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Keeping Warm

AS fall and winter approach each year, we become much concerned about our heating facilities. If we own a house, the coal problem becomes a momentous question, and just now, a very expensive one as well.

But if you were to tell a man that out of twenty tons of coal he uses a season to heat his house, some sixteen or seventeen are a total unnecessary waste, he probably would doubt your sanity.

The trouble, you see, lies not in the coal or in the heating apparatus, but in the *house* itself, or rather in our low intelligence. We build houses to live in, and to have a roof over our heads, or to provide a place for our furniture, but with no forethought to keep warm in winter, and cool in summer. If an ice-box manufacturer built his ice-boxes like we build our houses, he would soon go out of business.

Now let us see what is wrong. On a nice summer's day with a temperature of 70° outdoors, close all doors and windows of your house. Start your furnace with a few pounds of coal and it won't take but a few minutes to warm the house up to 75°. With less than five pounds of coal you can keep up this temperature for a whole day or longer. The reason of course is that as it is 70° outdoors you loose practically no heat to the outside temperature, which is almost as high as the interior of the house. But let the outside temperature drop to zero, your five pounds of coal will have given up their heat thru the *good conducting* walls of your house in less than five minutes.

Evidently the moral is: *Don't heat your house and all outdoors,* but just *heat the air* of your house, and KEEP the heated air indoors.

That is what a Canadian engineer thought last year, when he built his house up in Alberta. Here the temperature drops to 20° below zero for weeks at a time and zero weather is the rule rather than the exception. So he built his house on the ice-box plan. The entire house is built of cement, with double walls, double ceilings, double roof, and double floors. Between the double walls is an airspace about two to three inches wide. This airspace alone would be a great improvement to keep out the cold, but our engineer went further. He filled in every bit of space between the walls with cork dust. This is both cheap and one of the very worst conductors of heat. By doing so he effectively insulated his entire house against the outside temperature.

The windows were double and triple panes of glass with air spaces between the panes. The doors leading outside are all of the revolving kind and they too serve as the only means for ventilation, as all windows must be kept closed hermetically.

Now comes the astonishing part. The house is entirely heated by a few electrical heaters. No steam is used at all. The owner figures that his electric heaters consume an equivalent of *three tons of coal a season,* were he to use a furnace. And this too in steady zero weather.

Another example of what a little intelligence plus science will do.

Of course this is all good advice if you are to build a new house, but how about your present one? Naturally you cannot build double walls now; it is too late for that, without doing the house over. But you can do this. The source of the greatest loss of heat lies without question in the window panes. Your house walls may be two to four inches thick, while the glass panes measure but an eighth of an inch thick. Suppose you build a wooden frame one inch thick inside of the present window frame. On top of this frame place a second pane of glass and putty it in place. This gives you an airspace of one inch between the two panes.

It will also reduce your coal bill over one-third.

