wire gages but the *American Standard* or *Brown* and *Sharpe*, or *B and S* as it is called for short, is the one mostly used by [108]
machinists in the United States.

Other useful gages are for the measurement of wood and machine screws; for finding the pitch of screws; for measuring the inside of tubes, holes, etc., and for measuring the outside of rods, tubes, etc. These tools and all others used by jewelers and machinists can be bought wherever tools are sold.

**Buying Materials.—**Many inventors waste time and sacrifice accuracy in making, or trying to make, wheels, gears, threaded rods, nuts, binding posts, contact points, switch levers and blades, hard rubber knobs, handles and other parts.

Now all of these things and hundreds of other parts can be bought ready made of model makers, gear works and dealers in hardware, model aeroplanes, electrical and wireless apparatus. And before you begin a model of any kind you should get catalogues from all of the supply houses you see advertised. Fig. 74 shows quite a number of parts you can buy ready made.

**About Making Patterns.—**Very often though you will have to make a special part out of metal or have it made. Like everything else there is a *best way* to do this.

Suppose you need a *standard* something like that used for a telegraph sounder, as shown in Fig. 75. To saw and file out a solid piece of brass would not only take a long time but it would prove a very tedious job; and this is also true of many [109]
other parts you will need in the course of making your model.

The best way is to make a pattern of wood of the desired part, take it to a brass, or iron, foundry and have it cast. It is easy then to smooth it up with a file or to *machine* it in a lathe, or shaper, and *lacquer* it when it will look like a mechanic's job.

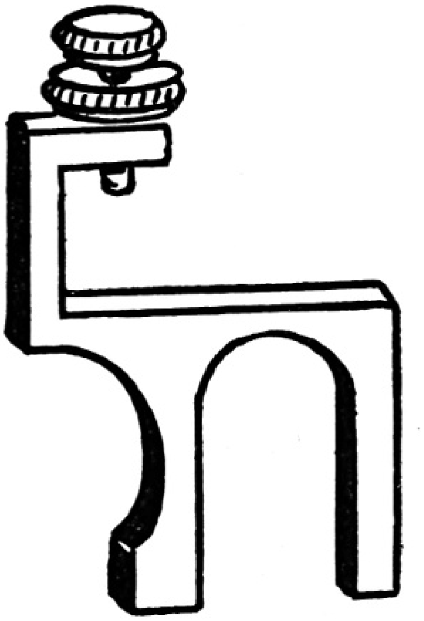


FIG. 75. A STANDARD FOR A TELEGRAPH SOUNDER

It is nice and easy work to make a *wood pattern*, that is to cut out of wood the needed part of exactly the size and shape you want the finished casting to be. The wood for your pattern should be pine or poplar and thoroughly seasoned. A scroll saw frame will come in handy for sawing out small patterns.

Where two pieces of wood are to be fastened together a good glue should be used. After the pattern is built up file out the uneven places with the kind of files [110]
made for scroll-sawyers' use. When this is done smooth up the pattern with medium fine sandpaper and finish it with very fine sandpaper.

Should any holes or cracks show in the pattern after it has been sandpapered fill them up with *putty*; and, last of all, give the pattern a couple of coats of *shellac varnish* or rub *graphite* into it all over to keep it from sticking to the mold. Your pattern is now ready to be cast in metal.

FIG. 76. POURING A MOLD

A pattern, if it is complicated, should be made by a skilled pattern maker for it must be made in a certain way so that it will *draw* from the mold easily and without injury to the latter and leave it perfectly smooth.

**Casting in Iron and Brass.—**Somewhere above I said that a pattern should be the exact size you want the finished casting to be but as a matter of precise [111] statement iron, brass and nearly all other metals shrink when they are cooling and so the pattern must be a trifle larger than the exact size you require and you must also allow for filing and machining. (See Fig. 76.)

As iron shrinks about $^{1}/_{10}$ of an inch to a foot, brass shrinks ⅕ of an inch to a foot and steel and aluminum shrink about ¼ inch to the foot you must allow this much for shrinkage in making your patterns. Type-metal is an alloy which expands on cooling and this is a useful thing to know. You will find a formula for making it in *Appendix L*, and all of the *appendices* from A to N contain detailed information on a variety of subjects that should be very helpful when you are making your model.

---

[112]

# CHAPTER VI

## HOW TO PATENT YOUR INVENTION

With your model in such shape that it shows what your invention is and what it will do you are ready to apply for a *patent*, or *letters patent* as it is technically called, by those versed in the art.

**What a Patent Is.—**The term *letters patent* comes from the Latin *litteræ patentes* which means open or disclosed, as against the French *lettre de cachet* which means closed or secret.

A letters patent, or patent as it is called for short, is exactly what its name implies and that is a disclosure of your secret and for this disclosure of a new and useful invention on your part the government agrees to give you a *monopoly*, that is the sole right to make, use and sell it as you please for a term of 17 years.

But the government does not live up to its agreement with the inventor and the invention and patent for it are never securely yours until it has been tested in the United States Supreme Court and its judges have handed down their opinion in your favor. But since there is no better protection than a patent at the present time of course you will have to get one.

**Choosing a Patent Attorney.—**The next hardest thing to do after making a working model of your invention is to get a *patent attorney* to take out a patent [113] for you.

I don’t want to infer by this that it is hard to find a patent attorney for on the contrary they are as numerous as sharks in the sea and twice as voracious, but a patent attorney who really understands his business and will take an interest in your affairs is as scarce as a *pseudotriakis microdon*,[3] unless you are backed by unlimited funds, and then you *may* get service.

It is a strange thing but just as soon as you begin to work on an invention you will see in every weekly paper and magazine you pick up the advertisements of patent attorneys and usually they are located in Washington “in a building across the street from the patent office” or in a building up the street from which the patent office can be seen.

Their *ads* are very alluring as they often offer as an inducement to make a *free search*, as explained in Chapter III; to keep your signed *evidence of conception* in their fire-proof safes, and to refund your money if they do not get a patent for you. That these knights of the patent bar will do all they say there is not the slightest doubt and that is just where the rub comes in.

Any patent attorney can get a patent allowed on nearly anything if the claims are written *narrow* enough but when it is granted it won’t be worth the paper it is [114] written on and the patent examiner knows it, the patent attorney who gets it knows it and you will know it too after you have spent your good money for it but then it is too late. A patent attorney of this kind is a good one to keep away from.

The safest way is to go to a patent attorney in your own city or get into communication with one who lives nearest to you and engage him to prepare your patent application and *prosecute* it in the patent office.

And whatever you do make him agree to a *flat-rate*, that is to name a fixed sum which you are to pay him for his services including the fee for filing the application in the patent office. The *filing fee* is $15 and the lowest fee I ever heard of any patent attorney taking to prepare a case and seeing it through the patent office was $30, which with the final government fee of $20 makes a total of $65; and from this his fee will go on up to whatever amount he thinks he will be able to get you to pay.

Should you happen to secure the services of a so-called really high-grade patent attorney you will not be likely to induce him to make a flat-rate for this is poor business on his part. Instead the way a better class patent attorney will deal with you, as a rule, is to induce you to start in by giving him a *retainer* of say $25 or $50; then from time to time he will send you statements and as you pay them the amounts he demands will grow larger and the statements more frequent until by the time the patent is granted, you will have paid in enough to buy him a fur- [115]
trimmed overcoat or a Ford automobile.

The amount thus spent is not of so much consequence but what does matter is that where you and your patent attorney have no definite arrangement as to fees he is tempted, and in many cases yields to the temptation, to string the patent application along over a period of months if not of years, when if it had been followed up right along it would have been granted to you in a much shorter time.

The moral of this un-fable is to hold your patent attorney down to a fixed price right in the beginning and have him write you a letter stating the amount he is to get and the work he intends to do for it, and this will serve as an agreement.

The above are only a few of the bubbles in the patent system and to warn you of them all would take a book as large as an unabridged dictionary. The best advice I can give you is to study your invention from every angle, look up the state of the art in all its phases and then with a full understanding of just what you are entitled to write down all the points you want your patent to cover.

Now catch your patent attorney, being sure he does not catch you first, and to *parodize* a *caption*[4] of the immortal Roosevelt, *fear the patent office examiner and take your medicine*.

**Applying for a Patent Yourself.—**To get even a small part of what you are
*legally* entitled to in a patent you should write to the *Commissioner of Patents*, [116]
Washington, D. C., for a copy of the *Rules of Practice in the United States Patent Office*, see Fig. 77, which will be sent to you free of charge. Read this booklet through not once, but many times, or at least until you understand everything in it for it will help you mightily in the preparation of your *patent application* and the prosecution of it.

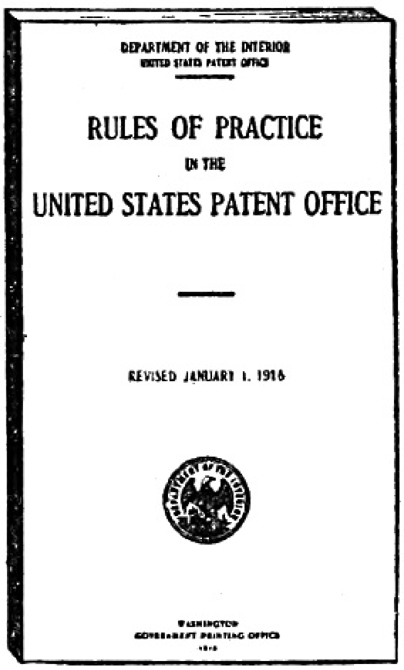



FIG. 77. RULES OF PRACTICE OF THE PATENT OFFICE

You will learn from the *Rules of Practice* that you as an inventor may apply for your own patent and act as your own patent attorney in prosecuting it. And after you have learned the *rules* by heart you may feel that since you know more about your invention than any one else you can make the drawings and write the specification and claims as well or better than the average patent attorney.

But you should think twice and count ten with your eyes shut before you
conclude to do this rash thing. Why? Because the patent office will not accept [117]
your *drawings* unless they conform exactly to certain rules; your *specification*, which means the description of your invention, must be written in a certain way, and the *claims*, which are the very vitals of the whole patent, must be drawn with exceeding care for while nothing of value must be left out it is even worse to write in too much as this limits your claims.

Besides these reasons it grieves a patent office examiner whenever a mere inventor comes forth and files his own patent application and conducts his own case even if he has the ability to do so and when it comes to *amending* his claims he will find the hurdles are rather higher to jump over than he at first supposed.

**Applying for a Patent through a Patent Attorney.—**Taking all these things into consideration my advice to you is to retain a patent attorney to prepare your case and see it through the patent office, and then you want to be prepared to watch every move he makes—that is to say when he has drafted your application, get a copy of it and go all over it yourself taking plenty of time to do it in; and then go over it with him covering every detail.

In due time after your application has been filed the patent examiner will send a *letter* to your patent attorney in which he notifies you that some, if not all of your claims, have been *rejected* and *citing references* to other patents chiefly to show that your claims lack newness and novelty.

The next step is taken by your patent attorney who *amends* the specification [118]
and claims to meet the objections raised by the patent examiner. Here again you should know how and where your claims are affected and you should aid your patent attorney to determine whether or not you should insist on your claim being allowed to stand as it is written or to so change it that it will satisfy the patent examiner.

It must be clear now that if your patent attorney is permitted to keep on changing your claims to meet every rejection of the patent examiner instead of fighting them out by the time the patent is granted it will have degenerated into merely a scrap of paper. Hence if you leave the whole case to the ability and judgment of your patent attorney you can be reasonably sure that your $65 or $250 or whatever sum you have paid him for obtaining your patent is as good as thrown away.

**What You May Patent.—**In all of the foregoing text I assumed that your invention consisted of a machine but according to rule 24 of the *Rules of Practice* a patent may be obtained for *any new and useful art, machine, manufacture or composition of matter, or any new or useful improvement thereof*.

Since all mechanical movements have been invented and all necessary electric currents have been discovered and enough chemical elements are known it may seem on first thought quite impossible to invent or discover anything either new or useful, yet the patent office is granting patents at the rate of about 125,000 a year.

The way inventions are made is by forming new *combinations*. Just as there is [119]
no practical limit to the number of new words that could be formed by new combinations of the letters of the alphabet, so there is no practical limit to the new machines that can be invented by novel combinations of the mechanical movements, with the result that something can be done that had not been done before, or that something is done in a better, cheaper and easier way than it had ever been done before. And the same is also true of combining electro-mechanical devices and of combining chemical elements.

Inventing means that you are clever in combining certain movements, devices and chemicals in a new way to produce a certain result which may or may not have been done before, and so it is the new *combination* of things that you really get a patent on.

**Looking Ahead.—**It must be plain now from what has been said that when you have completed your machine, or product, or compound, all your inventive efforts will be in vain unless you go over every part with the utmost care and try to think out how it could be changed or done in some other way by some one else and so make your patent worthless, and your hard efforts wasted.

What you should do, though it is easier to advise than it is to accomplish, is to so word the claims of your patent application that they will broadly cover not only your particular combination but every other form of it. Finally should your invention be one of considerable magnitude and great importance you must keep working on it all the time and making improvements and covering the last named [120]
with patents or the other fellow—the patent thief—will get you sure, and often he will do it anyway.

**What a Patent Consists Of.—**All through this chapter the words *drawings*, *specifications* and *claims* are used and now suppose we find out just what is meant by them.

Every patent application is made up of five parts and these are (1) the *petition*; (2) the *drawings*; (3) the *specification*; (4) the *claims*, and (5) the *oath*. The petition and the oath are separate papers and do not appear in the patent when it is granted. The drawings, specification and claims form the patent when it is granted.

*The form of petition* by a sole inventor is as follows:

*To the Commissioner of Patents:*

Your petitioner, ..............., a citizen of the United States and a resident of ......, in the county of ...... and State of ...... (or subject, etc.), whose post-office address is ........, prays that letters patent may be granted to him for the improvement in ..........., set forth in the annexed specification.

Signed at ........., in the county of ....... and State of ......, this .... day of ......, 19..

Other forms by joint inventors, etc., will be found in the *Rules of Practice*.

[121]

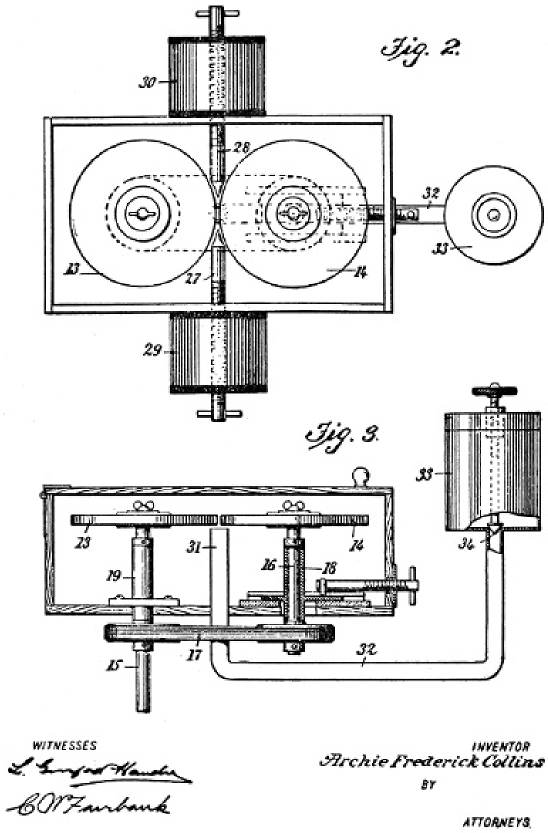



FIG. 78. A PAGE OF DRAWINGS FOR A WIRELESS TELEPHONE ARC

*The drawing* or drawings come first and these are made on white paper the thickness of Bristol board and the size of the sheet must be exactly 10 by 15 [122] inches with a line drawn 1 inch from the edges all round making the *sight*, that is, the space in which the drawings are placed, exactly 8 by 13 inches. A reduction of a sheet of drawing for the author’s *revolving arc* for his wireless telephone is shown in Fig. 78.

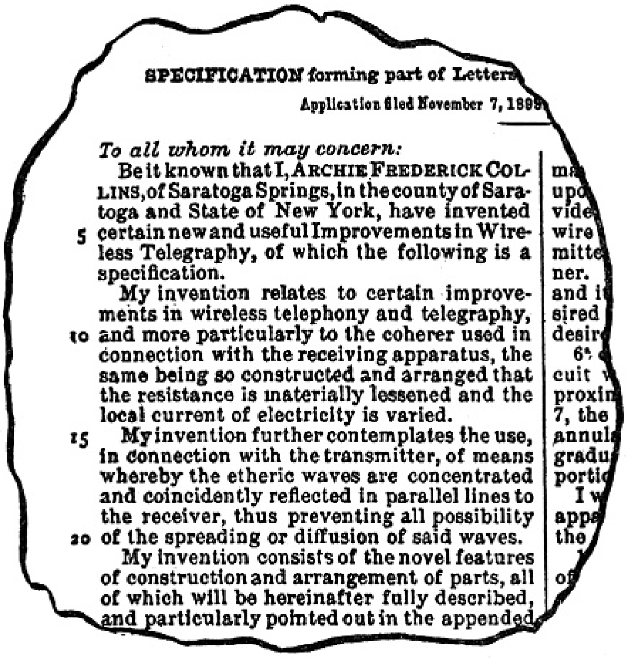
The drawing or drawings, there may be one or more on a page and several pages if needs be, must show every detail covered by the specification and claims. The drawings may be made in *isometric perspective* as described in Chapter II, or plan or elevation views can be used, or both of these kinds of drawings as long as the pictures show exactly what the invention consists of and how it works. Usually the different parts are numbered and these are referred to in the description of the invention.

Should your invention be an electrical one, then a diagram of the apparatus formed of symbols (see Chapter II) should be used.

The *specification*, the front page of one of which is shown in Fig. 79, is that part of a patent which describes your invention or discovery and it should be as full and as clear as you and your patent attorney can make it and yet it must be concise and to the point.

Don’t try to hide, or keep anything back for should the patent be granted to you under these conditions it will be without value if it should ever figure in a suit. If you are not willing to make every detail known it is better not to apply for a patent at all.

[123]



SPECIFICATION forming part of Letters

Application filed November 7, 1899

*To all whom it may concern:*

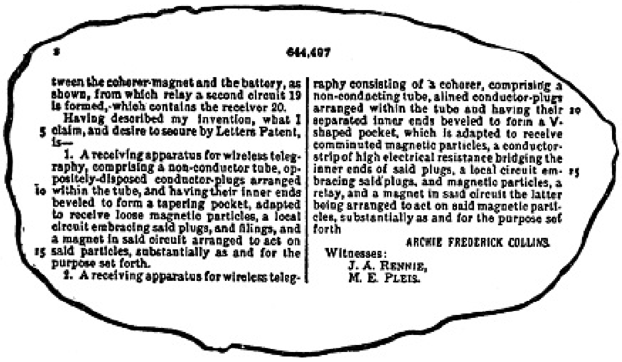
Be it known that I, ARCHIE FREDERICK COLLINS, of Saratoga Springs, in the county of Saratoga and State of New York, have invented certain new and useful Improvements in Wireless Telegraphy, of which the following is a specification.

My invention relates to certain improvements in wireless telephony and telegraphy, and more particularly to the coherer used in connection with the receiving apparatus, the same being so constructed and arranged that the resistance is materially lessened and the local current of electricity is varied.

My invention further contemplates the use, in connection with the transmitter, of means whereby the etheric waves are concentrated and coincidently reflected in parallel lines to the receiver, thus preventing all possibility of the spreading or diffusion of said waves.

My invention consists of the novel features of construction and arrangement of parts, all of which will be hereinafter fully described, and particularly pointed out in the appended

FIG. 79. SPECIFICATION OF ONE OF MR. COLLINS' PATENTS



2 644,407

tween the coherer-magnet and the battery, as shown, from which relay a second circuit 19 is formed, which contains the receiver 20.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A receiving apparatus for wireless telegraphy, comprising a non-conductor tube, oppositely-disposed conductor-plugs arranged within the tube, and having their inner ends beveled to form a tapering pocket, adapted to receive loose magnetic particles, a local circuit embracing said plugs, and filings, and a magnet in said circuit arranged to act on said particles, substantially as and for the purpose set forth.

2. A receiving apparatus for wireless telegraphy consisting of a coherer, comprising a non-conducting tube, alined conductor-plugs arranged within the tube and having their separated inner ends beveled to form a V-shaped pocket, which is adapted to receive comminuted magnetic particles, a conductor-strip of high electrical resistance bridging the inner ends of said plugs, a local circuit embracing said plugs, and magnetic particles, a relay, and a magnet in said circuit the latter being arranged to act on said magnetic particles, substantially as and for the purpose set forth

ARCHIE FREDERICK COLLINS.

Witnesses:
J. A. RENNIE,
M. E. PLEIS.

FIG. 80. THE CLAIMS OF THE SAME PATENT

The *claims*, a few of which shown in Fig. 80, are the all important part of every patent and these must be clearly, cleverly and carefully worded so that if you ever have to fight an infringer in court your claims will be found to cover exactly the details of your invention and this will make it harder for the other fellow's expert to misconstrue them. [124]

*The oath.* When you apply for a patent you must affirm, or make oath that you believe yourself to be the "first and original inventor or discoverer of the art, machine, manufacture, composition or improvement" for which you ask a patent. A form of oath to accompany a patent application is as follows:

........... ...........}
........... ...........}*ss*:

........ ........, the above-named petitioner..., being sworn (or affirmed), depose ... and says ... that .......... citizen ... of ....... and resident ... of ......, that .... verily believe ...... ....... to be the original, first and ...... inventor ... of the improvement in .......... described and claimed in the annexed specification; that ........ do ... not know and do ... not believe that the same was ever known or used before ..... invention or discovery thereof, or patented or described in any printed publication in any country before ...... invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by ........ or ...... legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvement has been filed by ...... or ...... representatives or assigns in any country foreign to the United States, except as follows: ........... [125]

Inventor's full name: {...............................
{............... ...............

Sworn to and subscribed before me this ............... day of ......, 19..

[SEAL.]

............... ...............
[Signature of justice or notary.]
............... ...............
[Official character.]

A good way to get an idea of how a patent looks and reads is to send 5 cents in coin to the Commissioner of Patents, Washington, D. C., with the request that a copy of patent No. 814,942 be mailed to you.

**While Your Patent is Pending.—**In a month or six weeks after your application has been sent in to the patent office your patent attorney will receive an official reply, or *action* as it is called, and don’t be surprised and don’t let it worry you if you find that all your claims have been rejected by the examiner.

He will state his reasons in his letter for the rejection and give references, which are usually other patents, to show that some other inventor has *anticipated* you and that your claims are neither new nor novel.

Your patent attorney must then either *amend* the claims, that is reword and change them if you and he think the examiner is right, or else in your letter of amendment, you must show the examiner where and why he is wrong. At any rate you must satisfy his objections.

By the time your amended application reaches the examiner and he again acts [126] on it he will have dug up a lot more of references from the *archives* of the patent office; and then you and your patent attorney can go all over the amending process again.

After having gone through with this sort of thing a dozen or more times and covering one or more years—I have just had a patent allowed that had been pending for nearly seven years—you and your patent attorney and every one else that may be interested with you will be sore unto death over the delays—that is everybody except the patent examiner and he thrives upon the inventor’s discontent.

**Interference.—**As if all these trials and tribulations are not enough it often occurs in the course of a pending patent that some one applies for a patent on the same, or nearly the same, invention as your own.

When this happens the patent examiner declares an *interference*, the purpose of which purports to be to show which applicant is the first, or real inventor.

When interference proceedings are begun you will have to make under oath a *preliminary statement* showing when you first conceived the idea of your invention, when you first explained it to some one else, when you made your first drawings of it and when you constructed a model of it; all of which shows the importance of keeping a record of each step of your invention and of having them frequently attested.

These sworn statements by yourself and your opponent are passed upon by the *examiner of interferences* and if either you or your opponent are not satisfied with [127] his findings either one of you may take an appeal to the *board of examiners-in-chief*, and from this board to the *Commissioner of Patents* and finally, to the *Court of Appeals of the District of Columbia*.

And don’t forget that all these proceedings and appeals are as meat and drink to the patent lawyers and that you and your opponent are contributing *all* of the money in exchange for a lot of red tape that ought to be abolished.

**When Your Patent is Granted.—**But some bright morning you will receive a government document printed on vellum, showing a picture of the patent office at the top and signed by the Commissioner of Patents at the bottom, the whole being tied together with a pair of baby blue ribbons and to the ends of which is affixed a red seal bearing the imprint of the *Patent Office of the United States of America*, and at last you have your patent. The front cover of a patent granted to your humble servant is shown in the frontispiece.

**After Your Patent is Granted.—**But after you have this valuable grant conferred by the government in your possession which is alleged to give you a monopoly on your invention for a period of 17 years you have only started on your career as *patentee*, for about the next thing that will happen, if your invention is worth anything and you are manufacturing and marketing it, you will find that some one else is making and selling exactly the same thing.

He may or may not have a patent on the article or machine and it—the patent—may or may not be remotely like yours but this doesn’t in the least matter, he will [128] keep right on working your invention and *infringing* your patent until you will either have to sue him, or continue to lose large profits that should be yours and perhaps be driven out of the business entirely.

So, of course, you see your patent attorney and he, of course, advises you to begin suit at once. It sounds to your abused ears like right and justice but it means an outlay of much time and more money than you could begin to think of unless you have been through the mill before.

This time you will have to engage *patent counsel*—no mere patent attorney will do if you are to win—and you must have *experts* to testify for you and your *patent cause*—it is no longer called a patent case—and testify against your opponent. The only limit to the fee that able patent counsel will demand and collect is fixed by your bank account while $100 per day is the usual fee of a *technical expert* though like his legal ally he will ask and get much more if you can afford it.

After long months of drawn out preparation and taking testimony and quibbling you will find, if your legal talent is the smartest, that the patent granted you by the patent office has been sustained by the court. Such a decision may put the other fellow out of the business but it isn't once in a thousand causes you can collect damages when you win. And from this you will observe that the business of [129] the patent office is not to give you a monopoly but simply to grant you a patent and as to its validity the courts must settle that.

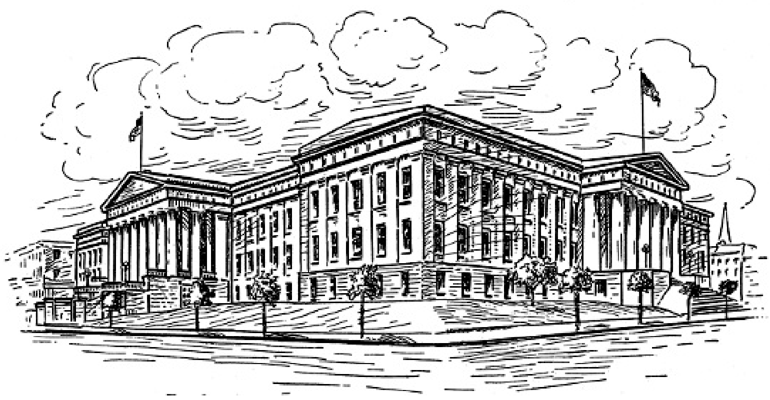


FIG. 82. THE UNITED STATES PATENT OFFICE, WASHINGTON, D. C.

**About Paper Patents.—**A *paper patent* is a patent that has been granted by [130] the patent office for a new and novel idea that has never been worked out in practice.

For instance, suppose you get an idea for an invention or an improvement that seems a good thing especially after you have looked up the state of the art, and when you draw it out on paper it seems certain to work. And let's suppose that for the want of time or money you are not able to experiment on, or build a model of it; and you have fears that by the time you could build the actual machine some one else may have applied for a patent on the same thing.

Of course, you feel you want to protect the idea and to do so you proceed to apply for a patent and in its own good time the patent office grants you one. You have then a thing called a *paper patent* but you haven't got the machine, or device or composition to back it up with.

Well, it's just like writing a book about a trip to the moon; you know how far from the facts your guesses would probably be and it is the same thing with getting a patent before you have made the experiments or built a model.

A paper patent is not usually worth the time and money you spend on it because it lacks backbone, but they have caused many real inventors a deal of trouble and expense in fighting them.

---

[131]

# CHAPTER VII

# MAKING YOUR INVENTION PAY

After reading what has gone before you may well conclude that an inventor's life is not a happy one but let me remind you that whatever road you take to seek fame and to win fortune you will find it just as full of petty strife and big difficulties.

In sooth inventing is one of the easiest and pleasantest pursuits in which you can engage to make a good living and many inventors who were as poor as Job's turkey when they began to think up new ideas and concoct useful schemes now have their thumb-nail biographies in *Who's Who* and live on the fat of the land.

And you can do the same thing too if you have a real invention and a lot of native shrewdness. Yes, to be a money-making inventor you must have inventive ability plus business ability, or rather the other way about, for business ability counts for more in the game of success than inventive ability.

There are hundreds of inventors of the highest type who are comparatively poor men for the lack of business ability while many others, like Edison, all round inventor, Westinghouse, inventor of the air brake, and Eastman, inventor of the kodak, have made fortunes that run up into the millions because they are first, [132] last and all the time hard headed business men. And you must be a business man too if you want to make money out of your invention.

**How to Raise the Initial Funds.—**By *initial funds* I mean the first money. It is easy to tell an inventor who has a rich dad or a bank account in his own name how to finance his invention.

But mine is a harder task in that I am taking it for granted you are like 999 out of every 1000 inventors and that you have little or no money, are fired with ambition and that you have a big idea.

Assuming that this is the precise state of affairs let's go back to where we started from in Chapter I, that is to the last part of it where you had drawn out your invention on paper, written a description of it and had some of your friends put their signatures to it.

Should your invention seem to your friends to have merit it will take but very little urging to get one or more of them to furnish whatever amount of money you think will be needed to carry on the experiments or to build a working model. Of course you will in turn have to agree to give him, or them, a certain small interest in your invention, and this is fair exchange for you are putting up your brains against their money.

If your invention is a small one and but little money is needed to develop it into a *marketable* product a 5 per cent. interest is enough to give those who back you for taking the risk. A 10 per cent. interest is ample to offer for sufficient funds to develop a more complicated invention.

This will leave you a 30 or 35 per cent. interest to sell to others later on, when [133] you have a working model and your patent is granted, to furnish the capital necessary for equipping a factory to make the device and to provide funds to market it—that is if you work out a plan along these lines.

But take my advice and keep a 55 per cent. interest in the invention for yourself; otherwise the control of it is taken out of your hands, and whenever it suits those who hold the controlling interest to freeze you out they will do so with pleasure.

By using the following form you can save the expense of having a lawyer draw up one for you and moreover you can also be sure there is no *joker* in it.

FORM OF AN INTEREST AGREEMENT

*Memorandum of Agreement* made this *third* day of *September, 1916*, between WILLIAM FRANKLIN, of Peoria, Illinois (inventor), and GEORGE WILSON, of Peoria, Illinois, WITNESSETH: That

WHEREAS, the said *William Franklin* has invented what he verily believes to be a new and useful improvement in *gas engines* and for which he will apply for letters patent of the United States, provided certain tests which he shall make shall work out satisfactorily, and

WHEREAS, the said *George Wilson* is desirous of obtaining an interest in the net profits arising from the sale or working of the said invention after the said letters patent of the United States has been granted:

NOW, THEREFORE, in consideration of the premises and of One Dollar to each in hand paid by the other, the receipt whereof is hereby acknowledged, the parties hereunto do covenant and agree as follows:

FIRST: That the said *William Franklin* for and in consideration of the payment of $1000 by [134] the said *George Wilson* will pay to the said *George Wilson* 5 per cent. of all net receipts accruing in any manner from the sale or working of the said invention and patent during the term of its life.

SECOND: That the said *George Wilson* shall pay to the said *William Franklin* the sum of $1000 which shall be applied to the making of a *model* of the said invention and to securing a letters patent of the United States for the same.

It is understood and agreed that this instrument shall bind the parties hereto, their heirs, executors, administrators, successor or successors or assigns.

IN WITNESS WHEREOF, the parties hereto have hereunto interchangedly set their hands and seals the day and year first above written.

IN THE PRESENCE OF

*Charles Howard*
as to the Inventor.

*John D. Prentiss*
as to George Wilson.

*William Franklin* [L. S.]

*George Wilson* [L. S.]

**About an Interest in a Patent.—**There is a big difference between assigning an interest in your invention and assigning an interest in your patent.

Many an inventor assigns an interest in his patent either before or after it is granted to some one who will advance the needed money. But this is a thing you should never do for after having made such an *assignment*, however small the part, the person who owns it can make, use or sell the invention which the patent covers, as he chooses, just as though he owned the whole patent and you can [135] neither stop him nor even sue him for damages.

You can, of course, make, use and sell the invention covered by the patent too but usually it is the other fellow who gets the best of the bargain.

**Royalties, Shop Rights, etc.—**After you have built a working model and obtained a patent on it there are many ways of making money out of your invention.

One is to sell your invention and patent outright; another is to sell *shop-right licenses*; another is to have some manufacturer give you a *royalty* on each machine or device he makes and sells, and yet another way is to sell *territorial rights*, that is the town, county and state rights to manufacture your invention. Forms of agreements for all of these deals will be found in the *Rules of Practice* of the United States Patent Office.

Besides the above arrangements you can go into partnership with some moneyed man, or interest, and finally a good plan, where a large amount of capital is required to build a plant and start a business, is to form a company, or *corporation* as it is called.

**Forming a Partnership.—**Now that you have your model completed and your patent granted you will of course want to begin *commercial operations* immediately, and let's suppose you think better of forming a partnership than any of the other above named plans.

There are a hundred ways to secure a partner, or *business associate* as the sharer of your fortunes is called, but it is a mighty hard thing to get a satisfactory [136]
one. A favorite way to enlist capital and one that is often resorted to by inventors in large cities is to advertise in the newspapers under the head of *business opportunities*.

An advertisement of this kind may put you in touch with the man you are looking for but it will also bring you a lot of curiosity seekers, riff raff and other undesirables who come generally with a view of inducing you to part with your money rather than to invest any of their own. This is also true of the so-called *brokers* who advertise to procure working capital for meritorious inventions.

One of the best ways to secure a partner who has the necessary capital and requisite business ability is to arrange to show your invention in operation and then invite your moneyed neighbors and the business men of your town, though you may not know the latter personally, to call and see it; and they will call and get interested if they believe in its possibilities for they are as anxious to make more money as you are to make a little of it, and they are keen to the fact that great fortunes have been built up out of simple as well as complex inventions.

This method of showing your invention to your towns-folk, either individually or collectively, is the safe way to get one or more good, substantial men interested in your proposition and to lay the foundation of a paying business.

**Where the Promoter Comes In.—**There are promoters and promoters; by [137]
which I mean that there are various sorts of promoters and then some.

A *tin-horn promoter* is an unprincipled fellow of some ability who secures an *option* on a patented invention, or on the stock of a company based on an invention, and exploits it for all he is worth to his own profit and without regard to the inventor or the stockholders. The chief business of a tin-horn promoter is to secure control of the entire stock issue of a company, sell it at inflated prices, pocket 90 per cent. of the proceeds and either doctor the books or disappear then altogether. Steer clear of the tin-horn promoter.

An *ordinary promoter* is merely an agent who acts as a go-between for the inventor and people with money to invest and by his enthusiasm brings them together for the good of the cause. A *real promoter* is a genius who possesses both business ability and the necessary wherewithal to start, *accelerate* and carry on any kind of an *industrial*, *financial* or *commercial* enterprise.

You will meet the promoter in one shape or another as soon as it becomes noised around that you have an invention of merit. The ordinary promoter will be of assistance to you at any stage of the invention where experiments are still to be made and the patent is yet to be granted. He may also prove of service after the *preliminary* work is done in securing for you a real promoter.

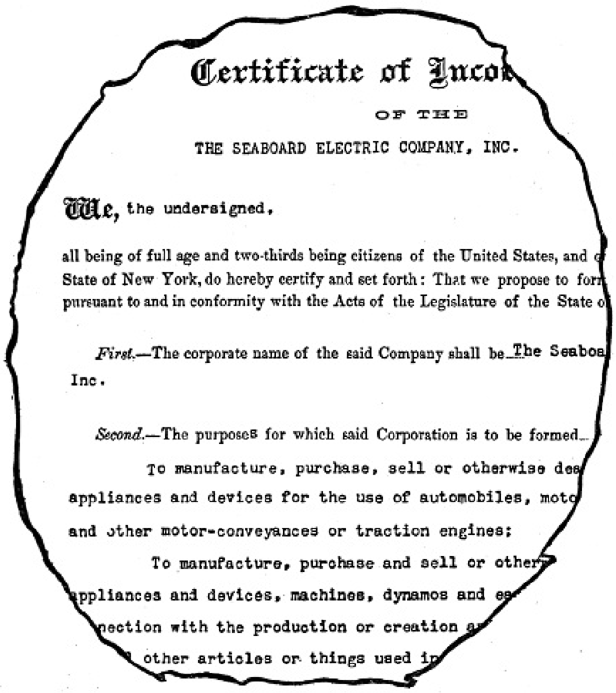
On signing contracts with the latter he will relieve you of all the cares of [138]
starting the business or of starting a company to start the business. And if you are not shrewd and careful and know just what he is doing and you should fail to have a hard and fast contract he will not only be likely to relieve you of the business cares but of everything else you may hold dear and sacred in this world.

An ordinary promoter will ask about 25 per cent. of whatever money he brings in for your use in developing the invention and a certain small interest—1 to 5 per cent.—in the company that exploits it. The real promoter wants and usually gets a working agreement of 50 per cent, of whatever profits there may be made out of the invention. If possible you should hold a 55 per cent, interest for this will give you the whip-hand and will save you much trouble in the end.

Few promoters though will agree to such a division and about the only way you can keep the controlling interest is to organize a company and manage it yourself but this takes business ability of quite a high order.

**What a Stock Company Is.—**A *company* is a number of persons who band themselves together for business purposes. A *stock company*, or *stock corporation* to call it by its proper name, is a company whose *capital* is represented by *shares* and which is held either in the *treasury* of the company, or by persons who buy the shares.

Three or more persons may form themselves into a stock company for any industrial purpose in the State of New York. A stock company must be *incorporated*, that is *legally formed*, under the laws of a State and different States [139]
have different laws. A copy of the corporation laws of any State may be had free of charge by applying to the Secretary of State.



Certificate of Inco

OF THE

THE SEABOARD ELECTRIC COMPANY, INC.

We, the undersigned,

all being of full age and two-thirds being citizens of the United States, and o
State of New York, do hereby certify and set forth: That we propose to for
pursuant to and in conformity with the Acts of the Legislature of the State o

*First.*—The corporate name of the said Company shall be The Seabo
Inc.

*Second.*—The purposes for which said Corporation is to be formed
To manufacture, purchase, sell or otherwise de
appliances and devices for the use of automobiles, mot
and other motor-conveyances or traction engines;
To manufacture, purchase and sell or other
ppliances and devices, machines, dynamos and e
ection with the production or creation a
other articles or things used i

FIG. 83. CERTIFICATE OF INCORPORATION

**How a Stock Company is Organized.—**Suppose, now, you and two other, or more persons want to organize a stock company under the laws of the State of New York for say $10,000, although the value which you, and those interested [140]
with you, place on your invention and patent may be a great deal more.

Then you and the others make, sign, acknowledge and file a *certificate of incorporation*, a reproduction of which is shown in Fig. 83 (see outfit necessary for a Corporation), and this must contain: (1) the name of the proposed company; (2) the purpose for which it is formed; (3) the amount of the *Capital stock* (which means the entire amount of the stock, for which the company is capitalized and which, let's say, is $10,000); (4) the number of *shares* of which the capital stock is to consist (each share of which must not be less than $5 nor more than $100 and the amount of actual capital must not be less than $500 in cash with which the company is to begin business) and the amount of cash must be stated; (5) The certificate must also contain the name of the city, village, or town, in which its principal business office is to be located; (6) its duration, which you can put at 50 years; (7) the number of its directors which must be not less than three; (8) the names and post-office addresses of the directors for the first year, and (9) the names and post-office addresses of the subscribers to the certificate of incorporation and a statement of the number of shares of stock which each agrees to take in the company. A *certificate of incorporation blank* ready to fill in can be bought for 10 cents of stationers who deal in law books and forms.

**The Fees of the State.—**The fees for incorporating a company are payable in advance at the Secretary of State's office and these are for (a) filing the [141]
certificate of incorporation $10; (b) recording it, 15 cents per folio of 100 words; (c) a *certified copy*, if you want one, 15 cents a folio and $1 additional for the seal affixed to it; (d) the *organization* tax, payable *direct* to the State Treasurer *in advance* is 1-20th of 1 per cent, on the amount of the capital stock, which on a capitalization of $10,000 would be $5, and (e) all personal checks for fees or taxes must be *certified*, that is to have the paying teller of the bank your check is drawn on write *good* on it together with his name.

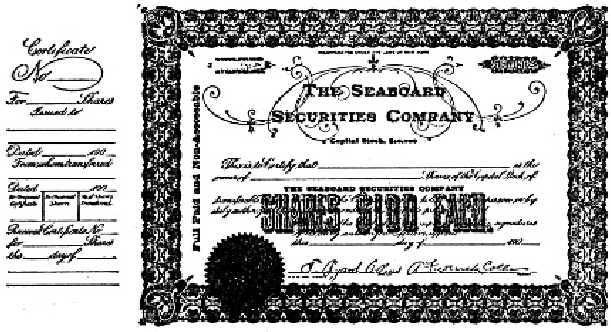



FIG. 84. STOCK CERTIFICATE

**Outfit Needed by a Corporation.—**To begin business with after you have received your certificate of incorporation you must have:

(1) A *minute book* in which to record the proceedings of the directors' and stockholders' meetings. A minute book with *printed forms* can be obtained which makes it easy to record the minutes accurately.

(2) A *stock certificate book*; suppose your certificates, or shares, have a *par value* of $100 then you will need a book of 100 certificates to equal $10,000. A [142]
stock certificate is reproduced in Fig. 84.

(3) A *book of account* is required by the New York State *transfer tax* law where companies are doing business in the State, and *transfer agents* must also have one to show every transfer of stock. Neglect to keep this book imposes a heavy penalty.

FIG. 85. A SEAL PRESS

(4) The New York *transfer law* also requires New York companies to keep a *stock transfer book* which shows when shares, or certificates, are sold, or transferred, by one person to another.

(5) A stock ledger is also needed by every corporation to enter the stock transactions of each day in. A combination book with all of the three last named can be bought ready for use.

(6) A *corporate seal*, which is an embossed impression of the name of the company, see Fig. 84, is made by a *seal press* as shown in Fig. 85, and this is also [143]
required by law. The whole outfit above described for incorporating and maintaining a company can be bought for the small sum of $10 or less of the Brown-Green Company, 48 John Street, New York City.

**How a Stock Company is Operated.—**When you receive your certificate of incorporation you can then call a meeting of the *directors* (named in the certificate of incorporation) or *board of directors* as they are called. At this first meeting the directors elect the *officers*, that is a president, a secretary and a treasurer.

The president then takes the chair and the secretary writes down all the minutes of the business transacted at this and subsequent meetings. The first business that will come before the directors after the election of the officers is to make the stock of the company *full paid*. To do this you must turn your invention and patent over to the company in exchange for the full amount of the stock the company is capitalized for, say $10,000. In other words you sell your right, title and interest in the invention and patent for $10,000 worth of stock, which is all of it.

Next you turn back into the treasury of the company 45 per cent, of the stock and keep 55 per cent. for yourself. The 45 per cent. of the stock in the treasury, which is called *treasury stock*, can then be sold at its *par value*, that is full value, which is $100 per share or at any smaller price the board of directors may agree upon. The sale of the treasury stock gives the company the capital it needs to start the business and to keep it moving until it becomes self-supporting. [144]

If $4,500 is not enough money to finance your company then capitalize it for whatever amount you think will be needed and add about 50 per cent. more to it. You can incorporate a company for $100,000 just as easy as you can for $10,000, but this is a matter you and your friends should consider most carefully.

Should you at any time sell more than 5 per cent. of your holdings, that is of the stock you own, the control of the company will pass out of your hands and the other directors and stockholders will whip-saw you as they like, if they can pull together, for the majority of the stock will be in their hands.

The stock, or *securities*, as it is called, of a company can be sold in a number of ways but the usual method is to sell it (a) by personal solicitation, (b) through stock-salesmen, (c) have a broker take the whole stock issue, and (d) by advertising. If your invention is what it seems to be, your patent as good as the average patent, your company capitalized for a moderate amount and the product looks good for making quick sales and large profits you won't find any trouble in placing the stock with the moneyed people of your community.

Besides receiving 55 per cent. of the stock for your invention and patent you should as the inventor and practical man be voted a salary of $25, $50 or $100 per week to superintend the manufacturing end of the business. Have a salary contract drawn up with the company in which the amount you are to receive weekly and the length of time you are to receive it is stated, and have it signed by [145] the president and secretary for the company.

**About Retaining a Lawyer.—**In all of your business dealings with other people from the very beginning the safest way is to have the advice and help of a *corporation* lawyer and while he is keeping you safe, whole and harmless from all damage be sure he doesn't mulct you while he is doing it.

A good way is to pay him a flat-rate for whatever advice he gives you and the contracts he draws up for you. But if you can't do this then give him a 1 per cent interest in the net amount which you may receive from your invention.

When you and your associates have decided on organizing a company the usual and proper way is to retain a lawyer and have him take care of the incorporation certificate, conduct the first meeting and open the books, to the end that it may all be done right and in good legal form.

---

[146]

# CHAPTER VIII

## SOME HINTS ON MANUFACTURING

After you have formed a partnership or a company and have the coveted capital to go ahead with the business, you and your associates must consider two problems and the way you work them out will decide whether your venture will lose money or *declare dividends*.

**The Problem of Manufacture.—**These two problems are the manufacturing and the marketing of your product and in this chapter we will talk about manufacturing it first and then take up the marketing end of it in the next chapter, for while they are closely allied in a common cause they have to be treated as entirely separate things.

In this respect a manufacturing concern is very like a human being in that it has a brain and a body. You and those interested with you are the brains of the organization and those who work for you, to the end that profits may pile up for your benefit and behoof, form the body.

On your head, most likely, will fall the responsibility of turning out a high-grade product at the lowest possible cost and to do this the right way and to the best [147] advantage you must begin at the beginning and think and scheme out how you can obtain the best results with the least outlay of time, labor and money.

There are many ways to start in manufacturing your product but the *efficient* way will depend on what you have to make, the number you are to make and the amount of capital you have to do it with.

**Farming out the Work.—**In the beginning you will often find it much cheaper, and hence more profitable, to give a contract to some manufacturer—who has a big factory fitted out with thousands of dollars worth of machine tools and a capable force of skilled mechanics—for a given number of the articles, or machines, you want to have made and delivered in and at a certain time.

By this arrangement there is no *initial* time, effort or money spent on buying machinery and getting a factory into running order, neither is there the work and worry of keeping a shop force going and besides you know exactly what each device will cost you when the lot is done and delivered. Still this scheme is not one that appeals to many inventors especially if they have, or think they have, a genius for mechanics and shop management.

Another way to start operations in an economical manner is to have some one or all of the parts of your invention done by outside manufacturers, or *farm them out* as it is called, and then assemble the parts in your own shop. Scattered all over the United States are shops and all sorts of factories where you can get a [148]
lower price quoted on a certain part or parts made of wood, brass, rubber or any other material than you could possibly make it or them for, in a shop of your own in the beginning.

Of course the larger the quantity of a given piece you can order at a time the lower will be the *pro rata* cost, that is the cost of each piece; for instance suppose a brass founder quoted you a price of $1 each on a certain casting in lots of ten, he might scale the price down to 50 or 60 cents each in lots of one hundred, and if you ordered a thousand at a time you might *get* the price down to 35 or 40 cents each. In figuring cost things like this must be taken into consideration.

In many cases it is not the mere material put into, and labor put on making a part that brings up the cost of the first lots but before the part can be turned out a special *die*, or *jig*, or *fixture* must be made for duplicating the part and very often a special machine must be designed and built for making a certain part. Such special tools and machines are very expensive and their cost must also be reckoned with.

**Starting Your Own Shop.—**In starting your own shop the question of what you are going to make and the quantity you intend to make will fix very largely the kind of machinery, the floor space and everything else you will need, nearly.

In this age of cheap electric power you can have an electric motor installed, to run your lathes, drill presses, shapers and other machines, almost anywhere you happen to be located. And besides it is better, as a rule, to start and operate your [149]
plant in your home town. For a shop on a small scale, wherever it may be, it is cleaner, less troublesome and cheaper to use electric power than it is to use gas or steam power.

Should you intend to operate on a very large scale it may then be to your advantage to look up a place where there is water power, or if your industry is one that calls for the large use of electricity you would then be justified in moving to Niagara Falls, or some other place where there are great hydro-electric plants.

The matter of being near to certain raw materials you need for manufacturing, or to a market for your product is not one that you will probably have to decide alone. Nor need the question of labor take up your time for the wages of skilled machinists, electricians and chemists are about the same throughout the United States, and while rents are higher in large cities than in the towns and villages still nearly one-half of the articles and machines made in the United States are turned out in 100 of the largest cities.

One of the advantages of manufacturing in a large city is that you can always get skilled labor and a great variety of materials on short notice. Should your product be in the nature of gas or steam engines, harvesting machines or automobiles you should locate your factory on some navigable river, on the Great Lakes, or on a railroad line (with a spur-track running alongside), in order to insure good and cheap transportation.

When you rent or build a shop the main thing is to have plenty of windows on [150]
every side and see to it that the ventilation is good and the heating system is adequate. There is no economy in making men work with poor light, bad air and in a cold place.