H. GERNSBACK.

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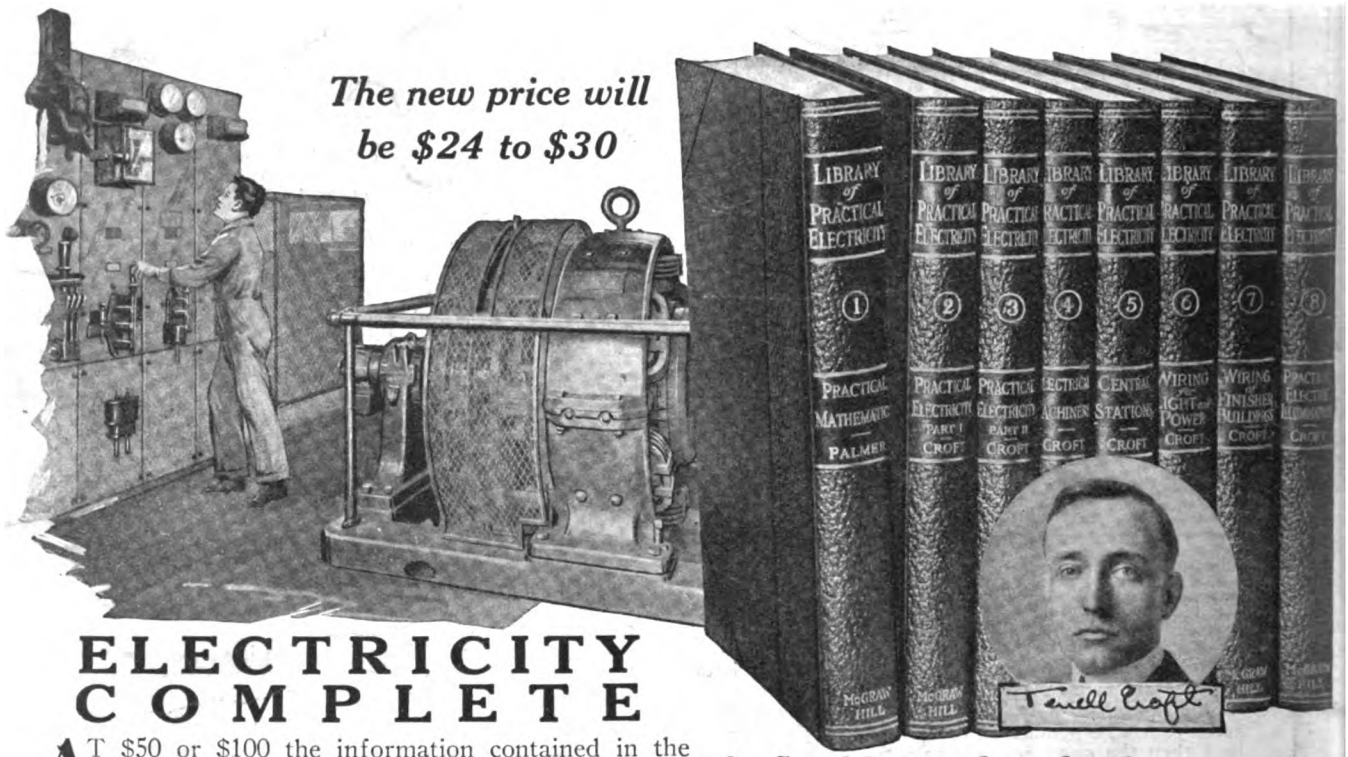

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Volume VIII.
Whole No. 91

Science and Invention

H. GERNSBACK – EDITOR
H.W. SECOR – ASSOCIATE EDITOR

NOVEMBER
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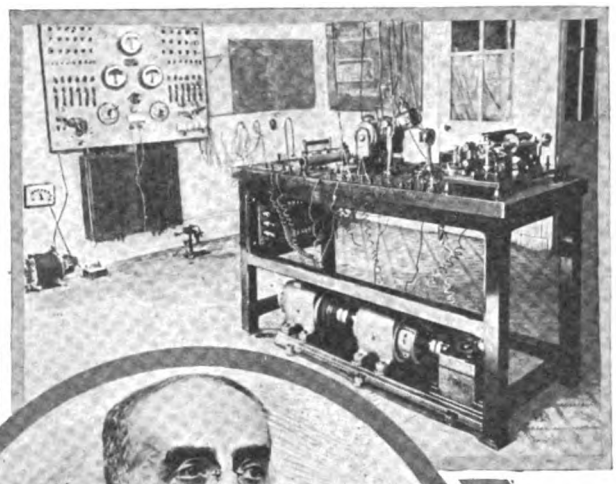
The Belin System of Telephotography

HOW PHOTOGRAPHS ARE TRANSMITTED AND RECEIVED OVER A TELEGRAPH OR TELEPHONE WIRE.

EDOUARD BELIN, a French inventor and electrician, has invented an apparatus for transmitting autographic writing, photographs and the like, by what may be termed a telegraphic process. In a few minutes a photograph or other design may be sent hundreds of miles; an occurrence of any sort or an important personage may be photographed and the picture may be received hundreds of miles away inside of an hour.