**Buying Machine Tools.—**Having secured by lease or by purchase a shop, or factory suitably located your next effort will be directed toward equipping it with the proper tools and machinery.

Besides the usual machinists’ hand tools you should buy (1) a *gas furnace*; (2) a *grinder*; (3) a *plain lathe*; (4) a *screw cutting lathe*; (5) a *drill press*; (6) a *planer*; (7) a *shaper*; (8) perhaps a *milling machine*, and (9) a *buffer*. Several of each of these kinds of machines may be needed.

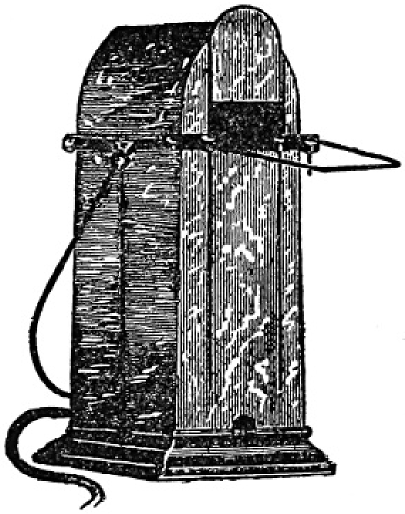


FIG. 86. A GAS FURNACE

A gas furnace, see Fig. 86, is useful for tempering tools and other operations where an intense heat is needed. A grinder, shown in Fig. 87, is used for grinding [151] off rough parts of iron or brass castings and for smoothing up rough surfaces. It is formed of a *mandrel* which turns freely in a pair of bearings set in a *headstock*. A pulley is fixed to the middle of the mandrel and the latter is threaded on the ends; an *emery*, or a *carborundum* wheel is slipped over each end and these are held in place by washers and nuts. A swivel *hand rest* makes it easy to hold the work against the wheel.

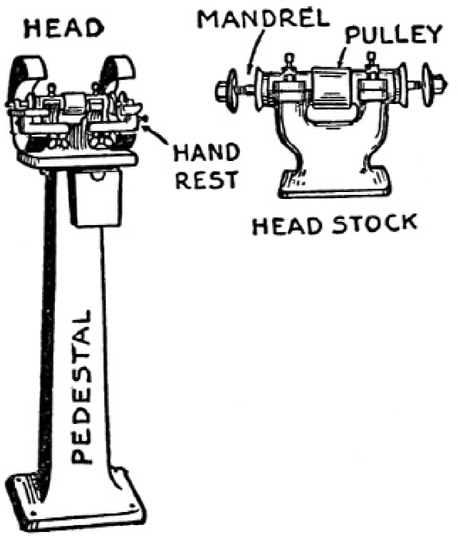



FIG. 87. A GRINDER AND POLISHER

A plain lathe, see Fig. 88, is good for turning, drilling and facing metal parts and for many other operations. It consists of a bed supported on a frame which carries the driving pulleys; the latter in turn is belted to a *cone pulley* which is *keyed* to the mandrel and this runs in bearings in the *headstock*. The inner end of the mandrel projects beyond the bearing and this is threaded so that a *chuck*, that is a device with adjustable jaws for holding the work, can be screwed on it. [152]

Besides the headstock which carries the rotating mandrel, and which is fixed on the left hand side of the bed, there is a *tailstock* with an adjustable mandrel which slides on the right hand end of the bed, and between the headstock and the tailstock there is an adjustable hand rest.

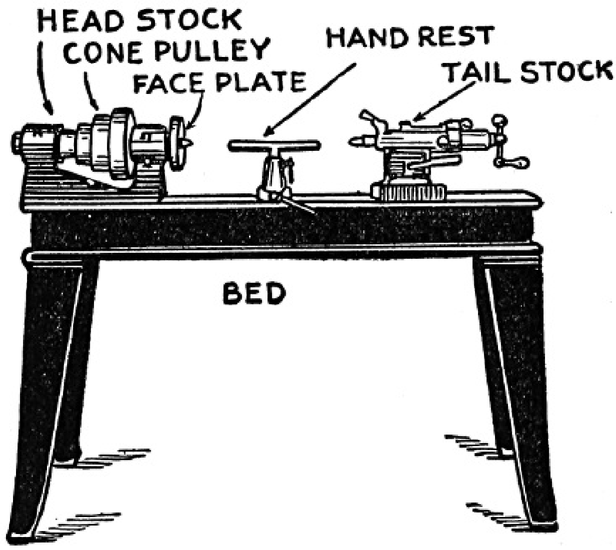



FIG. 88. A PLAIN LATHE FOR TURNING METAL WITH HAND TOOLS

An engine lathe, as shown in Fig. 89, besides doing all an ordinary lathe can do can be used for accurately turning up cylinders, disks, etc., turning out cylinders and cutting screws of any size or pitch, within certain limits, and it does all these things with rapidity and precision.

A lathe of this kind has a *guide-screw*, a set of *change wheels*, that is a number of interchangeable gears, and a *back-gear*, and by means of these gears the [153] guide-screw is revolved in any *ratio* to the speed of the gears which may be desired. For turning or cutting a *slide-rest* is used, that is an attachment sliding between the headstock and the tailstock, for holding the tools.

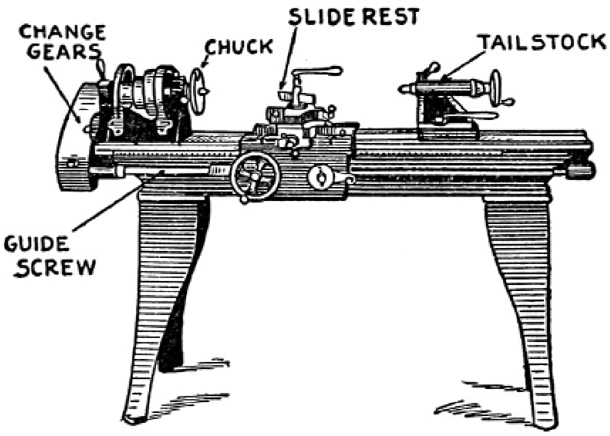



FIG. 89. AN ENGINE LATHE FOR TURNING METALS WITH TOOLS IN A SLIDE REST

The slide-rest is made with two adjustable slides so that the tool can be held in any position. The slide-rest can be moved freely by hand or by means of the guide-screw which carries it along the bed at any desired speed.

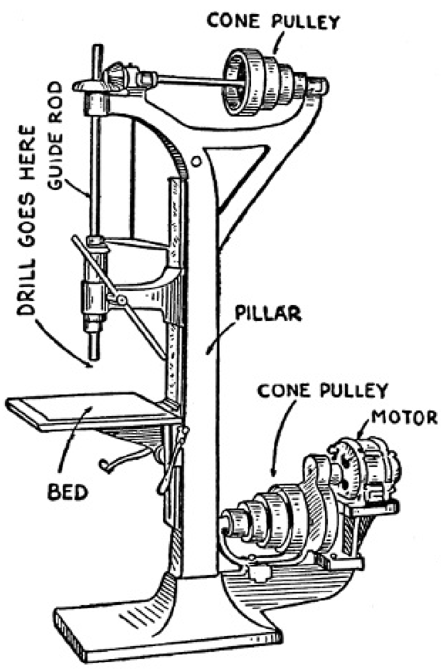



FIG. 90. PILLAR TYPE OF POWER DRILL

A drill press makes drilling an easier and a more accurate operation than when a lathe is used for this purpose. A pillar type of power drill is shown in Fig. 90. It is so constructed that the drill can be rotated at any one of a number of speeds and by means of a guide-rod it is caused to advance into the metal *automatically* [154]
at the proper speed.

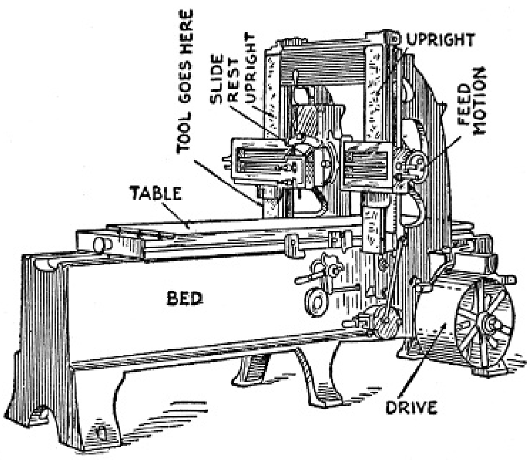



FIG. 91. A PLANER FOR SURFACING METAL WORK

A planer, see Fig. 91, is a machine for turning up flat surfaces, cutting slots and [155]
the like in metal parts. A planer is made up of a *bed*, a *table* in which the work is clamped and which slides back and forth on the bed by means of a feed motion; a slide-rest, which carries the cutting tool, is held above the bed by an upright frame and this moves to and fro across the table.

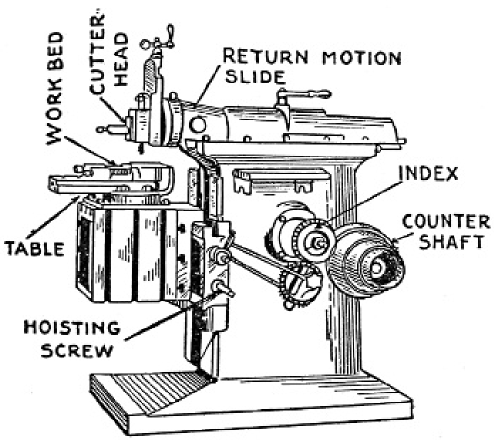



FIG. 92. A SHAPER FOR SHAPING UP METAL WORK

There are several kinds of shapers made and Fig. 92 shows one of them. A shaper cannot only be used for planing, but for turning, boring and slotting. In a shaper the work is held in a fixed position on the table, which can be raised and lowered by a hoisting screw, and the tool is made to move across the table by a quick-acting return motion.

There is also an *arbor* on which the work is mounted where a circular cut is to be made. The cutter head has a vertical adjusting screw with a *worm feed* and an index plate so that it can be set to any ratio. In a shop where only small work is to be done a planer may be dispensed with and a shaper used instead. [156]

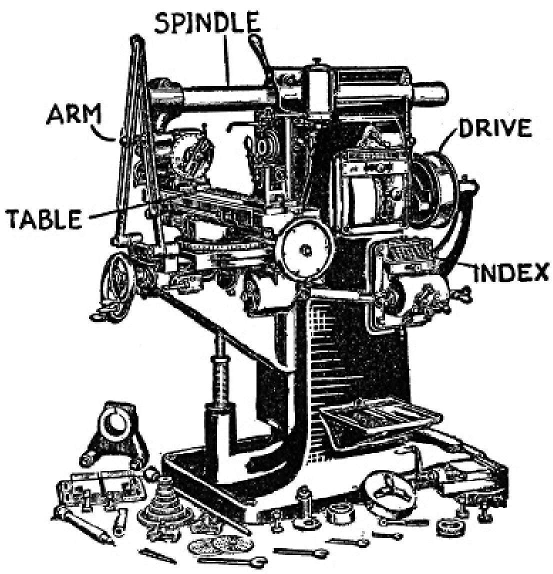



Fig. 93. A UNIVERSAL MILLING MACHINE FOR AUTOMATIC SCREW CUTTING AND OTHER OPERATIONS

A *universal milling machine*, see Fig. 93, is also a handy combination tool in that it can be used for drilling, cotter drilling, boring, profiling, key-seating, rack- and gear-cutting and other operations.

A buffing machine is made nearly like a grinder but leather, felt and rag wheels are used on the spindle and when either pumice-stone, crocus and rotten-stone is [157] applied to them tool marks and scratches can be buffed out and the work polished when it is ready to be *lacquered* or nickle plated.

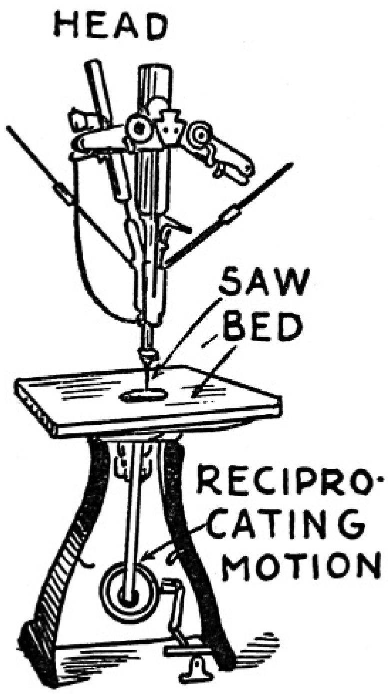



Fig. 94. A JIG-SAW FOR SAWING SMALL WOODWORK

If you are buying new machines get them fitted with individual electric motors, as shown in Fig. 90, as this will save shafting, the time and cost of putting it up, the cost of belting, besides the time the machine is idle while the belt is broken and it is being laced again, the loss of power in transmission, when the machine is idle, etc., etc.; boiled down, these machines equipped with individual motors are the last word in modern shop practice and it is a good one for you to follow. [158]

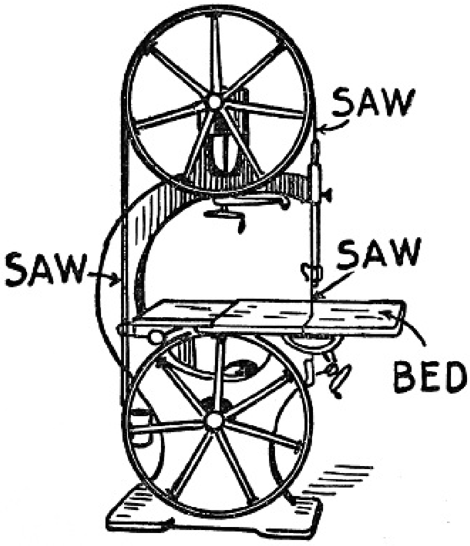



FIG. 95. A BAND SAW FOR SAWING HEAVIER WOODWORK

Whatever machines you order be sure to also order at the same time a full supply of tools to use with them for otherwise you may find when you have your machinery all set up and you think you are ready to start that you are minus the cutting tools and should this happen you will be in for another long delay.

Unless your product requires a lot of wood-work it will hardly pay you to add a woodworking shop to your plant, though sometimes a *jig-saw*, see Fig. 94, or a *band-saw*, as shown in Fig. 95, will often prove of service.

It is the same way with a foundry, for unless you need a large number of castings right along it is as a rule cheaper to farm the work out to some founder in your own town. [159]

**Buying the Stock.—**I do not mean the stock of your company—let your friends and the public do that—but the raw materials, as the *stock* is sometimes called, which you are to convert into the finished product.

Before you order either machinery or stock, try to *standardize* your product, that is to say whatever it is you intend to manufacture have it in such shape that you are satisfied to market it without making any further changes in it, at least for some time to come. It is the after-changes, the constant changes that have kept many a manufacturer poor, aye, forced him to the wall.

Having a standardized article, object or machine, you and your associates should determine on the number to be built first and then you can go over the model in detail and figure out just how much of each kind of stock, such as brass rod, sheet hard rubber, screws, washers, nuts, etc., you will need, allowing of course for waste and breakage.

Now when you are ordering the tools and machines for your shop get prices on and order your stock at the same time and see to it you do not overlook any little thing and so have to wait for something you forgot.

Screws, nuts, washers, bolts and some other small supplies can be bought in wholesale lots cheaper than you could possibly make them in your own shop and it is false economy to make anything with ordinary machine tools that can be bought from some other manufacturer who does the work with automatic machinery. [160]

**Organizing a Shop Force.—**I am taking it for granted that if you have enough ability to invent, design and make a working model of an invention and get an *organization* together to manufacture and market it you will certainly have enough ability left to build up and superintend the *body* of your enterprise and that is your shop force.

Your first effort in this direction should be to hire a good foreman; this, though, is not an easy thing to do for a foreman must be something more than a thorough machinist who can use any tool or run any machine. He must be able to get the best there is in them out of the other men under him and see that each one is put on the job which he is best adapted to do.

Some of the men will shine as bench hands, others will show an aptitude in running machine tools and yet again others will be naturally clever in assembling your device; he must be able to pick out these good qualities and put the men where they will do the best work in the shortest time.

By all means get a foreman, if you can, who has worked on something like, or nearly like, your own product. He should be a man of shop ideas with enough *initiative* to put them into use. To get all these things rolled into one human being for $25, $30 or $35 dollars a week is asking a good deal but there are boss machinists in almost every city who can fill the bill. [161]

Your foreman can usually get all the mechanics you need but don't make the mistake of starting in and letting him hire the men. After he has found a man and wants to take him on, then you talk to the prospective employee, and you do the hiring. Hiring and *firing* the men should be your *prerogative*. This will make all of them respect you without respecting their foreman the less and they will do more and better work by knowing that you are the real boss of the works.

**The Stock Room.—**The tools that belong to the shop and the stock, or raw materials, should be kept under lock and key in the stock-room and a stock-clerk should be put in charge of and made responsible for them.

Have slips printed and whenever the foreman, or anybody else, including yourself, wants a drill, or a piece of brass, or a machine screw, insist that the stock-clerk get a slip signed for it. By this method you will know exactly where your tools and stock went to; and when a man returns a tool credit him with it.

You should also have a record kept of the time spent on each job by the man who did the work and the easiest way to do this is to use a time-stamp as shown in Fig. 96. If your shop is a small one your stock-clerk can take care of the time-slips. By doing things in this systematized way you will be able to keep pretty close tab [162]
on tools, stock and labor and these are three *factors* where a great deal of waste usually occurs in small shops and factories.

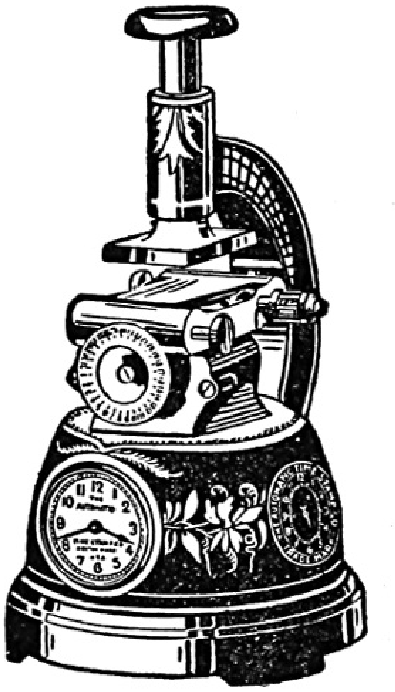


FIG. 96. THOMPSON TIME STAMP

**The Finished Product.—**Whatever you are manufacturing, the finished product must be made as attractive as can be with the littlest extra cost and this applies alike to a toaster for a gas-stove or a threshing-machine. It's the finish the buyer sees and he will gladly pay for the paint and the gloss that covers up the defects, if the thing looks nice.

Where a number of different materials enter into the make-up of a device it is always well to give some thought not only to the design,[5] but also to the color effect.

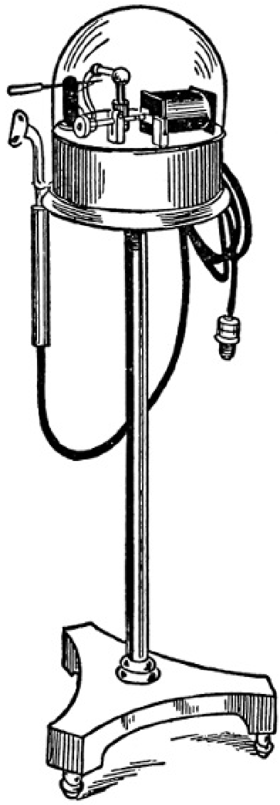


FIG. 97. A HIGH FREQUENCY MACHINE

Figure 97 shows a *high frequency* (violet ray) electric machine designed by the author in which this idea is carried out. The stand is of iron, nickle-plated; the base of the apparatus proper is of wood, japanned black; the rim is of brass, nickle-plated; the plate-base, on which the visible part of the apparatus is mounted, is made of slate and japanned black; the metal parts of the interruptor are nickle-plated, and the coil and insulating standards are of hard rubber as is also the handle. The cover shade and the violet ray vacuum tube are of glass, [163]
while red or green flexible silk cords are used to make the connections, and [164]
finally the lamp socket is of a composition called *electrose*.

Thus the color scheme is polished ebony, the wood base, the slate plate base, hard rubber fittings and electrose socket all appearing precisely alike; the blue-white nickle-plated parts alternate with the black, the glass lends an added touch of beauty while the red, or green, cords give it a dash of color that relieves and sets off the other parts.

Iron work can be *japanned* black, *enameled* any color, or nickle-plated; brass can be lacquered or nickle-plated, and wood can be enameled. After the device or machine is assembled it should be rubbed up to remove all finger marks and to brighten it, then wrapped in tissue paper and packed carefully in a box if it is small enough so that this can be done, or it must be crated in such a way that it can be transported without marring or breakage.

**Overhead Charges.—**In figuring on the cost of a completed device, machine or product so that a selling price may be put on it which will insure a handsome profit the cost of the stock, of the breakage of tools, of the labor, or production, and of the power—gas, electricity, water or coal—are all easy to keep track of.

But there are other costs that must be taken into account which, while they do not stick out so plainly must also be reckoned with, or your venture will be a money losing one. These are the *overhead* charges, such as the *depreciation* of
your machinery, that is the wear and tear of it; the rental of your factory, or the [165]
taxes if you own the building; the insurance on the building and the machinery; transportation costs such as teams and teamsters or automobile trucks and drivers; telephone calls and the other little and big items of expense—all of these must be carefully thought up and worked out for the year and charged against the number of machines you are going to make in that year.

To these fixed and variable charges must be added the salaries of yourself and your associates and the office staff together with the printing bills, advertising accounts and all the incidental expenses of maintaining an executive office. Divide the total running expenses for the year by the number of machines you have turned out in a year and you will have the net cost of each article or machine you have produced.

**Where Your Profits Come In.—**Add 33⅓ per cent., 100 per cent., or 500 per cent. to the cost of production and let that be your selling price to *consumers*, agents, jobbers or wholesalers, less the usual small discount for cash. And the difference between the cost of production and your selling price will be your *profits* less certain losses on accounts which even an agency can't collect.

---

[166]

# CHAPTER IX

## PUTTING IT ON THE MARKET

Long before you get your shop into running condition and you are able to fill orders, you and your associates will have talked over the best way that should be adopted to put your article or machine on the market so that it will bring in the largest returns in the shortest time.

Here again the method you will choose and use will depend on what you have to sell and the backing you have to sell it with. Just as there are only seven original jokes and all the others that you see and hear are worked over and out of them so, too, there are only a few *basic principles* in the art of selling goods but these are modified into a thousand and one schemes.

**How Best to Do It.—**How? Aye, that's the question! But even as you have had the genius to invent a new and useful time, labor and money saving device—there will, among the men you have surrounded yourself with, rise up one whose brains teems with schemes of ways and means to dispose of the factory's output at the greatest profit and you may have a few stray ideas too as to how the thing can best be done.

In every business however small or large there should be frequent *conferences* of the partners, or of the heads of departments, and to save time and to conserve energy it is better that these meetings should be held at certain times each week, or oftener, when all of the matters of the office and shop can be discussed freely and threshed out. Indeed it is the common practice of every business concern where there are a number of departments for the heads of them to get together every day in conference to learn the viewpoints of the others. [167]

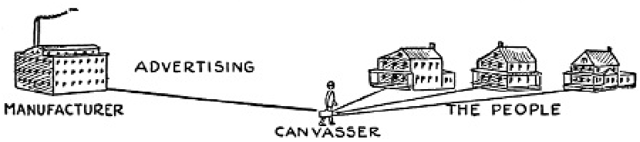



FIG. 98. FROM THE MANUFACTURER TO THE CANVASSER, THENCE TO THE CONSUMER

By this method every one knows exactly where the business stands for that day not only in his own department but in the other fellow's as well and he conducts his part of it accordingly. This welds the whole business into an efficient unit instead of having it made up of a bunch of straggling ends. If the business can't be put on a paying basis under such favorable conditions then you had better get a new partner, hire a new manager or call in the old sheriff.

**Agents Wanted.—**Hundreds of small patented inventions as, for instance broom hangers, pinless clothes lines and burglar alarm traps are sold by the manufacturers of them directly to small agents all over the country and who, in turn, sell them by making a house to house canvass. See Fig. 98.

The amount of your sales under this plan will depend on the number of agents you are able to secure and generally on the persuasive ability of the rhinoceros skinned peripatetic to sell the good housewife something which she truly doesn't want. But should your invention be one of exceeding merit—and of course it is—then the path of the itinerant salesman is made glad and he sees a rose for every prick of the thorn he gets. [168]

Agents can be had by running small ads in the daily and Sunday papers in the large cities under the classified head of *Agents Wanted*. There are advertising agents who will *run* an ad for you in 15 or 20 papers throughout the United States, whose combined circulation runs up into the millions of copies and all for a $10 bill. An ad of this kind can also be run in such magazines as *Popular Mechanics*, *Popular Science* and a dozen other like publications.

**The Mail Order Business.—**The two chief plans for working a mail order business are (1) by selling direct from your shop to the consumer and (2) by selling your product to agents whom you start in the mail order business.

To work the first plan there are two ways by which you can get the names of prospective buyers and these are (a) by running small ads in the papers and magazines and (b) by buying a list of the names of firms who make a business of classifying and selling them.

Regarding the first plan suppose you have invented a new *blood testing apparatus* in which case you couldn't possibly hope to sell it to any other class [169]
than doctors. Now you can buy a list of all of the doctors in Boston, or of any other city, in Illinois or any other State, or of all of them in the whole United States from *Boyd's City Dispatch*, 19 Beekman Street; *Rapid Addressing Machine Company*, 374 Broadway, and R. L. Polk and Co., Inc., 87 Third Avenue, all of New York City.


FIG. 99. FROM THE MANUFACTURER TO THE ORDER AGENT, THENCE TO THE CONSUMER

When you get this list you can then send out to each doctor a nicely gotten up *folder* or *booklet* and a clearly worded letter, which you can have *mimeographed*, that is duplicates made from the original typewritten letter, and according to business rules and regulations these ought to make a noise like a lot of orders.

Lists of men and women in every line of business, profession and trade; including R. S. Dun and Company's list which is guaranteed 99 per cent. accurate, can be bought of the above concerns that are classified to fit whatever article or device you intend to market. This is one way of conducting a mail-order selling campaign.

The second plan as outlined above is to run small two to ten line classified ads for agents offering to start them in the mail order business. See Fig. 100.

Your proposition to each prospective agent who replies is something like this: [170]
you will give him, provided he buys, for cash in advance, of course, one dozen, one gross, or a dozen gross of the product you manufacture, the exclusive territory of a city, a county, or several of them, or of an entire State as you choose and according to the quantity he buys.

Included in the price he pays, you furnish him with so many letter heads and envelopes with his name printed thereon as *manufacturer's agent*; printed circulars or folders, a *series of follow-up letters* and whatever else is needed to start him in the mail order business except the list of names and the postage stamps he will use. It is up to him to get these accessories.

**A Series of Follow-up Letters.**—By a series of follow-up letters is meant that a number of different letters, say six, are written up in such a way that each one makes a stronger appeal to the consumer than the one he gets before.

Let's say that your agent sends a circular describing the merits of your *patent mailing box for eggs* to an egg grower in the rural district and with it a letter stating how glad he would be to receive an order from him for a dozen mailing boxes, the price, etc.; if, now, in ten days' time no reply is forth-coming the agent mails him a second letter, stating that he can't understand why he hasn't heard from him, et cetera and so on. If this brings no response the agent mails a third letter in another ten days saying that since he (the agent) has used several stamps in writing to him suppose that he (the egg grower) sits down and uses a stamp on [171]
him and so forth and *e pluribus unum*, as Artemus Ward used to say.

And so the letters are mailed until the series of six have been sent out at ten day intervals. The idea is that as the letters, each of which is a little stronger than the one before it, reach the egg grower with clocklike regularity the value of your patent mailing box for eggs will sink deeper and with more telling effect into his *cranium* and that somewhere between the first and the last letter he will conclude he had better order a dozen or more boxes.

If the sixth and last letter does not bring an order the agent may then conclude that the chickens are dead, or that the roosters are sleeping, or else that the egg-grower doesn't want the mailing box and he knows that he doesn't want it. At any rate it is time for the agent to quit wasting stamps on him.

**Selling Through Sales Agents.**—Turning now to big business one of the most successful ways now in vogue to sell goods is the one adopted by automobile manufacturers.

By this method the manufacturer sells his product to his own sales agents and these in turn sell them to the consumer. Both the manufacturer and his agents advertise, the former nationally, that is he tries to reach all the people, and the latter locally, that is in his own territory.

The result of their joint advertising is inquiries and these the sales agent follows up by personal solicitation. Fig. 100 shows diagrammatically how the [172]
scheme works out.

**Selling Direct from Factory to Consumer.**—A large number of manufacturing concerns have built up profitable businesses by advertising in various publications and dealing directly with the consumer. See Fig. 101.

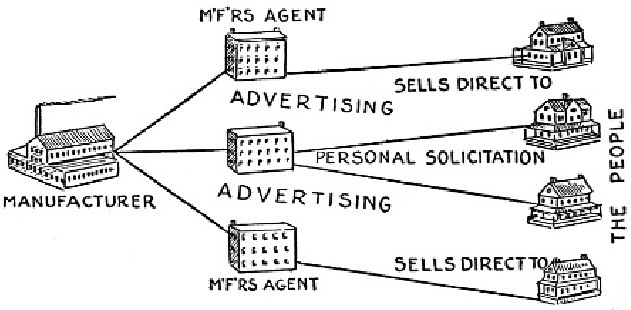



FIG. 100. FROM THE MANUFACTURER TO THE MANUFACTURER'S AGENT, THENCE TO THE CONSUMER

Many products, especially those in the nature of machines, can be sold by this method where they could not be marketed in any other way. Take as an example the larger sizes of hand power printing presses. One firm has sold thousands of these machines through the persistent use of small advertisements where only a few could have been disposed of through dealers of any kind, for the reason that there is not a sufficient demand for them in any one locality.

Any article, device or machine can be sold directly to the people through the medium of cleverly displayed advertisements placed in the right publications. [173]
When you get ready for an advertising campaign write to any advertising agent—and he also advertises—telling him what it is you have to sell and he will send you a list of the periodicals which will reach the class of folks who will be interested in your commodity and also quote you advertising rates. But of advertising I shall have something more to say later on.

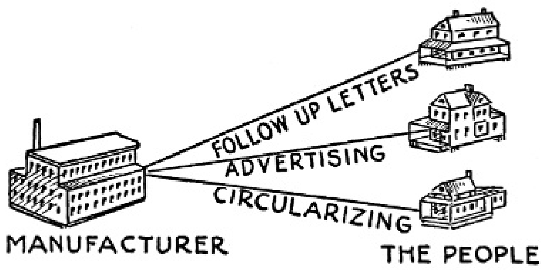



FIG. 101. SELLING DIRECT FROM THE FACTORY TO THE CONSUMER

Where you sell direct to the consumer you should also use, of course, a series of attractive *pictorial* cards, circulars, folders and booklets which describe your offering in terms of glowing color and cold, hard facts. Don't try to deceive your customers for no business can be conducted on misrepresentation and last, and besides it is just as easy to enthuse with the truth as it is to equivocate, *not to use a harsher and uglier word*.[6]

A series of follow-up letters should also be used and lists of the people you want to reach are sometimes as useful, and occasionally more so, in bringing results as [174]
advertising. In fact every art and device known to the system of business should be freely used where there are no middlemen.

**Selling Through the Trade.—**The older plan for a large manufacturer to dispose of his goods is through the retail stores, but this is a more costly and a harder way than by the direct method of reaching the consumer.

The reason for this is that the manufacturer does not deal directly with the retailer, but must do so through a lot of middlemen of whom there are in some cases not less than three and often more.

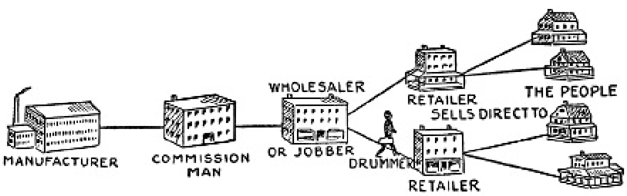



FIG. 102. SELLING THROUGH THE TRADE

Figure 102 shows how many different concerns stand between the manufacturer and those who buy his goods; the manufacturer turns his product over to the *commission man* who unloads it on the *jobber* or *wholesaler*, who sends *drummers* on the road, who make the *retailer* buy it, who hands it out over the counter to his *customers*, who are merely acquaintances of his.

All of the middlemen make big profits while the manufacturer and the retailer have to be satisfied with a very small margin and the consumer knows that he is [175]
paying several prices too many for the article he buys.

The advantage, though, of handling your product through middlemen lies in the fact that you can very often get a commission man, or a jobber, to contract for the entire output of your factory, and sometimes a certainty of this kind with small fixed profits is better than taking a chance of putting a large sum into advertising with the uncertainty of large profits or of no profits at all.

**Getting Publicity.—**Going back once more to the time when you have completed your model and your patent has just been granted, it is often a good idea to give some *publicity* to your invention.

By publicity I mean to get some *write-ups* in the papers and some articles in the magazines and if you go about it the right way it will not cost you anything for space and sometimes the editors will even pay you for your contributions.

When you have reached the stage where you want some publicity write up a clear description of say 500, 1000 or 2000 words, depending on the importance and intricacy of your invention, and have a typewritten copy made of it; next have some good 5 by 7, or better, 8 by 10 photographs made of your model from different viewpoints. Small kodak pictures are of no value in obtaining free publicity for clean-cut, large pictures, count for as much or more with the average editor than either subject matter or written copy.

Now the kind of publications in which you will want your article to appear will [176] hinge on the class of readers who will be interested in it. But let's suppose that it is a new machine, or a new electrical apparatus of some sort or other. If it is a machine send your typewritten article to the editor of the *Scientific American*, Woolworth Building, New York; if your photos and article appeal to the editor as being new and novel he will most certainly print them in his paper.

In an article of this kind it is not good policy to crack up yourself or put in your street number, as this savors too much of trying to get a page or so of advertising in the body of the paper free of charge; your name and the city where you live are enough to include in the article, but in a letter accompanying the latter you can send your detailed address. And you can send in another article and photos to the *Engineering Magazine*, 140 Nassau Street, New York; *Machinery*, 140 Lafayette Street, New York, and other publications of a like character.

Should your invention be electrical, or have a single electric element connected with it, send your article to the *Electrical World*, 239 West 39th Street and to the *Electrical Review*, 13 Park Row, both of New York, and the editors of either of these publications will most surely and gladly accommodate you with space for your contribution.

The purpose of having articles appear in these *technical* papers is not so much to sell your product as it is to give you an *authentic* article in a standard publication which you can refer to and reprint from for distribution to those whom [177] you may want to interest either as partners or shareholders. Reprints are also useful for *circularizing* agents or consumers after you have your factory in shape to take care of the orders.

Should your invention have to do with mining send in your article and photographs to the mining papers, if it is in the notion line mail it to the dry-goods papers and so on for no matter what you have invented you will find one or more trade papers in that particular field who will give you the desired publicity.

After some good technical, or trade paper has published an account of your invention the daily and weekly papers in your home-town are apt to be impressed with the importance of what you have done and one or all of them will give you quite a write-up.

**Advertising.—**While publicity and advertising are one and the same thing in that both of them make known to the great body of buyers the merits of your invention I have *arbitrarily* divided them into two classes calling (1) everything that is printed as straight reading matter in a paper and free of charge *publicity* and (2) all that is displayed to attract the attention of the reader and paid for at space rates as *advertising*.

You can begin an advertising campaign with a very small outlay of capital by running a ½ inch, one column wide ad in ten or a dozen papers or magazines as a starter. To have your ad *displayed* as you want it, that is the style of type and the illustration that goes with it, get your local printer to set it up and have as many [178] *electrotypes* made from it as there are papers you intend to buy space in. Then all you have to do is to mail one of these electrotypes to the publisher and it appears in his paper exactly like the type from which it was made and it can be used over and over again.

This *stereotyped* kind of an ad which meets the reader's eye in nearly every publication he picks up will finally get through the pores of the calcium salts which form his skull and impress the sensitive area of his brain, or, to use the language Evelyn doesn't like, it *gets on his nerves* and he will read it. Every time he sees it after that he will remember its message and then when the *psychological moment* arrives and he wants your product he will send to you either for a catalogue and price-list or for the thing itself.

Larger ads should have the reading matter and the cut changed frequently, but it is always well to use some design, or a name (see Chapter XII), which stands out boldly in relief so that it will flag the attention of the reader immediately he turns to the page where it is displayed. The rest of the ad must then be catchy enough to induce him, or her, who sees it to read it, and last of all it should contain some gem or germ of knowledge which he, or she, will carry away and think over and always to the end for which your ad was written and designed—and that is to buy your product.

Writing alluring ads requires inventive ability but of an order very different from that which produces a new machine. Hence there are inventors who make a [179] specialty of writing ads but they are content to call themselves originators.

Should you have a product that you intend to give wide publicity to, whether it is your intention to sell to the consumer direct or to sell to him through the retail trade, it is a good plan to engage the services of an advertising firm to conduct the campaign for you.

If you are going to spend $1,000 or $100,000 on making your product known among men and women and popularizing it so that everybody will buy it, or wants to buy it, it is well to have an advertising agent or firm get up the ads, place them in the papers where they will do the most good—in a word engineer the whole thing for you while you are superintending your factory and your partner is taking care of the orders—then all you have got to do is to count the *shekels* that roll in or out as the case may be.

---

[180]

# CHAPTER X

# THINGS FOR YOU TO INVENT

All through this book I have done my best to nickelplate you in the bath of my own experience and I believe I have made everything clear unless it is just how to get the big idea.

And even if I could give you a hard and fast rule for thinking up new and novel things I have grave fears I would be tempted to keep that bit of information to myself and start up an *idea factory* in opposition to Edison.

But while it is not yet possible to lay down a law for the creation of an original idea it may prove of some value to tell you something about what is needed both small and large and this in itself may serve to stimulate your thought centers to activity.

As you look about and see all the different materials, apparatus and machines that have been invented to make work easier, to save time or goods and to increase safety and comfort you may on first thought conclude that everything the human race really needs has been invented and this is in a large measure true.

But the secret of present day inventing was let out of the bag by Edison when he said that “hardly any piece of machinery now manufactured is more than 10 [181] per cent. perfect.” Certainly the electric lights we now have are good enough as far as the light goes but light costs us ten times as much as it ought to cost for the reason that 90 per cent. of the energy there is in a ton of coal is wasted and only 10 per cent. of it is transformed into actual light.

Oliver Lodge, England’s greatest electrician, once said that if we knew how the glow worm makes his light then a boy could turn a machine that would develop enough electricity to light a factory. The problem for you to tackle then is not to make a *better* light but to make a *cheaper* light.

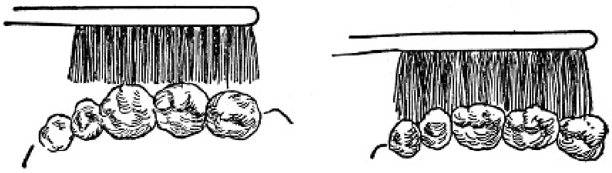
And what Edison has said about machines and Lodge has said about light, I say is just as true of everything else we have for lessening labor, for saving time and materials, making for safety and adding to comfort. Everything that has been invented up to the present time, with very few exceptions, such as the electric motor which is 98 per cent. efficient, can be made nearly 90 per cent. better.

This gives you your cue for inventing, that is to conceive and *improve* upon what has been done rather than to sap your life’s blood and waste time, which is just as precious if you only know it, in trying to invent something entirely new and original under the shining sun.

Nor do you need to undertake to improve upon the big things—unless, of course, you get a great idea and you feel that the world can’t get along without it and that you would lose a fortune unless you straightaway developed it. [182] Otherwise just keep your eagle eye on the lookout and your inventive brain cells on the alert and it will not be long before you will see something where there is room for improvement.

**Some Little Things Needed.—***For the Person.*—There isn’t a thing you wear, or carry in your pockets, or use in making your toilet but which can be improved upon.

Your suspenders, your corset, cuff buttons, dress-shields, necktie clasp, hose supports, garters, hat pins, collar buttons, eye glasses and eye-glass guards, hair curlers or straighteners according to the dictates of fashion, jewelry guards, fasteners for clothing, clothes hangers and clothes presses ought all to be done over and re-invented.



A B

FIG. 103A. OLD STYLE TOOTH BRUSH
FIG. 103B. AN IMPROVED TOOTH BRUSH

A better way to clean teeth, see Fig. 103, to shampoo the head, to manicure nails, to wash backs and to shine shoes should all have attention. Improvements in false teeth and in making the deaf hear are in order; but it is just as well to keep away from inventions to make the hair grow and to remove freckles.

*For the House.*—You can help to save mother’s time and conserve her strength [183] by inventing any of the following devices and besides you’ll make enough money so that she won’t have to use them and that will be still better.

A B

FIG. 104A. THE OLD WAY—THE CARPET SWEEPER
FIG. 104B. THE NEW WAY—THE VACUUM CLEANER

Odorless cooking utensils, candy making apparatus, visible ovens, dish washer, ironing machine, soap saver, milk jar seal, fish scaler, fire extinguisher, water cooler, water purifier, cheap ice machine, ice crusher, window cleaner, silver cleaning apparatus, vacuum cleaner, see Fig. 104, knife sharpener, fountain scrub brush and all kinds of handy tools are needed.

A self-serving dining room table that will let the folks eat instead of keeping every one busy waiting on everybody else between bites should and undoubtedly would find a large sale.

*For the Farm.*—Improved farm machinery has made the farmers and the inventors rich and important but the little things around the farm have been sadly [184] neglected and if some one doesn’t come to its rescue pretty soon it will go to rack and ruin.

FIG. 105. A LABOR SAVING PAINTING MACHINE

A substitute for leather, mail conveyer to carry mail from the road to the house, a painting machine, see Fig. 105, cheap fence posts, fattening apparatus for chickens, insect exterminators, portable fences, nests and coops for chickens, traps for preying birds, parcels post cartons for butter and eggs, incubators, brooders, cream separators, milking machines, and everything else used on the farm can be made more efficient than the present apparatus and machines which are now used.

*For the Office.*—There was once a time when a shingle swinging in the breeze, a desk, a chair and a spittoon constituted an office, but those halcyon days of Lincoln and Douglas, Calhoun and Webster are gone forever.

[185]

FIG. 106. A QUICK FIGURING AND BOOKKEEPING MACHINE

What is needed now are not brains so much as an improved file case, time stamp, check protector, gumless mucilage bottle, inkwell that cleans the pen, safety envelope that can’t be opened without detection, mailing boxes and tubes, envelope inserting and folding machine, duplicating processes for typewritten copy, envelope opener, improved dictaphones, that is phonographs for dictating to stenographers, and figuring and bookkeeping machines; see Fig. 106.

*For Fun.*—There is a great demand for toys and amusement devices and novelties of all kinds.

Little 5 and 10 cent jokes, like the snake jar, shadow dancer, shooting pack of cards, rubber dagger, see Fig. 107, and the musical seat, puzzles like the beast, the star and crescent, Billy Possum, devil lock and Chinese conjuring rings and [186]
games, tricks, magical advertising novelties and the like are profitable in a small and sometimes in a big way.

FIG. 107. A RUBBER DAGGER, AN AMUSING TOY

Merry-go-round, shoot-the-chutes, bump-the-bumps, see Fig. 108, dips and slides are some of the larger amusement inventions that have been making money at summer and seaside resorts. What you must do is to provide other new and novel means for the fun loving people to do ridiculous stunts and pay you for the privilege.

Now while all of the above devices have been invented and patented the point is that every one of them has a *bug*, that is a flaw in it somewhere; by which I mean that in each and every case, except the toys and amusements, the device is too hard to work, costs too much, takes too much time, is too troublesome, is too poorly made or is not as comfortable as the old-fashioned thing.

It is your business as an inventor to improve it so that your device will do the work or serve the purpose better than it has ever been done before. In order to [187]
improve a compound, device or machine to this extent you will have to introduce some new principle, or element into it and it is this added cause, or part in *combination* with the other and well-known arrangements that gives it a new and novel twist and for which you pray that letters patent may be granted.

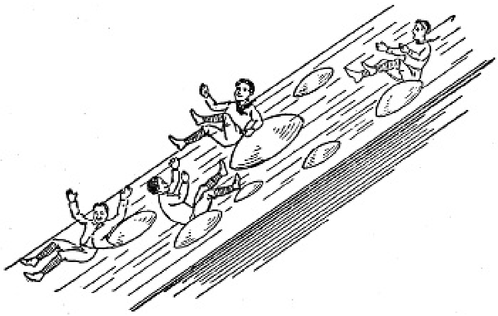


FIG. 108. BUMPING-THE-BUMPS

**Some Big Inventions Needed.—***Safety First.*—That there were 38,000 deaths, 500,000 seriously injured and 2,000,000 slightly injured persons caused by all manner of accidents in 1915, shows how badly improvements are needed for all kinds of machinery, in the operation of mines, railroads and steamships and in the manufacture of certain chemical products such as phosphorus matches and dynamite. There is money and lots of it in inventions that have for their object the safeguarding of human health, limb and life. Fig. 109 shows a life-saving gun.

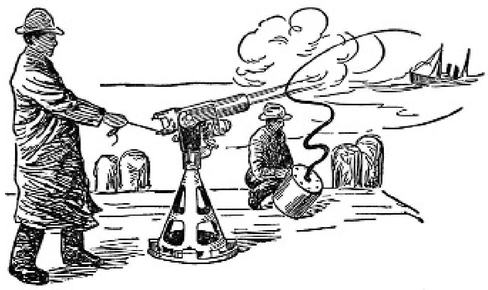


FIG. 109. A NOVEL LIFE-SAVING GUN

*Automobiles.*—The automobile is the speed machine of to-day. Pneumatic tires, [188]
transmission gears and differentials, must go for they are bothersome, complicated and costly. An engine without poppet valves, carburetor, high tension ignition system and water cooling system with its expensive radiator would be most welcome. A magnetic clutch that does away with the transmission gears is shown in Fig. 110.

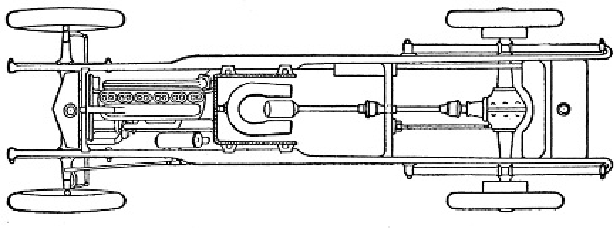


FIG. 110. THE OWEN MAGNETIC CLUTCH

A cheap substitute for gasoline is heartily to be hoped for and inventors are searching for it now. The engine of the future will be driven by some high explosive mixture each ingredient of which will be perfectly harmless in itself but when the fractional part of a drop of each chemical is mixed with the other in the cylinder of the engine they will combine and explode violently.

*Aviation.*—The aeroplane is the speed machine of to-morrow. The great requirement of the present time in the flying machine is *inherent stability*, which
means that it is so designed that it will not overturn, or if overturned it will right [189]
itself of its own accord. Fig. 111 shows a gyro-stabilizer for this purpose.

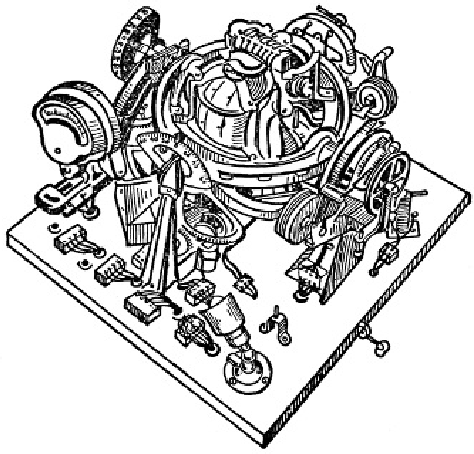
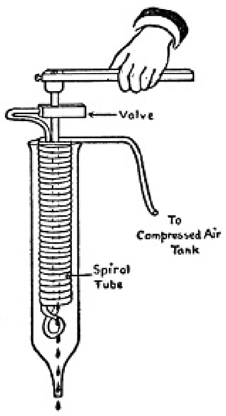


FIG. 111. A GYRO-STABILIZER FOR MAKING AN AEROPLANE KEEP ITS BALANCE

After stability the next most desirable improvement needed in an aeroplane is one that will make it rise from the ground at a far larger angle from the horizontal, that is fly more nearly straight up than those that are built at the present time. A better engine, an easier way of starting and a surer way of alighting, are next in order.

*Chemistry.*—There are unlimited possibilities in chemistry for making big [190]
inventions. A method to produce cheap liquid air, see Fig. 112, would revolutionize many industries. Radium which is worth $1,000,000 a pound, or thereabouts, is plentiful in nature and requires some simpler method only for its cheap extraction. But both of the above are very hard things to do.



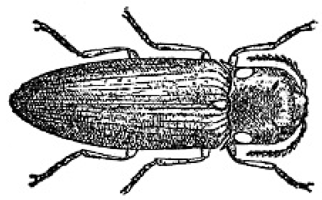



FIG. 112. A LIQUID AIR MACHINE
FIG. 113A. THE CHEAPEST FORM OF LIGHT

*Artificial* milk, tea, coffee and eggs, the extraction of *caffeine* from coffee, *thein* from tea and *nicotine* from tobacco—which are the harmful chemicals in these products, a cheap method of producing artificial ice, or refrigeration without ice, a substance to *denature* alcohol are only a few of the things to be invented in chemistry.