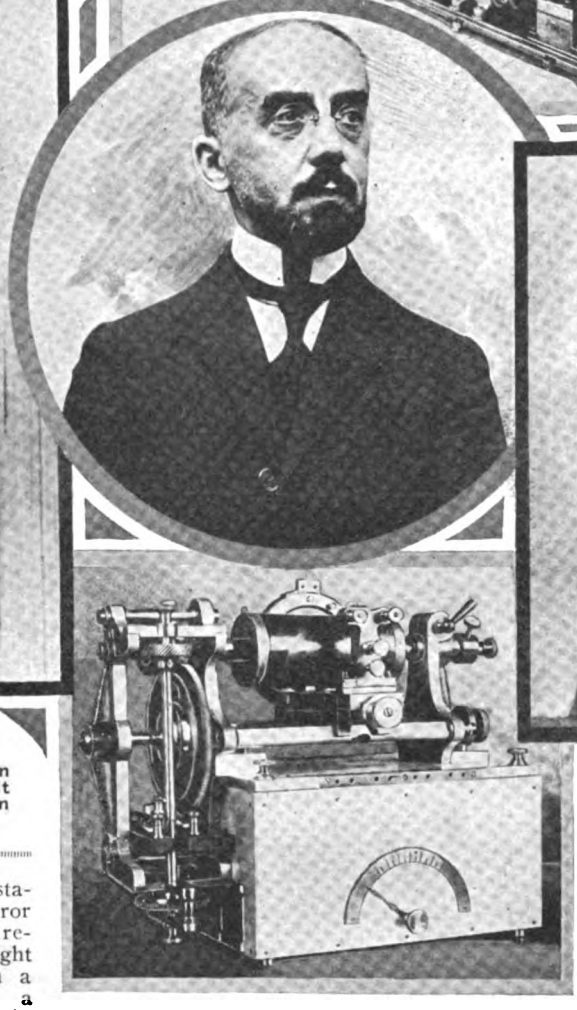
To do this the inventor uses a varying electric current, whose variations are produced mechanically at the sending station, and due to this current a mirror is caused to vibrate at the distant receiving station. The spot of light from the mirror is received on a sheet of sensitized paper and a photographic reproduction of the object at the distant station is produced on development of the latent image.

The transmitting apparatus comprises a cylinder on which is mounted the picture or script to be transmitted. This may be a sheet of gelatine, which has been so treated that the dark parts of the image on it are in relief. It may be a sheet of manuscript so prepared that the writing is in relief.



At Left: The Perfected Receiving Apparatus Used in the Belin System of Telephotography, Which Recently Transmitted Successfully Photographs and Hand-writing Over a Long Distance. Center Picture Shows the Inventor of the Newly Perfected Telephotography System, M. Edouard Belin.

Half-tone Reproduction of Film on Which General Mangin's Portrait Was Received Over the Belin System, Without Retouching.



Portable Sending Instrument Used in the Belin Telephotography System. The Cylindrical Negative Causes a Microphonic Contact to Transmit Impulses Over the Circuit to the "Receiver," Which Records the Image Photographically on the Film, as Here Reproduced.

General Pershing's Photograph as Transmitted by the Belin Telephotograph. (It Has Not Been Retouched.)

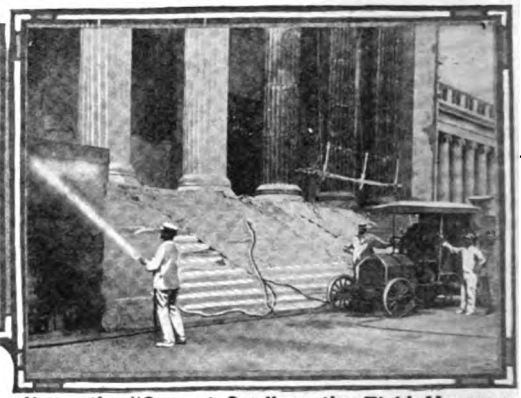
In transmitting, the cylinder rotates and an arm rests upon it and is caused slowly to traverse the length of the cylinder, exactly like the needle in the old-fashioned cylindrical phonograph. Thus the arm is thrown into vibration and the vibrations act upon a microphonic-type resistance by which a varying current is caused to pass over the telegraph line connecting the two stations. This current varies in (*Continued on page* 805)

Shooting Up Houses With Cement Gun

By ROBERT H. MOULTON

Illustrating Vividly What May be Accomplisht in Building Out in Relief, With But One Application of the "Cement Gun."

The Illustration Above Shows an Old Building Being Renovated With the "Cement Gun," After Covering the Walls With Wire Mesh to Support the Stucco.



Using the "Cement Gun" on the Field Museum at Chicago. Note the Difference Between the Two Columns at the Left Which Have Been Renovated and Those at the Right.

Very Rigid and Desirable Fences Are Quickly Constructed From a Wire or Wooden Slat Base, Afterward Treated with the "Cement Gun," as Shown in the Accompanying Picture at the Right. It Is Surprising How Rapidly Such a Fence or Wall Can be Covered By This New Process.

The "Cement Gun" Finds Another Rôle of Usefulness in "Tree Surgery." It Proves Particularly Efficacious for Such Work, as the Cement Is Blown Into the Holes Under High Pressure, Making the Joint Absolutely Air and Water Tight.

DURING the war *guns* were not only used for destroying buildings, but for erecting them, paradoxical as this may sound, and now the same principle is being applied to peace-time uses. This remarkable constructive shooting was effected by what are called "cement guns," used to apply cement stucco with great speed and in huge volume to steel or timber framing covered with wire network. The type of cement used for this purpose has been appropriately named "gunnite." In building army warehouses at various points a battery of "guns" was used, and as many as ten were sometimes projecting their sticky missiles at one time.