*Synthetic chemistry*, that is the artificial production of real rubber, camphor, [191]
diamonds, rubies and other precious stones, dye-stuffs and other products heretofore supplied only by nature, also offers a large and fascinating field for the inventive chemist.

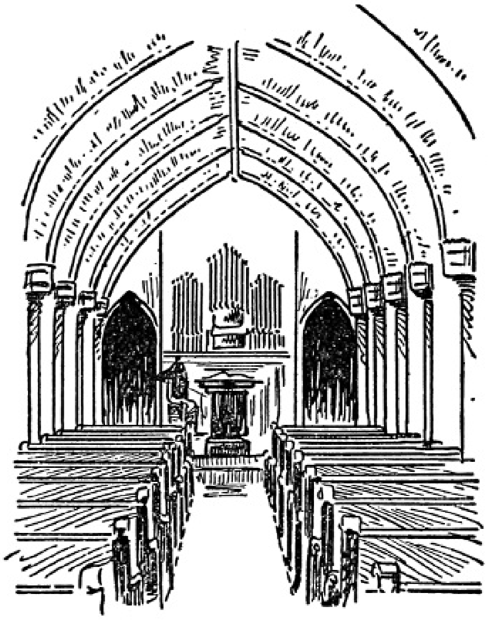


Fig. 113b. A TUBE SYSTEM OF ELECTRIC LIGHTS

*Electricity.*—There are hundreds, if not thousands of electrical inventors who are busier than a swarm of bees in a field of clover, but there is enough left for all of them and as many more to do if they worked in eight hour shifts until the dawn of the millennium.

An apparatus for dispelling fogs by electricity, television, or transmitting sight by electricity, cheap electric lights, see Fig. 113, a simple telautograph, or writing telegraph, a means for directing wireless telegraph and telephone messages, automatic block signals which operate in the engine driver's cab and are positive [192] in action, transmitting pictures by wireless and a cheap and powerful generator of sustained electric oscillations by a battery or other low voltage current, all these needs show that there is still plenty of room for improvement.

*Electro-Chemistry.*—In this field of endeavor the things that are needed would fill a large book and many things that will come have not even been dreamed of yet.

A few that I can think of is a self-charging primary battery, a light weight storage battery, a way to produce electricity direct from coal, a scheme to prevent *electrolysis* in underground pipes, the *electrification* of farming lands to make forty bushels of rye grow where only one was sown, see Fig. 114, to store up [193] electrical energy from the sun and the production of entirely new and unheard of substances in the electric furnace.

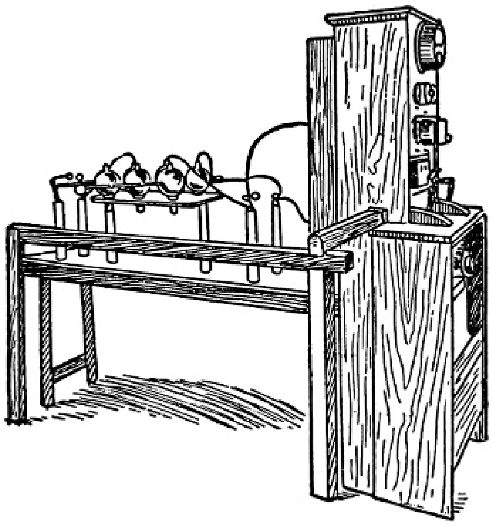


Fig. 114. FARMING BY WIRELESS. THE HIGH TENSION ELECTRIC GENERATOR

*Building.*—In the building line heating, ventilation and drainage are all open to great improvement. Glass that can be bent to shape and which cannot be so easily broken is much needed while fireproof materials and fire protection leave much to the inventor to perfect. Even improvements are needed for wrecking buildings as will be seen in Fig. 115.

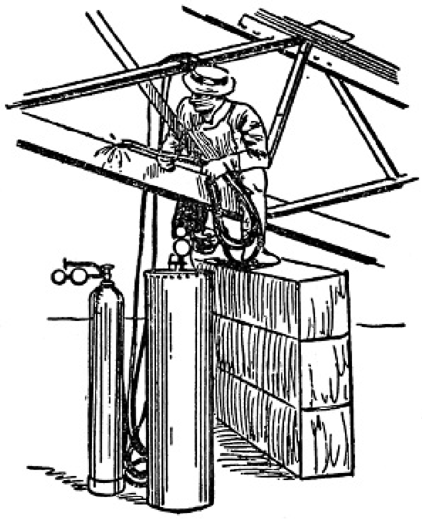


FIG. 115. CUTTING STEEL GIRDERS WITH THE OXY-ACETYLENE PROCESS

*Mining and Metallurgy.*—Safety appliances are of the first importance in mine inventions, see Fig. 116, and after these, machines for labor saving should receive attention. If you understand mining, be it for coal, metals or gems, you will see [194] that there is yet much to be done to make the operations safer, more saving and less laborious.

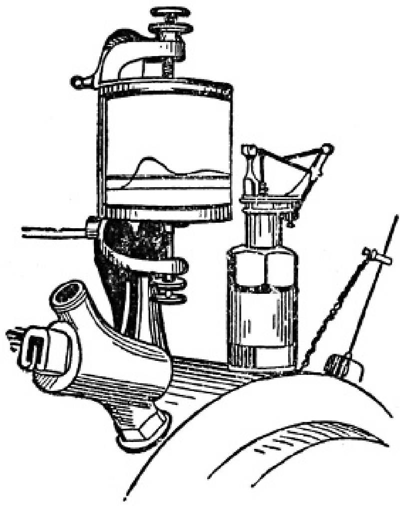


FIG. 116. AN APPARATUS FOR THE PREVENTION OF MINE DISASTERS.
It records the presence of gas

After the ore is mined, the metal must be separated from it and this is largely a matter of chemistry and mechanical devices. *Saving* is the watchword for the inventor who would improve the present methods and processes. If you can show how a saving of metal can be effected or how the same amount can be extracted more cheaply you are the boy the owners are looking for and you can name your own price, nearly.

An alloy for armor which will deflect projectiles, steel rolls which will roll and straighten sheets and rails with one handling, a process for extracting metals from low grade ores, a process for making small brass, iron or steel castings in much the same manner that a linotype machine casts a type slug, are all [195] improvements for you to think about even if you don't try to invent them.

*Printing.*—The noble art of printing has been brought to such a high degree of perfection it would seem to leave little to be invented. But like all the arts and sciences there is yet much to be done.

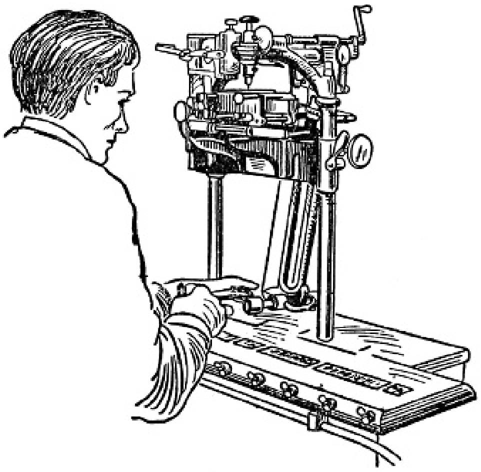


Fig. 117. A STEEL PLATE ENGRAVING MACHINE
One boy does the work of four men

A few gentle hints in this direction is the need of a three color printing press, machines for engraving steel plates, see Fig. 117, and presses for printing from them, power copper plate presses, printing without ink by means of electricity and bookbinding, electrotyping and typefoundry processes and machinery; all these, and many more need looking into.

*Moving Pictures.*—Three great improvements must be made in the moving picture industry before it will take on anything like perfection, and these are (1) a film that is not easily broken, is as transparent as glass and is fire proof; (2) pictures that are photographed on the film and projected on the screen in their natural colors, and (3) moving pictures that are made and projected on the principle of the *stereoscope* so that the picture will stand out true to life in color, time and space. The last word in moving picture machines at this writing is shown in Fig. 118. [196]

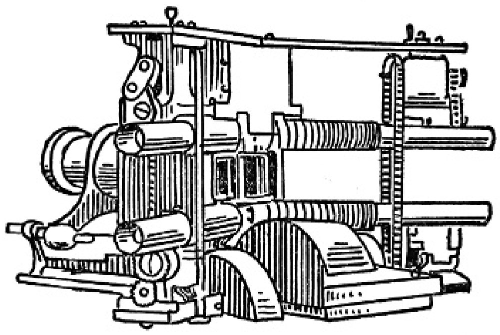


Fig. 118. AN ATTEMPT TO IMPROVE THE MOVIES
This machine uses glass slides instead of films

All of the above improvements have been made but they are each of them very crude and they must be re-improved to a very great extent before they can be successfully shown in theaters. I do not believe any attempt has yet been made to combine the three features in a single machine.

*Other Fields of Endeavor.*—There are many other fields that are just as full of promise for the inventor as those I have cited and among them may be named [197] railways and steamships, boilers and engines, bridge building, munitions of war, textile and boot and shoe machinery, medical and dental apparatus and instruments, devices for the postal service, musical instruments, vending machines and the utilization of by-products. Verily there is everything under the heavens for you to improve if you will but find out a new means, devise a scheme, discover by art, contrive by ingenuity or, in a nutshell, originate an idea, work it out, patent it and beat the other fellow to it.

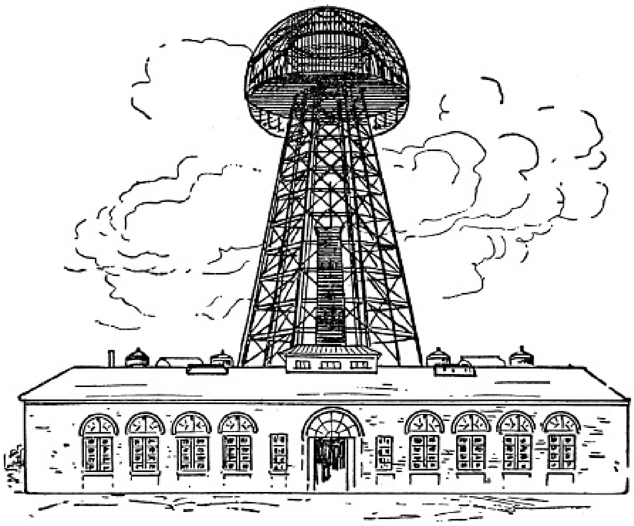


FIG. 119. THE WIRELESS TRANSMISSION OF POWER
Tesla's tower at Wardencliffe, Long Island

**What Not to Invent.—**If you have but little time, small means and are without tools it were better not to get too big an idea for your first invention. Try out your genius on some simple thing, that is if you can. [198]

Of course should some great improvement strike you it would be folly to drop it simply because you happened to be handicapped in two or three several little ways. When in such a predicament you must rise above the level of mediocrity and circumstance and invent a plan to raise the necessary funds to go ahead with your experimental work.

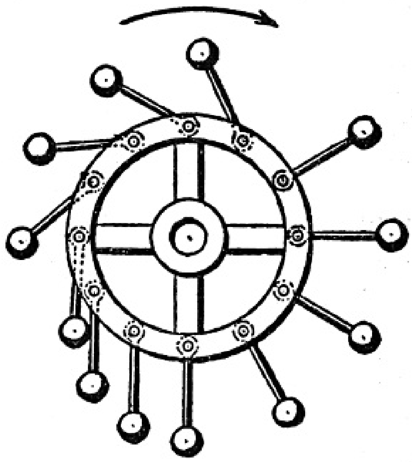


FIG. 120A. A PERPETUAL MOTION MACHINE. (IMPRACTICAL OF COURSE)

But whether you have or have not the quick capital of your own to draw on there are some things you should not try to invent—that is if you are an inventor for the financial profits you expect to accrue from your work. If you are doing it purely as a scientist that is a horse of quite another color and some scientific society may present you with a medal in a plush lined case and its *Transactions* will laud you for your unselfish work.

Such schemes as extracting gold from the salt water of the sea, milking electricity directly from the ether, blowing up ships at a distance by means of invisible waves, making a *phonotypograph* which will, when spoken into, print what you have said on a sheet of paper, printing without type by means of the X-rays, sending wireless messages to Mars and the wireless transmission of power, see Fig. 119, are all good things to let alone. [199]

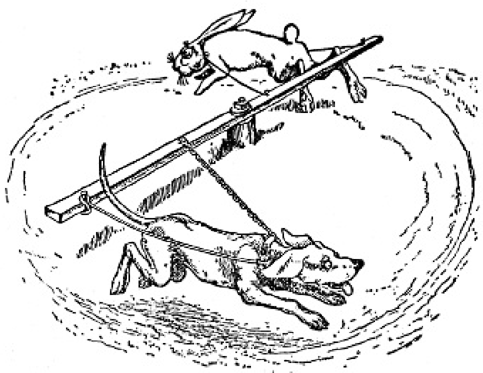


FIG. 120B. PERPETUAL MOTION AS SEEN BY A PATENT-ATTORNEY (HYPER-THEORETICAL)

Not because these innovations are impossible to invent—they will all come into general use some day—but because it is not given to any inventor to work a single one of them out alone and so I say don’t try to unless you are a real Simon pure scientist.

And as a last piece of advice don’t try to invent that monstrous impossibility—*perpetual motion*.

---

[200]

# CHAPTER XI

## WHAT SOME INVENTIONS HAVE PAID

One of the most alluring and sky-blue delights, next to working out a big idea of your own, is to read about the fortunes that other inventors have piled up by the simple use of their *grey matter*.

The stories of what they did and how they did it are far redder blooded and more gripping than any old sleuth yarn ever put between paper covers; but different from this kind of yellow fiction they are all true, their heroes are all real and each one had a great idea burning in his brain, like St. Elmo’s fire, and each had the business ability to transmute it into solid gold, twenty-four carats fine.

And it is not time wasted in harking back to what other inventors have done if you will but heed the lesson that they teach for their works stand out like guide-posts by day and signal-lights by night which point the way for you to go and do the same thing if you will only quit dreaming, get busy with your experiments and be careful not to run into any open switches.

**A Tour of the Inventive World.—**Nor need an invention be a large one to make money though of course the great inventions—those that have given the world all the civilization it has had or is likely to have for some centuries to come—have, as a rule, been the greatest producers of wealth for those who worked [201] them out.

So now suppose we make a personally conducted tour around the world of inventions and take a look at a few of the wonders which prove that *thoughts are things* and that *things are money*, that is when you know how to convert one into the other. And the route we will take will show us some small inventions as we go and we will see a few of the big inventions on our return to home and laboratory.

**Little Inventions.—**To begin with let us lead off with the smallest and least important inventions, though they also serve a purpose, and these are to be found in toys, games and other things for pleasure.

First is the return ball, which consisted of a piece of rubber strand fastened to a wooden ball; this simple invention, so ’tis said, paid its inventor $50,000 a year in royalties for a long time, and so he waxed fat and grew rich.

Such toys as the dancing dolls, the wheel of life and the chameleon top brought their respective inventors even larger sums, while the roller skate which Plimpton improved and made popular by his invention of *cramping* the wheels netted him $1,000,000 in royalties and so you need not feel sorry for him.

**Simple Inventions.—**The next class of inventions I shall call your attention to is just as simple but they are different from toys in that they are useful.

Among them may be named our friend of infant days, the safety pin, the rubber tip for lead pencils, the cork nose shield for eyeglasses, the grooved steel rib for [202] umbrellas, the stylographic pen, the glass lemon squeezer, paper clips, hook fasteners for shoes and the shipping tag reinforced around the hole which Dennison invented and still sells by the carload.

All of these little things and ten thousand others which you would hardly think were worth inventing have built up fortunes for those who thought of them and, more to their credit, were able to see that a future awaited them.

**Real Inventions.—**In passing we come to some small but none-the-less real inventions such as the spring roller window shade, automatic ink stand in which the ink is always at the same level, barbed wire fences, Mrs. Potts’ sad iron—the one with the attachable and detachable handle, the paragon umbrella frame, etc.

To the right you will see some inventions of a more complex kind such as the check protector, mimeograph, time stamp, combination lock, fountain pen, computing scale, compressed air rock drill, cash register, the comptometer and a thousand other devices we see in use or use ourselves every day. Many of them are small but each and every one produced anywhere from $10,000 to $1,000,000 for its inventor.

**Great Inventions.—***The Steam Engine, Locomotive, and Steamboat.*—How the steam engine was invented by Watt, how the locomotive was invented by Stephenson and how the steamboat was invented by Fulton are pretty well known.

Just how much these great pioneer inventors received in actual cash for their [203] efforts I cannot say offhand but it was not large when compared with the fortunes inventors have since made. But their names are writ large in the hall of fame, not the one at the New York University which doesn’t count, but in the hall of fame of progress and civilization which is the only one that really matters.

*The Telegraph.*—The *telegraph* was invented by Samuel F. B. Morse in 1832 but it was not until 1844 that he had a line working from Washington to Baltimore. After long years of *litigation* his patent rights were upheld by the courts and much wealth and more fame accrued to him.

*The Perfecting Press.*—The first *web printing press*, that is a press using a web, or continuous strip of paper, was invented by Bullock in 1845 and this the Hoe Brothers improved upon until the *web perfecting press* was evolved by them in 1846 and which revolutionized the printing of newspapers. The Hoe factory is the largest maker of printing presses in the world to-day.

*The Sewing Machine.*—After many experiments by others the *sewing machine* was invented by Elias Howe and patented by him in 1846. Like every other inventor who has a really great thing his patents were attacked in the court and for eight years he lived in poverty. When the courts finally found in his favor he made millions out of the royalties on his labor saving invention.

*The Ice Machine.*—The first machine for making ice was invented by A. C. [204] Twining in which *ethyl ether* was used for the compressed gas and for which a patent was granted in 1850. In 1867 an *ice machine* was made by Ferdinand Carré which used *liquid ammonia* for the compressed gas and from that date on the artificial production of ice on a commercial scale really began. Whether these two inventors made fortunes out of their brain children I cannot say, but this I know, that tens of millions have flowed into the coffers of those who commercialized their work.

*The Steel Process.*—The process of converting iron into steel cheaply and in quantities was invented by Henry Bessemer who patented it in 1855. It was the *Bessemer process* which made it possible to use steel for rails and structural purposes generally. The inventor grew rich beyond the dreams of the romancer and the steel industry has made multimillionaires of all its captains.

*The Gas Engine.*—Many inventions for using gas as the motive power for engines were made before 1861 but it was not until that year that N. A. Otto built a working model of a *gas engine* in which the explosive gases were mixed, compressed, and ignited in one cylinder when the waste gases were exhausted from it. The Otto gas engine became a commercial success in 1878 and netted the inventor many millions.

*The Dynamo and Motor.*—The principle on which the *dynamo electric machine* works was discovered by Faraday in 1831. In 1866 both Wilde and Siemens built [205] *dynamos*, but it was Gramme who made the dynamo a commercial machine by inventing the *ring armature*, which he did in 1870. Then some genius, or bonehead, no one seems to know which, found that when a current was passed through a dynamo it became a *motor*. From 1880 inventions for electric light, heat and power advanced by leaps and bounds and everybody that invented anything at all worth while in the electrical line got rich quick.

*The Air Brake.*—The *air brake* to stop and control the speed of trains was invented by Westinghouse in 1869. He had hard work getting any railroad to give it a trial but once that this was done it very quickly came into general use. Next to the *safety valve* it was the first important safety device applied to railroads. It has in the past and is still piling up millions for its inventor.

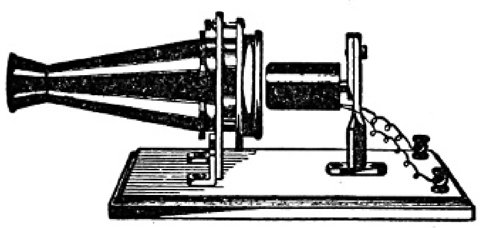


Fig. 121. THE FIRST TELEPHONE

*The Telephone.*—The first use of the word *telephone* was made by Charles Wheatstone in 1834, who applied it to a musical instrument otherwise known as the *magic lyre*. In 1854 Charles Bourseul suggested a way to make a speaking telephone, and in 1860 Johanne Phillip Reis constructed a telephone apparatus [206] along the line of Bourseul’s idea; while this instrument reproduced musical tones it would not reproduce the human voice.

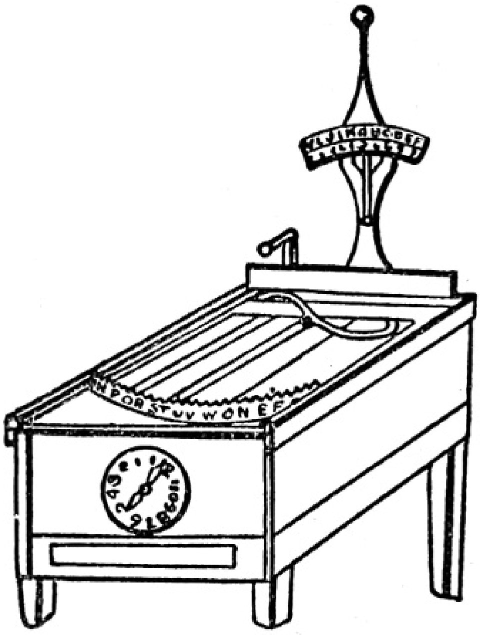


FIG. 122. THE ORIGINAL TYPEWRITING MACHINE PATENTED BY W. A. BURT, JULY 23, 1829

Alexander Graham Bell began working on the problem in 1874 and invented the first electric speaking telephone which he patented, showed in operation at the *Centennial Exhibition* at Philadelphia in 1876 and shortly after a company was formed to float it. Edison made a big improvement in the telephone in 1878 when he invented the *carbon transmitter*. Other rivals appeared in the field and after long years of costly law suits the rights of Bell were sustained by the courts and the Bell Telephone Company has had a practical monopoly of the business in this country ever since. The invention made Bell and its owners enormously wealthy.

*The Typewriter.*—This useful machine was invented by Charles Thurber in [207]
1843, but it was not until about 1875 that a practical machine was put on the market. Millions of dollars have been made out of the typewriter industry, subsequent inventors coming in for their big shares, but it is doubtful if the original inventor received anything more than honorable mention in the *encyclopædias* and a monument in some cemetery for the great benefit he conferred on mankind.

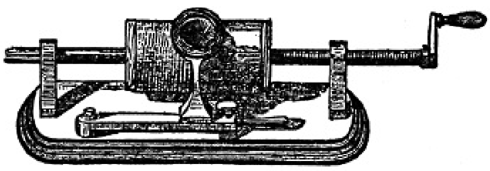


FIG. 123. THE FIRST PHONOGRAPH

*The Phonograph.*—This wonderful instrument for recording and reproducing speech and other sounds was invented by Edison in 1877 and improved by him in 1888. In 1887 Emile Berliner invented and patented the *graphophone* in which the vibrations are recorded on a disk instead of on a cylinder as it is in the Edison phonograph.

The phonograph was placed on the market in 1888 and the manufacture of graphophones began in 1897 when both the machines and the records became popular and rapidly grew into a great industry. The phonograph is only one of
Edison's 700 inventions and from some or all of them he has amassed a fortune of [208]
$10,000,000, and Berliner, who is also an inventor of renown, is very wealthy.

*The Storage Battery.*—Like many other great inventions the *storage battery* has made millions, but from the time it was invented by Gaston Planté in 1860 until it became a commercial product in 1880 was too long a stretch for the originator to have received his just reward. But those who followed with their little and big improvements made small and large fortunes out of them when the Electric Storage Battery Company of Philadelphia was organized to take over all the smaller concerns.

*The Snap-Shot Camera.*—The snap-shot camera, or *kodak*, is not an invention of magnitude but Eastman who invented it about 1880 has through his business ability made it a money-maker second only to inventions of great utility. So rich is his company that it paid $300,000 for the simple invention of enabling a kodak user to write a record on each film when it was exposed.

*The Steam Turbine.*—The steam turbine dates back to the time of Hero, that is 120 years B. C., and the place of its birth was Alexandria, Egypt. It consisted of a copper ball pivoted on trunnions. Projecting from opposite sides of its equator were two bent pipes and when the ball was partly filled with water and heated the steam would spout out of the bent pipes and on striking the air it reacted on the ball and this caused it to revolve at a high-speed. For this reason Hero's engine was called a *reaction* turbine.

In 1705 Branca, an Italian, invented a steam turbine in which a jet of steam was forced through a nozzle and impinged on the vanes of a paddle-wheel, the impact of the steam causing it to revolve. Hence this kind of a turbine is called an *impact* turbine. [209]

The first steam turbine to be built and operated as a competitor of the *reciprocating* engine was made by De Laval in 1883. It was a reaction turbine and it revolved at a tremendously high speed. Parsons of England brought out in 1884 the first multiple expansion turbine which combined the reaction and the impulse types. It made 18,000 revolutions per minute and was directly connected to an electric lighting dynamo. In a little over thirty years the steam turbine reached a degree of perfection and economy not attained in the two hundred odd years of development of the reciprocating engine and it is now used for driving the largest steamships.

*The Automobile.*—The so-called daddy of the *automobile* is George B. Selden; he built his *first self-moving wagon* in 1878 and applied for a patent on it. He did not let this patent issue, however, but kept it alive in the Patent Office until 1895 when in that year automobiles began to be made and used and he then had the patent granted to him.

His next step was to sell licenses to the various gasoline engine automobile manufacturers who paid him a royalty on each machine sold and in this very easy and genteel manner he accumulated much money. But there were some manufacturers who refused to recognize his patent rights and hence refused to [210]
pay him royalty. Henry Ford of Detroit was the leader of these rebellious souls and a bitter patent suit resulted in which the courts first decided for Selden and then against him and this ended his monopoly.

Ford organized the Ford Motor Company and at this writing it is the largest manufacturer of automobiles in the world. It employs 16,000 men and turns out 1000 automobiles a day. Mr. Ford has so much money he doesn't know what to do with it, but his great wealth is based upon his business ability and not upon any patents he may have.

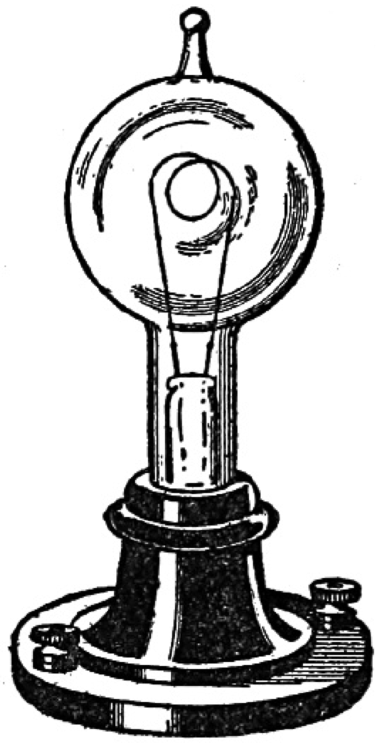


FIG. 124. FIRST INCANDESCENT LIGHT

*The Incandescent Light.*—The first electric *incandescent* lamp that was made used a *platinum* wire for the filament. J. W. Starr substituted a *carbon filament* for the platinum wire, but the first successful incandescent lamp was produced by Edison in 1879 after he had made over 2000 experiments in order to find a [211]
suitable fiber for the filament. In order to be able to use the incandescent lamps, Edison designed a new system of distributing the current through several circuits and between any number of lamps.

The lamps of to-day have filaments of *tungsten* and these are sealed in bulbs filled with nitrogen and which together greatly increases the candle-power and at the same time uses less current. In 1882 the Pearl Street Edison station in New York was put into service and was the first of the great central stations. The Commonwealth Edison Company of Chicago is the largest electric lighting system in the world. There are four stations and together they have an output of 320,000 kilowatts, or 430,000 horsepower.

*The Electric Railway.*—The first attempt to build a railway operated by electricity was made by Thomas Davenport, a Vermont blacksmith in 1835. Next,

C. T. Page made a sixteen horsepower electric locomotive in 1850 and when it was tried out on the Baltimore and Ohio Railroad it ran at a speed of nineteen miles an hour. Batteries were used in both cases to supply the current.

*The Trolley Car.*—The first practical overhead electric line was shown in Chicago in 1883 by C. J. Van Depoele and about the same time Leo Daft built a third-rail line from Saratoga Springs, N. Y., to Mount McGregor, while a conduit line was built by Bently and Knight in Cleveland, Ohio. In 1884 the first practical trolley line was built in Kansas City and from this time on horse- and mule-drawn [212] cars were doomed, except on West Street in New York City where they are still used to hold down a *franchise*.

There were in 1912 about 41,000 miles of track operated by electricity in the United States; over 76,000 passenger cars were in service and 12,100,000 passengers were carried, all of which goes to show that there is money in electrical inventions for somebody.

*The Electric Locomotive.*—The 1913 type of *electric locomotive* used on the New York Central is fifty-seven feet long, weighs 110 tons, has eight motors of 325 horsepower each, which are mounted on four trucks and driving eight axles. This powerful locomotive is capable of hauling a train of 1200 tons at a speed of sixty miles an hour on a straight level track. The stockholders of the General Electric Company of Schenectady, N. Y., profited by their building.

*The Linotype.*—The *linotype* is a machine that is operated like a typewriter and makes a *slug* or a solid line of type from metal type-bars each of which has a letter on it. These type-bars are then properly spaced and melted type metal is run into the matrix they form. This wonderful machine is the invention of Ottmar Mergenthaler who began working on it in 1876 and completed the machine in 1886. Thousands of linotype machines are in use at the present time and it goes without saying that the inventor was richly rewarded for his hard labors.

*Moving Pictures.*—The *moving-picture* industry, which is the third largest in the United States, came into being through the following inventions: In 1845 a toy [213] called the *zoetrope*, or wheel-of-life, was invented; it was so made that when a series of drawings showing the different positions of, say, a horse in motion was viewed through a number of vertical slits in a rapidly revolving cylinder the horse would appear to be running. It was truly a moving picture.

The next step was taken by Eadweard Muybridge in 1877, who was the first to make a series of instantaneous photographs of a horse in motion, and in this way he showed the true position of the animal at different instants of its gait, but since there was no exactness in timing the intervals between the exposures of the dry plates—the film had not yet been invented—they could not have been used for moving pictures.

The photographic gelatine film having come into use, Edison, in 1893, invented two machines, the *kinetograph* which was a camera for taking successive pictures of moving objects, and the *kinetoscope* which allowed the pictures made on the film by the kinetograph to be viewed. The kinetoscope showed each picture on the film to the eye for about $^{1}/_{40}$th of a minute, so that the figures seemed to move as in actual life. And this is the way the moving-picture industry was born. It was easy to combine a projecting lantern and a kinetoscope so that the little photographs on the film could be thrown on a screen and enlarged and this is the principle of all moving-picture machines as they are now constructed.

The moving-picture business has taken a tremendous hold on the public all over [214] the world. This is shown by the fact that in 1914 the distributers for three of the largest film makers handled 75 per cent. of the films released and are said to have received $15,000,000 for them. In 1915 the daily average attendance of moving-picture shows in the United States was about 5,000,000 people.

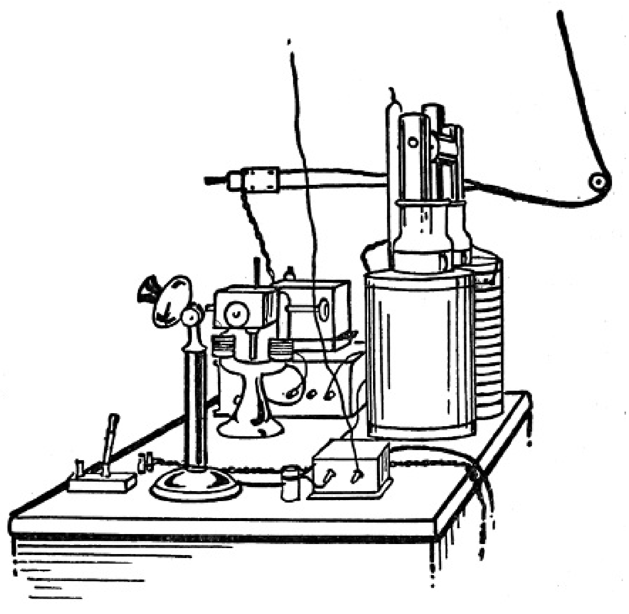


FIG. 125. THE COLLINS WIRELESS TELEPHONE. SHOWN AT THE MADISON SQUARE GARDEN, NEW YORK,

*The Wireless Telegraph.*—The *wireless telegraph* was invented by William Marconi, who showed a set in operation, in 1896, between the General Postoffice and the Thames embankment in London, the distance being about 300 feet. Since that time he has been almost constantly engaged in patent suits with infringers. [215]

Since then the signaling range has been increased until now a regular telegraph service without wires is carried on across the Atlantic. I do not know how well the inventor fared financially but whatever the amount he got, it was not nearly enough for his great work.

*The Wireless Telephone.*—The *wireless telephone* was invented by the author of this book in 1899 when he telephoned without wires between two stations in Narberth, Pa., a distance of about three blocks. During the past year the human voice has been transmitted without wires from Arlington, near Washington, D. C., eastward to Paris, France, and from Arlington as far westward as Honolulu, Hawaii. Patent litigation, patent hold-ups and government persecution have been my lot. I know about the amount I made out of my invention but I won’t tell.

*The Aeroplane.*—The *aeroplane* was invented by the Wright Brothers, Wilbur and Orville. They began their experiments in flying on the sand-dunes of Kitty Hawk, N. C., in 1900. Their first efforts were made with a glider fitted with elevation planes and after having developed the balancing instinct they installed a gasoline motor in the glider and this drove two propellers at the rear of the machine.

With this new born aeroplane they made the first motor-driven, man-carrying flight in 1903—a flight that lasted a small fraction of a minute. From this time on records and necks were broken by other fliers who tried to outdo their rivals and undo themselves.

[216]

## CHAPTER XII

# PROFITABLE INFORMATION

**Design Patents.—**Should you invent, or devise a new and original design for an object, be it a work of art, a fabric, a piece of jewelry or even a machine, you can obtain a design patent if it has artistic merit.

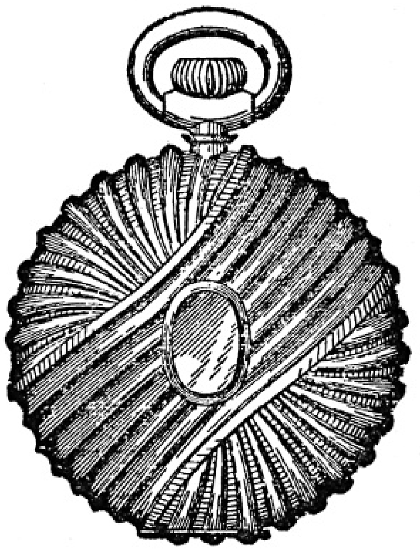


FIG. 126. ILLUSTRATION FOR A DESIGN PATENT, DRAWN ON A SHEET OF CARD-BOARD SIZE 10 × 15 INCHES

Design patents run for a term of 3½, or for 7, or for 14 years as you wish and care to pay for. The patent attorney’s fees for writing the specification, making the drawing and seeing the patent application through the patent office is usually [217] $20 regardless of the term it is to run; the government fee is $10 for 3½ years, $15 for 7 years and $30 for 14 years, making the total cost of such patents $30, $35 and $50 respectively.

**Assignments.—**If you want to you may sell or assign a part or the whole of your invention before you file an application for a patent, or you may do the same thing while your application is pending in the patent office.

Such an interest in your invention and patent rights may be disposed of by a complete assignment, by granting territorial rights, by mortgage, or by shop or other licenses. In whatever way the assignment, grant or conveyance is made it must be recorded in the patent office or it will not be valid.

**Caveats.—**A *Caveat* can no longer be filed in the patent office, the law relating to them having been repealed July 1, 1910. Before this time an inventor who had not completed his invention could file a *Caveat* in the archives of the patent office where it was kept a secret for one year, and the time could be renewed from year to year.

The purpose of a *Caveat* was to give the inventor more time to work out his invention and to be notified should any other inventor apply for a patent on the same thing. He could then immediately file his own patent application when an *interference* would be declared between them.

**Patent Office Fees.—**The following schedule of fees for patents and prices for [218] the various publications of the patent office are taken from the *Rules of Practice*. These fees are required to be paid in advance. All orders and moneys for the following fees should be sent to the Commissioner of Patents, Washington, D. C.; except for *The Official Gazette* which should be sent to the Superintendent of Documents, Government Printing Office, Washington, D. C.

RULES OF PRACTICE IN THE U. S. PATENT OFFICE

*Free on Request.*

| | |
|---|---|
| On filing each original application for a patent, except in design cases | $15.00 |
| On issuing each original patent, except in design cases | 20.00 |
| In design cases: | |
| For 3 years and 6 months | 10.00 |
| For 7 years | 15.00 |
| For 14 years | 30.00 |
| On every application for the reissue of a patent | 30.00 |
| On filing each disclaimer | 10.00 |
| On an appeal for the first time from the primary examiner to the examiners in chief | 10.00 |
| On every appeal from the examiners in chief to the Commissioner | 20.00 |
| For certified copies of patents if in print: | |
| For specification and drawing, per copy | .05 |
| For the certificate | .25 |
| For the grant | .50 |
| For certifying to a duplicate of a model | .50 |
| For manuscript copies of records, for every 100 words or fraction thereof | .10 |
| If certified, for the certificate additional | .25 |
| For 20-coupon orders, each coupon good for one copy of a printed specification and drawing, and receivable in payment for photographic prints [219] | 1.00 |
| For 100 coupons in stub book | 5.00 |
| For uncertified copies of the specifications and accompanying drawings of patents, if in print, each | .05 |
| For the drawings, if in print | .05 |
| For copies of drawings not in print, the reasonable cost of making them. | |
| For photo prints of drawings, for each sheet of drawings: | |
| Size 10 by 15 inches, per copy | .25 |
| Size 8 by 12½ inches, per copy | .15 |
| For recording every assignment, agreement, power of attorney, or other paper, of 300 words or under | 1.00 |
| Of over 300 and under 1,000 words | 2.00 |
| For each additional 1,000 words or fraction thereof | 1.00 |
| For abstracts of title to patents or inventions: | |
| For the search, one hour or less, and certificate | 1.00 |
| Each additional hour or fraction thereof | .50 |

| | |
|---|---|
| For each brief from the digest of assignments, of 200 words or less | .20 |
| Each additional 100 words or fraction thereof | .10 |
| For searching titles or records, one hour or less | .50 |
| Each additional hour or fraction thereof | .50 |
| For assistance to attorneys in the examination of publications in the Scientific Library, one hour or less | 1.00 |
| Each additional hour or fraction thereof | 1.00 |
| For copies of matter in any foreign language, for every 100 words or a fraction thereof | .10 |
| For translation, for every 100 words or fraction thereof | .50 |
| The Official Gazette: | |
| Annual subscriptions | 5.00 |

For postage upon foreign subscriptions, except those from Canada and Mexico, $5 or more as required. Moneys received from foreign subscribers in excess of the subscription price of $5 will be deposited to the credit of the subscriber and applied to postage upon the subscription as incurred. [220]

**Trade Marks.—**A *trade mark* is any kind of a mark, sign, name or picture, or a combination of these, by which a manufacturer, or a dealer can mark the goods he makes or sells so that a consumer can always know that the brand he is buying is genuine.

A registered trade mark gives the owner the sole right to use it and any one else who uses or imitates it can be restrained from its further use by injunction and sued for damages. After you have decided on the trade mark you want to use to show that the product is of your manufacture you should file an application to register the trade mark just as you would for a patent.


FIG. 127. A REGISTERED TRADE MARK

There are some kinds of words which you cannot have registered as a trade mark and you may have other words in mind which have already been registered in the patent office; nor can you register a trade mark unless you have sold your goods outside of your own State. Patent attorneys do not as a rule charge for a [221] search of the trade mark records where an application for registration is filed through them.

The patent office fee for registering a trade mark is $10; a patent attorney generally charges $15 for preparing the specification and $5 additional for making the drawing which makes a total cost of $30 for a trade mark. A registered trade mark remains in force for 20 years and it may be renewed for another 20 years.

**Copyrights.—**A copyright is the sole right granted by law to authors and artists to publish and dispose of their works for a term of 28 years when it may be renewed for 14 years more making 42 years in all.

A copyright may be had on written articles, books, lectures or other oral addresses, on dramatic and musical compositions, photographs, paintings, drawings, sculpture, plastic work, moving picture photo-plays, moving pictures other than photo-plays, maps, prints and pictorial illustrations.

A copyright cannot be had on trade marks, the names of companies, newspapers, manufactured articles or on prints or labels which are to be used for any kind of manufactured articles. Trade marks and patents are granted for the above classes of work.

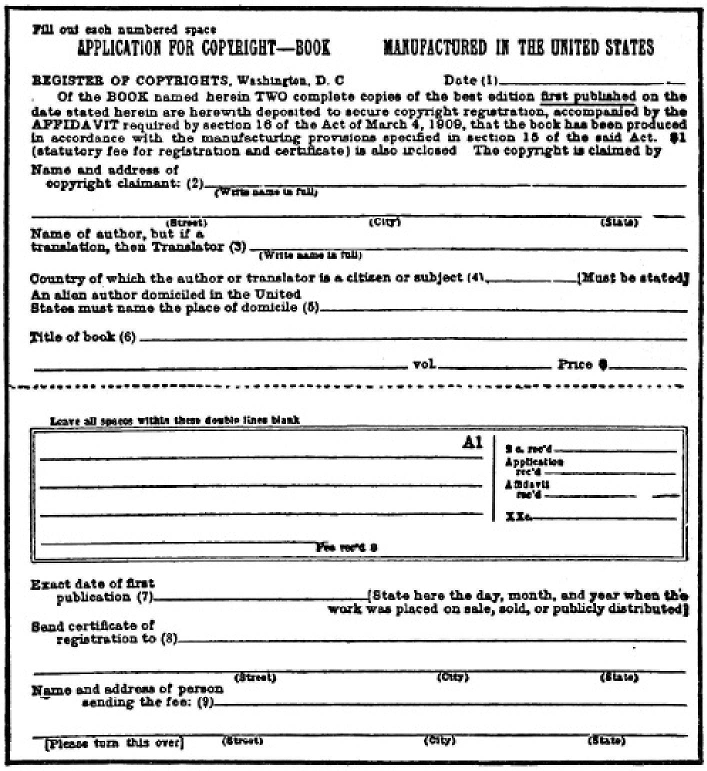
The general procedure for obtaining a copyright on the first named subjects is the same but the *application forms* issued by the Copyright Office differ a little from each other in wording and you should have the right one.

When you are ready to file an application for a copyright in the United States [222] send to the *Register of Copyrights*, Copyright Office, Washington, D. C., for a copy of *Steps Necessary to Secure Copyright Registration* and also a copy of *Explanatory Circular* No. 12, entitled *Application Forms*, for which no charge is made. A reading of these leaflets will tell you exactly how to obtain a copyright and also the *application form* to use.

When you have found from these the application form you need send again to the Register of Copyrights for one or more of the application forms, fill it in and [223] send it and $1 by money order or bank-draft made payable to the Register of Copyrights, together with a 10 cent revenue stamp—for these are war times—and you will receive in turn a certificate of copyright.

By copyrighting the thing yourself you will save just $9 for this is the amount a patent attorney will charge you for filing it, and if this isn't driving screws with a hammer I'd like to know what it is.

The following is an application form for copyrighting a book:—



Fill out each numbered space

APPLICATION FOR COPYRIGHT—BOOK MANUFACTURED IN THE UNITED STATES

REGISTER OF COPYRIGHTS, Washington, D. C. Date (1)

Of the BOOK named herein TWO complete copies of the best edition first published on the date stated herein are herewith deposited to secure copyright registration, accompanied by the AFFIDAVIT required by section 16 of the Act of March 4, 1909, that the book has been produced in accordance with the manufacturing provisions specified in section 15 of the said Act. $1 (statutory fee for registration and certificate) is also inclosed. The copyright is claimed by

Name and address of copyright claimant: (2) (Write name in full)

(Street) (City) (State)

Name of author, but if a translation, then Translator (3) (Write name in full)

Country of which the author or translator is a citizen or subject (4) (Must be stated)

An alien author domiciled in the United States must name the place of domicile (5)

Title of book (6)

vol. Price $

Leave all spaces within these double lines blank

A1

$ a. rec'd

Application rec'd

Affidavit rec'd

XXa.

Fee rec'd $

Exact date of first publication (7) (State here the day, month, and year when the work was placed on sale, sold, or publicly distributed)

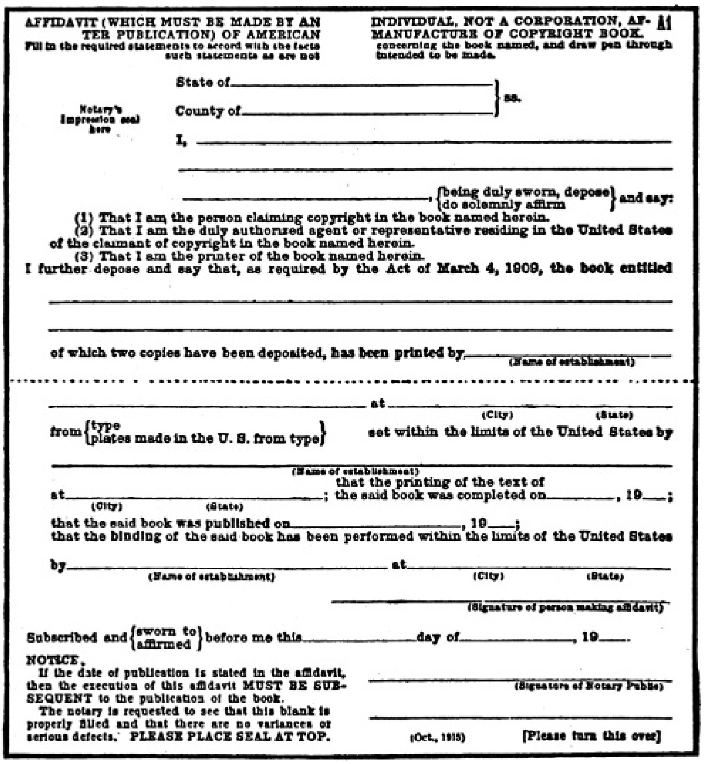
Send certificate of registration to (8)

(Street) (City) (State)

Name and address of person sending the fee: (9)

[Please turn this over] (Street) (City) (State)

FIG. 128A. APPLICATION FOR COPYRIGHT OF A BOOK



AFFIDAVIT (WHICH MUST BE MADE BY AN INDIVIDUAL, NOT A CORPORATION, AFTER PUBLICATION) OF AMERICAN MANUFACTURE OF COPYRIGHT BOOK. A1

Fill in the required statements to accord with the facts concerning the book named, and draw pen through such statements as are not intended to be made.

Notary's impression seal here

State of } ss.

County of

I,

, {being duly sworn, depose / do solemnly affirm} and say:

(1) That I am the person claiming copyright in the book named herein.

(2) That I am the duly authorized agent or representative residing in the United States of the claimant of copyright in the book named herein.

(3) That I am the printer of the book named herein.

I further depose and say that, as required by the Act of March 4, 1909, the book entitled

of which two copies have been deposited, has been printed by (Name of establishment)

at (City) (State)

from {type / plates made in the U. S. from type} set within the limits of the United States by

(Name of establishment)

at (City) (State); that the printing of the text of the said book was completed on, 19 ;

that the said book was published on, 19 ;

that the binding of the said book has been performed within the limits of the United States

by (Name of establishment) at (City) (State)

(Signature of person making affidavit)

Subscribed and {sworn to / affirmed} before me this day of, 19 .

NOTICE.

If the date of publication is stated in the affidavit, then the execution of this affidavit MUST BE SUBSEQUENT to the publication of the book.

The notary is requested to see that this blank is properly filled and that there are no variances or serious defects. PLEASE PLACE SEAL AT TOP.

(Signature of Notary Public)

(Oct., 1915) [Please turn this over]

FIG. 128B. AFFIDAVIT ON BACK OF APPLICATION

[224]

**Government Fees for Patents and Least Charges of Patent Attorneys.—** The United States patent office fees for patents of whatever nature and however simple or complicated, except for design patents, are always the same, namely $15 for filing the application and $20 which is payable when the patent is granted making a total cost of $35. The patent attorneys' fees may vary greatly but the following table shows about what their least charges are:

UNITED STATES PATENTS

| | *Attorney's Fees* | *Drawings* | *Patent Office Fees* | *Total Cost of Patent* |
|---|---|---|---|---|
| A simple mechanical patent | $30 | | | |

| | | | | |
|---|---|---|---|---|
| A simple electrical patent | $30 | $5 | $35 | $70 |
| A simple chemical patent | | | | |
| A simple electro-chemical patent | $35 | | | |
| A simple composition patent | | | | |
| A simple process patent | | | | |

DESIGN PATENTS, ETC.

| | | | | |
|---|---|---|---|---|
| Design Patent | | | | |
| 3½ year term | | | | |
| 7 year term | $15 | $5 | $15 | $35 |
| 14 year term | | | $30 | $50 |
| Trade Mark Registration | $15 | $5 | $10 | $30 |
| Print and Label Registration | $14 | | $6 | $20 |
| Copyright | $9 | | $1 | $10 |
| Assignment of Patents and Trade Marks | $5 | | | |

**Foreign Patents.—**After you have applied for a patent on your invention in the United States you should take out patents in foreign countries. Sometimes indeed you will find a more ready sale abroad for your invention, or the product of your invention, than you will right here at home. In many of these countries a yearly [225] tax is also charged by the government. The costs given below for each country include both the government and the attorney's fees.