The cement gun, which looks more like a fire-hose squirting out a semi-liquid mixture than like a gun, consists essentially of a hopper into which the dry cement and sand, or other materials, are placed, a hose connected to the bottom of the hopper thru which the dry mixture is forced by air pressure, and a nozzle at the other end of the hose to which another hose supplying water is attached for hydrating (mixing with water) the cement. The hydration takes place while the materials are all in motion, and, leaving the nozzle, the mixture is "shot" upon the surfaces, or into inter-spaces of any aggregate. As the combination of the elements necessary to produce a plastic product takes place in transit, it will be seen what an advantage this is in connection with quick-setting materials. It not only obviates the use of a retardant, thereby increasing the quality of the product, but materially lessens its cost.

Heretofore the most serious criticism that has been made concerning plastic products has been their lack of uniformity, due to the human element in mixing them and in the methods of application. It is a well known engineering fact, that the instant moisture is brought into contact with plastic materials the initial *set,* or crystallization, begins, and that any subsequent manipulation or handling tends to disturb this initial crystallization, thereby weakening the entire product. The only way by which this fault could be corrected would be to have the hydration take place in such a manner that crystallization would begin only at the moment of the actual emplacement of the material on the place where it belongs. This is what the cement gun actually accomplishes.

Another advantage claimed for the gun is that only the amount of water actually necessary for hydration is used, the materials being projected with sufficient force to expel all surplus water and air, and the resulting product is denser, more homogeneous, and, consequently, more water-proof than anything yet attained by hand or machine processes. The labor involved is also said to be considerably less, while the saving in time is so great that the total cost of making and applying any plastic mixture by means of the gun is reduced to a minimum.

There would seem to be a very large field for the practical use of the cement gun. Foundation work and water-proofing below grade should be well adapted to this process. As a means of coating steel to prevent rust and corrosion it should prove superior to the ordinary method of painting, for a cement coating will wear much better and longer than one of paint.

Tree surgery is another thing that seems destined to undergo a revolution. There are hundreds of torn, cracked and decaying trees in the private yards, on the streets, and in the public parks of every city that could have their years of usefulness and ornament doubled, if they were given proper attention. The trouble is that it doesn't pay to go around and patch them up with hand-made cement or plaster, as it might be termed.

In the case of fences and other similar structures, and the interior and exterior walls of entire buildings, a special design of frame work is required. This consists of a wire mesh of the required size, with a wooden backing. The cement is shot upon this and after it has hardened the wooden backing is removed, leaving what is practically a reinforced cement wall. Such walls are claimed to be as fire-proof as they can be made by any known method.

In order to demonstrate this, a small building of two-inch by four-inch wood was constructed. Both the inside and outside were covered with building paper and over this was placed a wire mesh reinforcement with one inch of cement-sand stucco, leaving a four-inch air space between the walls. A scientifically built fire was then allowed to burn in it for fifteen minutes, after which buckets of water were thrown on the inside hot walls, with the result that only a little of the surface scaled off, and not a single crack developed. The outer coating of the rear wall was left off in order to determine whether or not the wooden studding would be affected by the heat, and it was found to be not even charred.

The cement gun is, of course, not adapted to the use of concrete, or other mixtures in which coarse gravel or stone forms one of the ingredients. But a solution of this problem may eventually be found in the construction of a "Concrete Cannon," and future generations may yet witness the unique spectacle of whole towns literally "bombarded" into existence in the same length of time that it now requires to erect one building of moderate proportions.

Super-Silkworms and Super-Silkworm Food

By RICHARD HOADLEY TINGLEY

ALMOST everybody knows that silkworms feed on mulberry leaves and, in some mysterious manner, spin the beautiful and delicate threads that our manufacturers weave into such popular and expensive garments. But the mulberry is a little leaf, and a little leaf is quickly consumed by the worm which has a truly Gargantuan appetite.

If some "Burbank" were to come forward with a tree which would grow a leaf fifteen or twenty times the size of the mulberry, and that the silkworms liked just as well, and spun just as good silk from feeding on it, wouldn't you think it was quite a discovery?