*Dominion of Canada.*—In Canada a preliminary protection may be secured for one year. A patent is issued for 6 years and at the expiration of that time the patent may be extended for 6 years more and then for another 6 years, making 18 years in all.

| | |
|---|---|
| Preliminary protection | $ 5 |
| Patent for 6-year term | 45 |

*Great Britain.*—A British patent includes England, Ireland, Scotland and Wales. A *provisional patent* which secures priority of invention may be obtained for a term of 6 months. The complete British patent is then issued for 14 years.

| | |
|---|---|
| Provisional specification | $30 |
| Patent for 14 years | 70 |

*France and Colonies.*—The term of a French patent is 15 years. If the invention it covers is not worked within 2 years after it is issued it becomes public property.

| | |
|---|---|
| Patent for 15 years | $60 |

*Germany and Colonies.*—A German patent includes Prussia, Saxony, Bavaria and other kingdoms of the Empire. There are two classes of patents issued and these are 1, the *technical patent*, which is issued for 15 years, and 2, the *model patent*, which is issued for 6 years, the first corresponding to the U. S. ordinary [226] patent and the second to the U. S. design patent.

| | |
|---|---|
| Technical patent, for 15 years | $60 |
| Model patent, for 6 years | 35 |

*Austria and Hungary.*—

| | |
|---|---|
| Patent in either country for 15 years. Fee is | $70 |

*Belgium.*—Patent for 20 years. Fee is $40.

*Spain.*—Patent for 20 years. Fee is $65.

*Italy.*—Patent for 15 years. Fee is $65.

*Russia.*—Patent for 15 years. Fee is $90.

*Denmark.*—Patent for 15 years. Fee is $70.

*Norway and Sweden.*—Patent for 15 years in each country. Fee is $70.

*Switzerland.*—Patent for 15 years. Fee is $60.

*Portugal and Turkey.*—Patent for 15 years. Fee is $100.

*Holland.*—Has no patent laws.

*India.*—Patent for 14 years. Fee is $80.

*Australian Commonwealth.*—Includes Victoria, New South Wales, Queensland, South Australia, Tasmania and West Australia. One patent covers them all.

| | |
|---|---|
| Patent for 14 years | $100 |

*Japan and China.*—Fee is $100.

*Africa.*—Egypt, Natal and Transvaal, each $100. Cape Colony, $125. Congo Free State, $130.

*Central America.*—Costa Rica, $150. Guatemala, Honduras and Nicaragua, each $225.

*West Indies.*—Cuba, $90. Barbados, $100. Jamaica, $125. Trinidad, $140. [227]

Bahama Islands, $150.

*South America.*—United States of Colombia, $120. Brazil, $125. Peru and Panama, $200. Venezuela, $220; and Chili, $230.

---

[229]

# APPENDICES

## APPENDIX A [231]

### SOME USEFUL MATHEMATICAL FORMULAS

$\pi$ = 3.14159 ($\pi$ is a Greek letter pronounced Pi)
*d* = *diameter* of a circle
*r* = *radius* of a circle
*p* = *periphery*, or circumference of a circle
The *area* of a circle = $\pi r^2$
The *circumference* of a circle = $\pi d$

The *diameter* of a circle $= \frac{p}{\pi} = \frac{p}{3.14}$

The *radius* of a circle $= \frac{p}{2\pi} = \frac{p}{6.28}$

The *surface* of a sphere $= 4\pi r^2 = \pi d^2$

The *volume* of a sphere $= \frac{4}{3}\pi r^3 = \frac{1}{6}\pi d^3$

---

## APPENDIX B [232]

### THE METRIC OR DECIMAL SYSTEM

The *metric system* is a French system of weights and measures much used in the arts and sciences in every civilized country and as each unit is multiplied or divided by 10 to obtain ascending or descending values it is much more convenient to use than the older English system of arbitrary measures.

The metric system is based on the *meter*, which is one-ten millionth of the distance from the Earth’s equator to the North Pole. There are five units, the four latter being derived from the meter and these are:

1. The *meter* which is the unit of length and is about 3.280 feet in length.

2. The *are* which is the unit of surface and is 100 square meters in area.

3. The *liter* which is the unit of capacity and is 1 cubic decimeter, which is equal to 1.0567 United States quarts.

4. The *stere* which is the unit of solidity and is equal to 1 cubic meter.

5. The *gram* is the unit of weight and is the weight of 1 cubic centimeter of distilled water at its maxim density.

---

## APPENDIX C [233]

### METRIC MEASURES OF LENGTH AND VALUES IN INCHES

| | | | | |
|---|---|---|---|---|
| Divisions | Millimeter | (mm) = | 0.001 m. = | 0.03937 inch |
| | Centimeter | (cm) = | 0.01 m. = | 0.3937 inch |
| | Decimeter | (dm) = | 0.1 m. = | 3.937 inches |
| Unit | Meter | (m) = | 1. m. = | 39.37 inches |
| | Dekameter | (Dm) = | 10. m. = | 393.7 inches |

| | | | | |
|---|---|---|---|---|
| Multiples | Hektometer (Hm) = | 100. | m. = 328. | feet and 1 inch |
| | Kilometer (Km) = | 1,000. | m. = | 0.62326 mile |
| | Myriameter (Mm) = | 10,000. | m. = | 6.2326 miles |

---

## APPENDIX D

### METRIC MEASURES OF WEIGHT AND VALUES IN ENGLISH WEIGHT

| | | | | | |
|---|---|---|---|---|---|
| Divisions | Milligram (mg) = | 0.001 | g = | 0.0154 grain | avoirdupois |
| | Centigram (cg) = | 0.01 | g = | 0.1543 grain | “ |
| | Decigram (dg) = | 0.1 | g = | 1.5432 grain | “ |
| Unit | Gram (g) = | 1 | g = | 15.432 grains | “ |
| Multiples | Dekagram (Dg) = | 10 | g = | 0.3527 ounce | “ |
| | Hektogram (Hg) = | 100 | g = | 3.5274 ounces | “ |
| | Kilogram (Kg) = | 1,000 | g = | 2.2046 pounds | “ |
| | Myriagram (Mg) = | 10,000 | g = | 22.046 pounds | “ |

---

## APPENDIX E [234]

### TO CHANGE METRIC TO ENGLISH MEASURE AND VICE VERSA

| *To Change* | *To* | *Multiply by* |
|---|---|---|
| Inches | Centimeters | 2.54 |
| Feet | Meters | 0.3048 |
| Miles | Kilometers | 1.6093 |
| Square Inches | Square Centimeters | 6.4516 |
| Square Feet | Square Meters | 0.0929 |
| Square Yards | Square Meters | 0.8361 |
| Cubic Inches | Cubic Centimeters | 16.3872 |
| Cubic yards | Cubic Meters | 0.7646 |
| Fluid ounces | Cubic Centimeters | 29.574 |
| Quarts | Liters | 0.9464 |
| Ounces (avoirdupois) | Grams | 28.3495 |
| Grains | Milligrams | 64.789 |
| Pounds (avoirdupois) | Kilograms | 0.4536 |
| Meters | Inches | 39.37 |
| Meters | Feet | 3.2808 |
| Kilometers | Miles | 0.6213 |
| Square Centimeters | Square Inches | 0.155 |
| Square Meters | Square Yards | 1.196 |
| Cubic Centimeters | Cubic Inches | 0.0610 |
| Cubic Meters | Cubic Yards | 1.308 |
| Cubic Centimeters | Fluid Ounces | 0.0344 |
| Liters | Quarts | 1.0567 |
| Grams | Grains | 15.4324 |
| Kilograms | Pounds | 2.204 |

---

## APPENDIX F [235]

### SIZES OF TWIST DRILLS FOR TAPS OR SCREWS

| *No. of Drill* | *No. of Tap or Screw* | *No. of Threads to the Inch* |
|---|---|---|
| Use 38 for | 4 | 36 |
| “ 32 “ | 6 | 32 |
| “ 28 “ | 8 | 32 |
| “ 22 “ | 10 | 24 |
| “ 13 “ | 12 | 24 |

---

## APPENDIX G

### SIZES OF TAPS AND DIES

| *No. of Tap or Die* | *Threads to Inch* |
|---|---|
| 4 | 36 |
| 6 | 32 |
| 8 | 32 |
| 10 | 24 |
| 12 | 24 |

---

## APPENDIX H

### SIZES OF MACHINE SCREWS AND NUTS

Machine screws and nuts are numbered the same as dies and taps.

---

## APPENDIX I [236]

### REDUCING FRICTION

When two bodies are rubbed together the motion is opposed by a force called *friction*. When two surfaces slide against each other the friction between them is proportional to the force pressing them together. The *amount* of friction depends upon the pressure of the bodies, the roughness of their surfaces and also slightly on their *adhesion*. The friction is the same regardless of the speed with which the surfaces slide over each other.

The *co-efficient of friction* is the measure of friction and this is found by dividing the *force of friction* by the *force pressing the surfaces together*. Here are a few co-efficients of sliding friction:

| | *Per cent.* |
|---|---|
| Oak on Oak with Fibers parallel without lubricant | 0.42 |
| Oak on Oak with Fibers parallel rubbed with soap | 0.16 |
| Cast Iron on Oak | 0.42 |
| Cast Iron on Cast Iron, not lubricated | 0.15 |
| Cast Iron on Cast Iron, lubricated | 0.10 |
| Iron on Brass | 0.16 |
| Brass on Brass | 0.20 |
| Iron on Bronze, without lubricant | 0.25 |
| Iron on Bronze, thoroughly lubricated | 0.06 |
| Cast Iron Wheels on Rails (Rolling Friction) | 0.004 |
| Ball Bearings (Rolling Friction) | 0.001 |

---

## APPENDIX J [237]

### WEIGHT OF CASTINGS COMPARED WITH WOOD PATTERNS

The following table shows what the weight of a casting will be compared with the weight of the wood pattern from which it was made, less the weight of the *core point*, or piece projecting from the pattern to support it.

| A Wood Pattern Weighing One Pound | Will Make a Casting Weighing | | | | |
|---|---|---|---|---|---|
| Pattern of | Cast Iron Pounds | Brass Pounds | Copper Pounds | Bronze Pounds | Zinc Pounds |
| Pine | 14 | 15.8 | 16.7 | 16.3 | 13.5 |
| Beech | 9.7 | 10.9 | 11.4 | 11.3 | 9.1 |
| Oak | 9 | 10.1 | 10.4 | 10.3 | 12.9 |
| Birch | 10.6 | 11.9 | 12.3 | 12.2 | 10.2 |
| Mahogany | 11.7 | 13.2 | 13.7 | 13.5 | 11.2 |
| Brass | 0.84 | 0.95 | 0.99 | 0.98 | 0.81 |

---

# APPENDIX K [238]

## GEARS AND GEARINGS

A *spur-gear* is a gear with teeth cut on its *periphery*, that is an ordinary cog-wheel. *Miter gears* are two *bevel gears* of the same diameter which run together. A large miter gear will not mesh with a small miter gear nor with another bevel gear in the proper manner. Miter and bevel gears cannot be interchanged with other sets like spur gears.

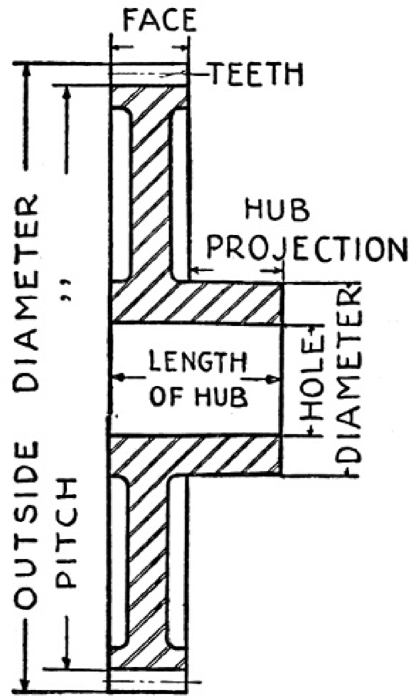



FIG. 129. CROSS SECTION OF GEAR

All miter gears that you buy ready cut are made so that their shafts run at right [239]
angles to each other as shown in Fig. 129, but you can have them cut to order to run at any angle you want.

To find the *pitch*, *pitch diameter*, *circular pitch*, etc., of both spur and bevel gears use these rules:

$\pi$ = 3.14159
*p* = pitch
*n* = number of teeth
*pd* = pitch diameter
*od* = outside diameter
*cp* = circular pitch

*To Find the Pitch*:

$$p = \frac{n}{pd}$$

*To Find the Number of Teeth*:

$$n = p \times pd$$

*To Find the Pitch Diameter*:

$$pd = \frac{n}{p}$$

*To Find the Outside Diameter of Spur Wheels*:

$$od = \frac{(2 + n)}{p}$$

*To Find the Circular Pitch*:

$$cp = \frac{\pi}{pd}$$

*To Find the Distance Between the Centers of Two Spur Gears*:

$$\frac{\frac{(n^1 + n^2)}{2}}{p}$$

Where $n^1 + n^2$ = the sum of the teeth of both gears.

# APPENDIX L [240]

## SOME USEFUL ALLOYS

| Name of Alloy | Parts of Copper | Parts of Tin | Parts of Zinc | Parts of Lead | Parts of Other Metals |
|---|---|---|---|---|---|
| Gun Metal | 91 | 9 | | | |
| Bell Metal | 75 | 25 | | | |
| Phosphor Bronze | 92½ | 7 | | | ½ phosphorus |
| Aluminum Bronze | 90 | | | | 10 aluminum |
| Common Brass | 66⅔ | | 33⅓ | | |
| Brazing Metal (soft) | 50 | 12½ | 37½ | | |
| German Silver | 60 | | 20 | | 20 nickel |
| Common Solder | | 50 | | 50 | |
| Fine Solder | | 66⅔ | | 33⅓ | |
| Babbitt Metal | 3 | 89 | | | 8 antimony |
| Pewter | | 80 | | 20 | |
| Type Metal | | | | 80 | 20 antimony |
| Aluminum Solder | 95 | | | | 5 bismuth |

Magnetic Alloy.—An alloy that has strong magnetic properties is made of 25 parts of manganese, 14 parts of aluminum and 61 parts of copper, yet none of these metals are even slightly magnetic.

---

# APPENDIX M [241]

## SOME HARD SOLDERS

Hard solders melt only at red heat and are used for soldering gold, silver, brass and other metals where a good strong joint is needed.

| Metal to be Soldered | Parts of Gold | Parts of Brass | Parts of Silver | Parts of Zinc | Parts of Other Metals |
|---|---|---|---|---|---|
| Gold | 66.67 | | 22.22 | | 11.11 copper |
| Silver | | 43.75 | 50 | 6.25 | |
| Brass | | 87.5 | | 12.5 | |

---

# APPENDIX N

## HIGH SPEED STEEL

A special steel alloy which is largely used for turning tools in *engine lathes* and which will cut ordinary steel when the latter is revolved at a high surface velocity is called *high speed steel*. A tool made of high speed steel will not lose its *temper* and will keep its cutting edge hour after hour if they are kept cool by a stream of water running on them. A good high speed steel for machine tools is known by the trade name of *blue-chip* and is manufactured by the Firth-Sterling Steel Company of Pittsburg, Pa.

---

# APPENDIX O [242]

SOME ELECTRICAL SYMBOLS, TERMS AND FORMULAS

| Symbols | | Terms |
|---|---|---|
| E or EMF | = | Electromotive Force |
| I | = | Intensity of Current |
| R | = | Resistance |
| C | = | Capacity |
| Q | = | Quantity of Current |
| $\mathfrak{F}$ | = | Magneto-Motive Force |
| $\mathfrak{R}$ | = | Reluctance (magnetic resistance) |
| μ | = | Magnetic Permeability |
| W | = | Electric Energy |
| P | = | Electric Power |

SOME DEFINITIONS

E or EMF, or *electromotive force*, is the force that moves a current through a conductor.

I, or *intensity of current,* or *current* as it is called for short, is the flow of electricity through a conductor.

R, or *resistance* is that property of a conductor which opposes the flow of the current.

### SOME ELECTRICAL UNITS

| *Practical Units.* | *Electrical Quantity* |
|---|---|
| Volt | is the practical unit of EMF |
| Ampere | is the practical unit of I |
| Ohm | is the practical unit of R |
| Watt | is the practical unit of P |

[243]

### OHM’S LAW

Since the intensity of an electric current varies *directly* as the electromotive force and *inversely* as the resistance, if you know the value of any two of the above units you can easily find the third.

$$\text{Amperes} = \frac{\text{Volts}}{\text{Ohms}}, \text{ or } I = \frac{E}{R}$$

$$\text{Electromotive Force} = \frac{\text{Current}}{\text{Resistance}}, \text{ or } E = \frac{I}{R}$$

$$\text{Resistance} = \frac{\text{Electromotive Force}}{\text{Current}}, \text{ or } R = \frac{E}{I}$$

*To Find Power of an Electric Current in Terms of Horse Power*

One Watt = 1 volt × 1 ampere
746 Watts = 1 horse power.

To find the power of an electric current in terms of horse-power, find the number of watts by multiplying the volts by the amperes and divide the watts by 746 and the result will give you the horse-power of the current.

---

[244]
[245]

## APPENDIX P

### NUMBER, DIAMETER, CAPACITY, WEIGHT, AND RESISTANCE OF PURE COPPER WIRE

| Gage, B. & S. No. | Diameter in 1000ths. | Sectional Area in Circular Mils. | Capacity in Amperes | OHMS Per 1,000 feet | OHMS Per Mile | OHMS Per Pound | FEET Per Pound | FEET Per Ohm | POUNDS Per 1,000 feet | POUNDS Per Ohm |
|---|---|---|---|---|---|---|---|---|---|---|
| 0000 | .460 | 211600. | 312. | .0490 | .2590 | .00007 | 1.5612 | 20497.7 | 640.59 | 12987. |
| 000 | .40964 | 167805. | 262. | .0618 | .3266 | .00012 | 1.9687 | 16255.27 | 507.85 | 8333. |
| 00 | .3648 | 133079. | 220. | .0780 | .4118 | .00019 | 2.4824 | 12891.37 | 402.83 | 5263. |
| 0 | .32486 | 105534. | 185. | .0983 | .5190 | .00031 | 3.1303 | 10223.08 | 319.45 | 3225. |
| 1 | .2893 | 83694. | 156. | .1240 | .6549 | .00049 | 3.9471 | 8107.49 | 253.34 | 2041. |
| 2 | .25763 | 66373. | 131. | .1564 | .8258 | .00078 | 4.9772 | 6429.58 | 200.91 | 1228. |
| 3 | .22942 | 52634. | 110. | .1972 | 1.0414 | .00125 | 6.2765 | 5098.61 | 159.32 | 800. |
| 4 | .20431 | 41473. | 92.3 | .2486 | 1.313 | .00198 | 7.9141 | 4043.6 | 126.35 | 505. |
| 5 | .18194 | 33102. | 77.6 | .3136 | 1.655 | .00314 | 9.9798 | 3206.61 | 100.20 | 318. |
| 6 | .16202 | 26251. | 65.2 | .3954 | 2.088 | .00499 | 12.5847 | 2542.89 | 79.462 | 200. |
| 7 | .14428 | 20817. | 54.8 | .4987 | 2.633 | .00792 | 15.8696 | 2015.51 | 63.013 | 126. |
| 8 | .12849 | 16510. | 46.1 | .6529 | 3.3 | .0125 | 20.0097 | 1599.3 | 49.976 | 80. |
| 9 | .11443 | 13094. | 38.7 | .7892 | 4.1 | .0197 | 25.229 | 1268.44 | 39.636 | 50. |
| 10 | .10189 | 10382. | 32.5 | .8441 | 4.4 | .0270 | 31.8212 | 1055.66 | 31.426 | 37. |
| 11 | .09074 | 8234. | 27.3 | 1.254 | 6.4 | .0501 | 40.1202 | 797.649 | 24.924 | 20. |
| 12 | .08080 | 6530. | 23. | 1.580 | 8.3 | .079 | 50.5906 | 632.555 | 19.766 | 12.65 |
| 13 | .07196 | 5178. | 19.3 | 1.995 | 10.4 | .127 | 63.7948 | 501.63 | 15.674 | 7.87 |
| 14 | .06408 | 4107. | 16.2 | 2.504 | 13.2 | .200 | 80.4415 | 397.822 | 12.435 | 5.00 |
| 15 | .05706 | 3257. | 13.6 | 3.172 | 16.7 | .320 | 101.4365 | 315.482 | 9.859 | 3.12 |
| 16 | .05082 | 2583. | 11.5 | 4.001 | 23. | .512 | 127.12 | 250.184 | 7.819 | 1.95 |
| 17 | .04525 | 2048. | 9.6 | 5.04 | 26. | .811 | 161.29 | 198.409 | 6.199 | 1.23 |
| 18 | .04030 | 1624. | 8.1 | 6.36 | 33. | 1.29 | 203.374 | 157.35 | 4.916 | .775 |
| 19 | .03589 | 1288. | | 8.25 | 43. | 2.11 | 256.468 | 124.777 | 3.899 | .473 |
| 20 | .03196 | 1021. | | 10.12 | 53. | 3.27 | 323.399 | 98.9533 | 3.094 | .305 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 21 | .02846 | 810. | | 12.76 | 68. | 5.20 | 407.815 | 78.473 | 2.452 | .192 |
| 22 | .02534 | 642. | | 16.25 | 85. | 8.35 | 514.193 | 62.236 | 1.945 | .119 |
| 23 | .02257 | 509. | | 20.30 | 108. | 13.3 | 648.452 | 49.3504 | 1.542 | .075 |
| 24 | .0201 | 404. | | 25.60 | 135. | 20.9 | 817.688 | 39.1365 | 1.223 | .047 |
| 25 | .0179 | 320. | | 32.2 | 170. | 32.2 | 1031.038 | 31.0381 | .9699 | .030 |
| 26 | .01594 | 254. | | 40.7 | 214. | 52.9 | 1300.180 | 24.6131 | .7692 | .0187 |
| 27 | .01419 | 201. | | 51.3 | 270. | 84.2 | 1639.49 | 19.5191 | .6099 | .0118 |
| 28 | .01264 | 159.8 | | 64.8 | 343. | 134. | 2067.364 | 15.4793 | .4807 | .0074 |
| 29 | .01125 | 126.7 | | 81.6 | 432. | 213. | 2606.959 | 12.2854 | .3835 | .0047 |
| 30 | .01002 | 100.5 | | 103. | 538. | 338. | 3287.084 | 9.7355 | .3002 | .0029 |
| 31 | .00892 | 79.7 | | 130. | 685. | 539. | 4414.49 | 7.7214 | .2413 | .0018 |
| 32 | .00795 | 63. | | 164. | 865. | 856. | 5226.915 | 6.1224 | .1913 | .0011 |
| 33 | .00708 | 50.1 | | 206. | 1033. | 1357. | 6590.41 | 4.8557 | .1517 | .0007 |
| 34 | .00630 | 39.74 | | 260. | 1389. | 2166. | 8312.8 | 3.8496 | .1204 | .0004 |
| 35 | .00561 | 31.5 | | 328. | 1820. | 3521. | 10481.77 | 3.0530 | .0956 | .0002 |
| 36 | .005 | 25. | | 414. | 2200. | 5469. | 13214.16 | 2.4217 | .0757 | .0001 |
| 37 | .00445 | 19.8 | | 523. | 2765. | 8742. | 16659.97 | 1.9208 | .0600 | .0001 |
| 38 | .00396 | 15.72 | | 660. | 3486. | 13722. | 21013.25 | 1.5229 | .0475 | .0000 |
| 39 | .00353 | 12.47 | | 832. | 4395. | 21896. | 26496.237 | 1.2077 | .0375 | .0000 |
| 40 | .00314 | 9.88 | | 1049. | 5542. | 34823. | 33420.63 | 0.9798 | .0299 | .0000 |

## APPENDIX Q [246]

### NUMBER OF TURNS OF WIRE THAT CAN BE WOUND IN A GIVEN SPACE

| No. B. & S. or American Gage | COTTON | | | | SILK | | | |
|---|---|---|---|---|---|---|---|---|
| | SINGLE | | DOUBLE | | SINGLE | | DOUBLE | |
| | Per Square Inch. | Per Square Qu. Inch | Per Square Inch. | Per Square Qu. Inch | Per Square Inch. | Per Square Qu. Inch | Per Square Inch. | Per Square Qu. Inch |
| 20 | 676 | 42 | 576 | 36 | 841 | 52 | 676 | 42 |
| 21 | 842 | 53 | 625 | 39 | 961 | 60 | 842 | 53 |
| 22 | 1.024 | 64 | 729 | 45 | 1.225 | 76 | 1.024 | 64 |
| 23 | 1.024 | 81 | 900 | 56 | 1.521 | 95 | 1.296 | 81 |
| 24 | 1.600 | 100 | 1.089 | 68 | 1.936 | 121 | 1.600 | 100 |
| 25 | 1.849 | 115 | 1.296 | 81 | 2.304 | 144 | 1.849 | 115 |
| 26 | 2.209 | 138 | 1.440 | 90 | 2.916 | 182 | 2.209 | 138 |
| 27 | 2.500 | 156 | 1.600 | 100 | 3.249 | 206 | 2.500 | 156 |
| 28 | 3.025 | 189 | 1.849 | 115 | 4.096 | 254 | 3.025 | 189 |
| 29 | 3.481 | 218 | 2.025 | 126 | 4.761 | 297 | 3.481 | 218 |
| 30 | 4.356 | 272 | 2.500 | 156 | 6.400 | 400 | 4.356 | 272 |
| 31 | 5.001 | 315 | 2.704 | 169 | 7.769 | 485 | 5.041 | 315 |
| 32 | 5.929 | 370 | 3.025 | 189 | 9.025 | 564 | 5.929 | 370 |
| 33 | 7.089 | 443 | 3.481 | 218 | 11.025 | 689 | 7.089 | 443 |
| 34 | 7.769 | 485 | 3.600 | 225 | 12.321 | 770 | 7.769 | 485 |
| 35 | 8.100 | 506 | 3.844 | 240 | 13.689 | 855 | 8.100 | 506 |
| 36 | 10.000 | 625 | 4.356 | 272 | 17.689 | 1.105 | 10.000 | 625 |
| 37 | 11.025 | 689 | 4.761 | 297 | 20.164 | 1.240 | 11.025 | 689 |
| 38 | 12.321 | 770 | 5.041 | 315 | 23.716 | 1.482 | 12.321 | 770 |
| 39 | 13.689 | 855 | 5.476 | 342 | 27.556 | 1.722 | 13.689 | 855 |
| 40 | 15.625 | 976 | 5.929 | 370 | 32.761 | 2.047 | 15.625 | 976 |

(W. J. Clarke.)

## APPENDIX R [247]

### PRICES OF SINGLE AND DOUBLE SILK AND COTTON COVERED MAGNET WIRE

PRICE PER POUND

| Size by B. & S. Gage | Single Covered. | | Double Covered. | |
|---|---|---|---|---|
| | Cotton | Silk | Cotton | Silk |
| 16 | | $0.80 | | $1.02 |
| 17 | | .82 | | 1.04 |
| 18 | | .84 | | 1.06 |
| 19 | | .86 | | 1.08 |
| 20 | $0.58 | .88 | $0.64 | 1.12 |
| 21 | .60 | .90 | .70 | 1.15 |

| | | | | |
|---|---|---|---|---|
| 22 | .62 | .92 | .74 | 1.22 |
| 23 | .65 | .96 | .78 | 1.28 |
| 24 | .68 | 1.02 | .84 | 1.38 |
| 25 | .73 | 1.10 | .92 | 1.48 |
| 26 | .80 | 1.20 | 1.00 | 1.65 |
| 27 | .86 | 1.30 | 1.10 | 1.85 |
| 28 | .92 | 1.40 | 1.20 | 2.00 |
| 29 | .98 | 1.53 | 1.30 | 2.22 |
| 30 | 1.08 | 1.70 | 1.42 | 2.56 |
| 31 | 1.19 | 1.92 | 1.54 | 3.08 |
| 32 | 1.27 | 2.16 | 1.64 | 3.40 |
| 33 | 1.44 | 2.46 | 1.88 | 4.00 |
| 34 | 1.73 | 2.90 | 2.20 | 4.60 |
| 35 | 1.86 | 3.38 | 2.67 | 5.28 |
| 36 | 2.12 | 3.93 | 3.00 | 5.98 |
| 37 | 2.70 | 4.66 | 4.30 | 7.37 |
| 38 | 3.60 | 5.58 | 5.70 | 8.43 |
| 39 | 4.70 | 6.76 | 7.20 | 9.75 |
| 40 | 6.00 | 8.14 | 9.00 | 11.53 |

There is a discount of about 50 per cent. on the above prices though this is subject to change.

---



## APPENDIX S

### A LIST OF SOME CHEMICAL ELEMENTS AND THEIR SYMBOLS

| Element | Symbol |
|---|---|
| Aluminum | Al |
| Antimony | Sb |
| Argon | A |
| Arsenic | As |
| Barium | Bi |
| Boron | B |
| Bromine | Br |
| Cadmium | Cd |
| Calcium | Ca |
| Carbon | C |
| Chlorine | Cl |
| Chromium | Cr |
| Cobalt | Co |
| Copper | Cu |
| Fluorine | F |
| Gold | Au |
| Helium | He |
| Hydrogen | H |
| Iodine | I |
| Iron | Fe |
| Lead | Pb |
| Lithium | Li |
| Magnesium | Mg |
| Manganese | Mn |
| Mercury | Hg |
| Nickel | Ni |
| Nitrogen | N |
| Oxygen | O |
| Phosphorus | P |
| Potassium | K |
| Platinum | Pt |
| Silicon | Si |
| Silver | Ag |
| Sodium | Na |
| Strontium | Sr |
| Sulphur | S |
| Tin | Sn |
| Zinc | Zn |

# APPENDIX T [249]

## THE COMMON NAMES OF SOME CHEMICALS

| Common Name | Chemical Name |
| --- | --- |
| Alum | Sulphate of ammonium, or potassium, etc. |
| Aqua fortis | Nitric acid |
| Aqua regia | Concentrated nitric and hydrochloric acid mixed. |
| Baking soda | Sodium carbonate |
| Calomel | Mercurious chloride |
| Carbolic acid | Phenol |
| Caustic potash | Potassium hydroxide |
| Caustic soda | Sodium hydroxide |
| Chalk | Calcium carbonate |
| Copperas | Ferrous sulphate |
| Corrosive sublimate | Mercuric chloride |
| Cream of tartar | Potassium bitartrate |
| Epsom salts | Magnesium sulphate |
| Fire damp | Methane |
| Fool’s gold | Iron pyrites |
| Glauber’s salt | Sodium sulphate |
| Grape sugar | Glucose; a carbohydrate |
| Hartshorn | Aqueous solution of ammonia |
| Jeweler’s putty | Tin oxide |
| Laughing gas | Nitrous oxide |
| Lime | Calcium oxide |
| Lunar caustic | Silver nitrate |
| Mosaic gold | Tin bisulphide |
| Muriatic acid | Hydrochloric acid |
| Monsel’s salts | Basic ferric sulphate |
| Plaster of Paris | Calcium sulphate |
| Realgar | Red arsenic sulphide |
| Red lead | Lead oxide |
| Rochelle salt | Sodium potassium tartrate [250] |
| Royal water | See Aqua regia |
| Sal ammoniac | Ammonium chloride |
| Salt (common) | Sodium chloride |
| Sal soda | Sodium carbonate |
| Salt of tartar | Potassium carbonate |
| Saltpeter | Potassium nitrate |
| Salts of lemon | Oxalic acid |
| Slacked lime | Calcium hydrate |
| Soda | Sodium carbonate |
| Spirits of salt | Hydrochloric acid |
| Sugar of lead | Lead acetate |
| Sugar of milk | Lactose |
| Tartar emetic | Potassium antimonious tartrate |
| Verdigris | Copper acetate |
| Vermilion | Mercuric sulphide |
| Vinegar | Dilute acetic acid |
| Vitriol, blue | Copper sulphate |
| Vitriol, green | Ferrous sulphate |
| Vitriol, oil of | Sulphuric acid |
| Vitriol, white | Zinc sulphate |
| Volatile alkali | Ammonia |
| Washing soda | Sodium carbonate |
| White lead | Lead carbonate |
| Zinc white | Zinc sulfid |

# APPENDIX U [251]

## THE FOUR CHIEF THERMOMETRIC SCALES

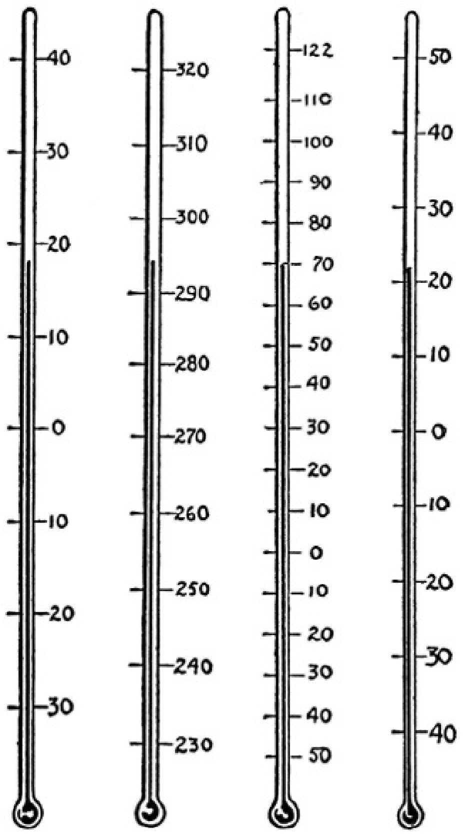



FIG. 130. THE FOUR CHIEF THERMOMETRIC SCALES: RÉAUMUR, ABSOLUTE, FAHRENHEIT AND CENTIGRADE

There are four different thermometer scales used for measuring temperature and these are (1) the *Fahrenheit* scale which is widely used for all ordinary purposes; (2) the *Centigrade* which is the standard scale used for scientific work [252] since it is based on the decimal system; (3) the *Réaumur* scale which is largely used in Germany, and (4) the *absolute* scale which is reckoned from *absolute zero*, that is the point at which there is absolutely no heat. It is about 461 degrees Fahr., 274 degrees centigrade, and 219 degrees Réaumur below the zero of these scales.

---

## SOME WORDS AND TERMS USED IN THIS BOOK [253]

*Accelerate.*—To hurry or speed up the usual slow state of events.

*Actuate.*—(1) To put into action. (2) Means by which anything is started to move. (See Operate).

*Adhesion.*—A force which makes certain bodies stick together.

*Aërial Wire.*—An elevated wire used to send out and to receive electric waves for wireless telegraphy and wireless telephony.

*Affidavit.*—A sworn statement made before a notary public or other legal authority.

*Agent.*—(1) A canvasser. (2) One who acts as a salesman or in any capacity for another.

*Amend.*—To change or correct, as to *amend* a claim in a patent.

*Analysis.*—See Chemical decomposition.

*Arbor.*—An axle, spindle, shaft or mandrel.

*Archives.*—A place in which official papers are kept and held secret.

*Arlington wireless station.*—A high powered wireless station at Arlington, Va., across the river from Washington, D. C.

*Assignment.*—To transfer to another a right or interest.

*Attest.*—To witness or to sign an oath that a thing is true.

*Automatic.*—A machine which performs certain operations of its own accord.

*Aviation.*—The art of flying.

*Axis.*—An imaginary line on or around which a body turns. (Plural Axes.)

*Basic principle.*—The first source or cause of a thing.

*Biologist.*—One who knows something about the science of life and living things.

*Broker.*—One who acts as an agent to negotiate purchases and make sales on a commission, as a *stock-broker*, *coffee-broker*, etc.

*Capital.*—Wealth that is used in or can be had for business.

*Capital Stock.*—The shares of a company that are sold to furnish funds with which to transact business.

*Capitalize.*—To fix a value on the stock of a company.

*Case.*—An application pending in the patent office. [254]

*Cause.*—A suit or action over patent rights which is conducted in a court.

*Certified copy.*—A paper or a copy of a paper that has been sworn to before a notary to prove it to be the original or an exact copy of the original.

*Chemical Combination.*—(1) The atomic union of chemicals. (2) A compound of chemical elements.

*Chemical Decomposition.*—The separation of a compound with its original elements.

*Circularize.*—To send out circulars to a list of names.

*Cite.*—To quote a reference to an authority.

*Citation.*—An article or patent quoted by a patent examiner as a basis for the rejection of a patent application or of a claim.

*Claim.*—The last part of a patent specification in which the inventor clearly and specifically sets forth what his invention consists of and what he demands to have protected by a patent.

*Claim, Broad.*—(1) A *broad claim* is one in which the inventor claims everything in sight and usually more than he is entitled to. (2) It is easy to write a broad claim but hard to get it allowed.

*Claim, Narrow.*—(1) A *narrow*, or *limited claim* is one in which a patent attorney puts in so many elements or parts that the combination is bound to be patentable. (2) Such a claim has no value because it is easy for another to change an element or a part when the combination no longer infringes. (3) The hardest thing that an inventor has to contend with is to get a claim written so that it will stand in court.

*Coincide.*—Exactly corresponding to or meeting.

*Conceive.*—To get an idea.

*Commission Merchant.*—A man who stands between the manufacturer and the wholesaler and who gets a percentage on the amount of goods that change hands.

*Commissioner of Patents.*—The head, front and center of the patent office.

*Concentric Circles.*—Circles drawn within circles and all of them having the same center.

*Corporation.*—(1) A company. (2) An imaginary person invented by law and formed of one or more real persons banded together to transact business.

*Correspondent.*—(1) An associate. (2) A lawyer that carries on his business with another lawyer at a distance. [255]

*Consumer.*—The last buyer and the user of an article or a device.

*Cross-section.*—See Drawing, Cross-section.

*Counsel.*—A patent attorney who is qualified to prosecute patent cases in court.

*Data.*—Information that is known or may be had.

*Deductive Proof.*—That form of thought by which an idea used as a starting point is brought to a conclusion by known principles and facts. (See Inductive Discovery.) Inductive discovery is the raw idea and does not lead up to certainty, whereas deductive proof does.

*Degree.*—(1) One three hundred and sixtieth part of a circle. (2) The unit of angular measurement.

*Detailed Drawing.*—See Drawing, Detailed.

*Device.*—(1) An apparatus or an instrument, or a machine or any part of any of them. (2) Any scheme for producing a desired result.

*Die.*—A steel tool having a sharp edge for cutting out special designs in paper, metals, etc.

*Directors.*—Members of a company chosen to direct its business.

*Disclose.*—(1) To make known. (2) To give up the secret of your invention.

*Display ad.*—An advertisement in which larger type is used than for the reading matter of the paper.

*Dividends.*—Money resulting from profits and which are distributed among the shareholders.

*Drawing, Free Hand.*—Pictures drawn without measurements or the aid of instruments.

*Drawing, Working.*—A drawing of a part, device or machine made to scale so that a mechanic can work from it.

*Drawing, Cross Section.*—A drawing of an object as though it had been cut in two in order to show its inside construction.

*Drawing, Detail.*—A drawing of any part of a device or a machine made large enough to show everything no matter how small.

*Drawing, Perspective.*—A drawing of a solid object on a flat surface so that it seems to stand out in space like the object itself.

*Drawing, Isometric perspective.*—See Isometric Perspective.

*Du Ponts.*—A firm at Wilmington, Delaware, who manufactures gun-powder and other explosives.

*Efficient.*—That which works the best with the greatest economy.

*Element.*—(1) A *chemical element* is a form of matter which cannot be decomposed. (2) A *mechanical element* is a single part of a device or a machine. [256]

*Electrolytic.*—The decomposition of a chemical compound by an electric current.

*Electroplating.*—Depositing one metal on another metal by an electric current.

*Electrotype.*—A duplicate of type or cuts for printing, the body of which is of type-metal and the face of copper which has been deposited by an electric current.

*Electrolytic.*—Decomposition of a substance, or a solution by means of an electric current.

*Electrolysis.*—About the same as *electrolytic*.

*Elementary.*—Simple; primary.

*Electro-Chemistry.*—Chemistry in which electricity is used.

*Engine lathe.*—A large and accurate screw cutting lathe fitted with all known attachments.

*Entering Edge.*—The front edge of the main plane of an aeroplane.

*Ether.*—A substance filling all space and in, by and through which light, electricity and magnetism acts and travels.

*Evidence of conception.*—A signed and sealed statement made at the time or shortly after you get the big idea which will serve as proof of the earliest time you thought of it.

*Excerpt.*—A part, or an extract of an article.

*Expert.*—One who is trained or is skilful, due to learning and practice.

*Experiment.*—(1) To find out an effect, or the cause of it by trials and tests. (2) To work out a process for the purpose of developing an idea. (3) To show the effect of some previous discovery or invention.

*Files.*—Patents that are arranged systematically for easy reference.

*Fixture.*—See Jig.

*Free-hand Drawing.*—See Drawing, Free-hand.

*Full paid.*—Stock that has been paid for either in cash or by a patented invention.

*High Frequency Oscillations.*—(1) Electric oscillations. (2) Electric currents which alternate in direction 100,000 or more a second.

*Idea, Raw.*—The first idea that comes into the mind as a basis for an invention.

*Improvement.*—(1) Adding a new element or part to a composition, device or a machine. (2) An improvement constitutes an invention and can be patented. [257]

*Impulse.*—A turbine wheel turned by steam forced against its blades.

*Initiative.*—The first step or action.

*Indicate.*—To point out. To show how a thing is done.

*Inductive Discovery.*—(1) The *raw*, or original idea that results from the mind process. It precedes *deductive proof*.

*Inherent stability.*—A natural tendency of a body to remain balanced, or when upset to right itself.

*Isometric.*—Of equal measure or scale.

*Isometric Perspective.*—Three sets of lines of equal measure, that is 120 degrees apart which represent the three dimensions of space.

*Isometric Cross-section paper.*—Paper ruled with lines of equal measure for making isometric perspective drawings.

*Jig.*—A tool, or *fixture* used as a guide for cutting tools where duplicate parts are made by a machine.

*Jobber.*—A man who buys in large quantities for the manufacturer and sells them to wholesalers or retailers.

*Key.*—A tapering wedge for fastening the collar of a wheel on a part of a shaft.

*Litigation.*—Law suits.

*Low Voltage Currents.*—(1) Currents having a pressure up to 500 volts. (2) Ordinary battery and lighting currents are low voltage.

*Machine Design.*—The scientific designing of machines.

*Math.*—Abbreviation for mathematics.

*Maxims*, Hiram and Hudson.—Inventors of high explosives, machine guns and other things that make for peace in times of war, and make for war in times of peace.

*Mechanical Movement.*—(1) The simplest form of a machine. (2) A combination of two or more of the mechanical powers.

*Memorandum.*—A written outline of an agreement, or a contract.

*Micawber.*—A character in Dickens' *David Copperfield*. He was never able to get down to anything but was always waiting for something to turn up.

*Model.*—(1) An object or a device made to represent an apparatus or a machine. (2) A device made to show how an apparatus or a machine works. (3) Scale models are smaller than the machines they represent and may be built either to show how the finished apparatus will appear or they may be actual working [258] models.

*Monopoly.*—The sole right to make, use and sell an invention or the product of an invention.

*Notary Public.*—A commissioned official who holds a seal of his office and who certifies papers, etc.

*Oath.*—A sworn statement of the truth.

*Operate.*—(1) To put into motion. (2) To do mechanical work. (See Actuate.)

*Ozone.*—A colorless gas formed by discharging electricity through the air or oxygen.

*Paper patent.*—A patent granted by the patent office for an idea that has never been worked out in practice.

*Part.*—A small portion of a device or a machine.

*Par value.*—The full, or face value.

*Patent attorney.*—A lawyer who makes patent law his business or ought to.

*Patent Expert.*—One who is specially trained in an art or a science which enables him to give expert testimony in patent causes.

*Patent Office.*—(1) The building in which the patent business of the government is transacted. (2) The office conducted by the government for handling of its patent business. (3) The patent office of the U. S. is one of the bureaus of the Department of the Interior and it is under the direction of a commissioner of patents.

*Patent Examiner.*—One who examines and passes on patents in the patent office.

*Patentee.*—The one to whom a patent is granted.

*Periphery.*—(1) The circumference of a circle. (2) The outer surface of a wheel.

*Perspective Drawing.*—See Drawing, Perspective.

*Perspective, Isometric.*—See Isometric Perspective.

*Philosophy.*—(1) The science of all natural laws. (2) The laws, causes and principles on which facts can be explained. (See Psychology.)

*Precision.*—(1) The state of being very accurate. (2) Said of any instrument or machine which works with exactness.

*Principle.*—A truth or cause.

*Priority.*—Being first.

*Protractor.*—An instrument for laying off and measuring angles by degrees.

*Prosecute.*—To follow up until a conclusion is reached. [259]

*Pro Rata.*—In proportion.

*Psychological moment.*—The exact time to impress the mind in the best way.

*Psychology.*—(1) A branch of philosophy. (2) The science of the mind and its operations.

*Ramifications.*—Subdivisions of a subject or branches of a thing.

*Reaction.*—A turbine wheel turned by steam forced from it against the air.

*Rectify.*—(1) To make right whatever is wrong. (2) To make a direct current of an alternating current.

*Rectangle.*—A four sided plane with right angle corners.

*Reject.*—To refuse to accept, as to reject a claim in a patent.

*Retainer.*—The advance fee paid to an attorney.

*Retailer.*—A man who buys in small quantities and sells piecemeal to consumers.

*Royalty.*—A share of the profits paid to the owner of a patented article or a device by those whom he allows to make or use it.

*Scale.*—A piece of wood, metal or other material with graduated lines on it and used for measuring.

*Securities.*—Property of any kind which has enough value to keep the credit good.

*Semi-circle.*—(1) Half of a circle. (2) A segment of a circle equal to 180 degrees.

*Shares.*—(1) The equal parts of the capital stock of a company. (2) The shares are represented by *certificates*.

*Shareholder.*—An owner of the shares of stock of a company.

*Shop-right license.*—A legal permit given to the owner of a shop to make and sell a patented article or device.

*Sketch.*—A crude picture.

*Standardize.*—To make a device or a machine to conform to a certain type.

*Stockholder.*—An owner of the shares of the stock in a company.

*Stock.*—(1) The shares of a company which represent its capital. (2) Goods traded in for a profit. (3) The raw materials used for manufacturing purposes. (4) The manufactured goods that are held in reserve.

*St. Elmo's Fire.*—An electric glow which is often seen at the end of a spar of a ship at night.

*Synthesis.*—To combine chemical elements to form a compound.

*Synthetic.*—A chemically prepared substance which is exactly like that found in nature, as *synthetic camphor*, *synthetic sapphires*, etc. [260]

*Technical Expert.*—See Patent expert.

*Transfer of Energy.*—Changing the energy of one body to another body.

*Transformation of Energy.*—Changing the form of energy, as from electricity to magnetism, or from heat to light.

*Transactions, or Proceedings.*—The published reports of scientific and other societies.

*Treasury stock.*—The shares that belong to the company and which are used to provide it with working capital.

*Trustees.*—About the same thing as *directors*.

*Tungsten.*—A steel gray metallic element.

*Tyro.*—A beginner.

*Useful art.*—Anything which requires ingenuity to fashion, and which can be used for some good purpose.

*Valid.*—(1) That which holds good. (2) A patent that is founded on fact and in law.

*Who's Who.*—A red book of noted men and women living in the United States.

*Wholesaler.*—One who buys and sells in large quantities.

*Wing.*—The main or supporting plane of an aeroplane.

*Working Drawing.*—See Drawing, Working.

---

[261]

# INDEX

# FOOTNOTES

[1] Ro is a universal language invented by the Rev. Edward P. Foster of Marietta, Ohio. According to the *New York Times* the frogs have talked *ro* from the first and any child ought to be able to learn it in less than twice the lifetime of Old Parr.

[2] For a further explanation of these very interesting phenomena, read

*Modern Views of Electricity*, by Sir Oliver Lodge.

[3] The *pseudotriakis microdon* is one of the rarest species of sharks. It is a small toothed nurse shark and is known from only two specimens, one of which turned up on the coast of Portugal and the other on Long Island.

[4] “Fear God and take your own part,”—*Roosevelt.*

[5] See Chapter XII on Design Patents.

[6] The italics are not mine.

**Transcriber’s Notes:**

The half-title page has been removed.

Variations in spelling, hyphenation, and accents remain as in the original unless noted below.

Page 34, “AB” changed to “A B” (“as shown at A B”).
Page 140, “incoporation” changed to “incorporation” (“the subscribers to the certificate of incorporation”).
Page 140, period changed to semicolon after “the amount of cash must be stated.”
Page 144, comma added after “(a) by personal solicitation.”
Page 178, “sensative” changed to “sensitive” (“and impress the sensitive area of his brain”).
Page 182, period added after “Fig” (“see Fig. 103”).
Page 203, “webb” changed to “web” (“The first web printing press”).
Page 233, “1000” changed to “1,000.”
Page 234, “1,6093” changed to “1.6093.”
Page 248, “Florine” changed to “Fluorine.”
Page 253, “operate” changed to “Operate” (“See Operate”).
Page 261, period changed to comma after “of mechanical movements.”
Page 263, “Ellipose” changed to “Ellipse.”
Page 264, “individual” changed to “Individual” (“Individual electric motors”).
Page 266, comma added after “Metric.”
Page 266, comma added after “Model.”
Page 266, comma added after “Models.”
Page 267, comma added after “Partnership.”
Page 267, comma added after “Patent.”
Page 267, comma added after “Patents.”
Page 268, superfluous comma removed in “Pseudotriakis microdon.”