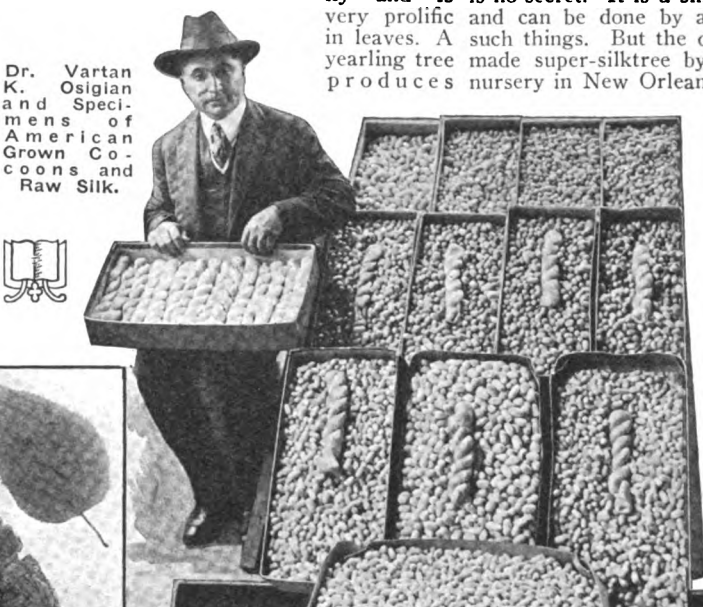
Almost everybody knows that silkworms spin their delicate threads around and around themselves an infinite number of times, and so encase themselves in cocoons from which the raw silk of commerce is unwound and skeined. What would you think if some genius had, by a process of domestication and breeding, developed a super-silkworm which, feeding on the big "Burbankized" leaves, would spin a cocoon twice as large as an ordinary cocoon, containing, of course, double the quantity of silk thread? Wouldn't you say he was "some inventor"?

And once more; if some inquiring mind had worked out a process of feeding silkworms by "doctoring" these big leaves in such a way that the worms would spin any color of silk desired, wouldn't you take off your hat to that man?

That all of these things have been successfully demonstrated, both experimentally and commercially, is the claim of the inventor, Dr. Vartan K. Osigian, an Armenian by birth tho a naturalized American citizen, who makes his home in New Orleans.

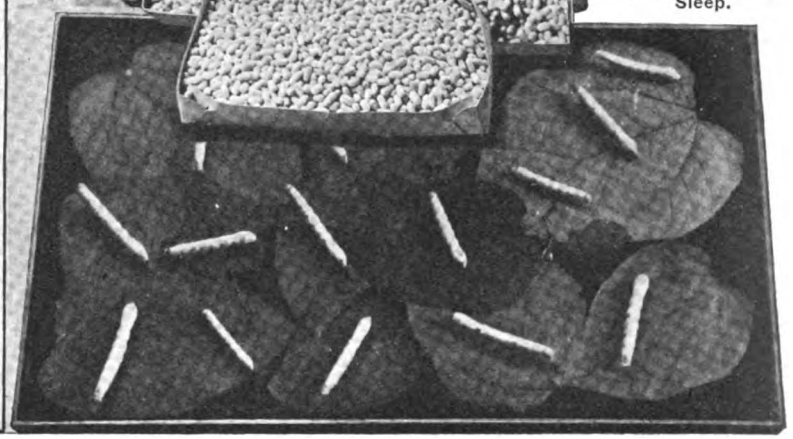
A Giant Silkworm that Spins Silk in Any Color

The wonderful tree that grows this big leaf is a cross between the mulberry and osage orange. The leaf is almost as big as your hat. The tree, which is known as the "Osigian Silktree," grows with great rapidity and is very prolific in leaves. A yearling tree produces from 5 to 10 pounds of leaves; a two-year-old, from 15 to 25 pounds; a three-year-old, from 35 to 40 pounds, and when eight to twelve years old, from 175 to 200 pounds. In his nursery at the Crescent City Dr. Osigian has two and a half million of these trees planted and growing which he sells to farmers who want to go into sericulture. It took years and years of trial and experiment to develop this tree and the doctor claims it will thrive in almost any soil.



Dr. Vartan K. Osigian and Specimens of American Grown Cocoons and Raw Silk.

Famous Osigian Silk Tree Leaf in Center, Others Shown are Japanese, Chinese, Italian and French. This Shows the Osigian Silk Tree Leaf to Be Ten Times Larger Than Leaves Produced in Any Other Country



Silk Worms Sleeping Fourth or Last Sleep.

It takes from seven to nine pounds of cocoons made by the ordinary silkworm to yield a pound of raw silk. A pound of raw silk can be spun from four and a half pounds of cocoons made by Dr. Osigian's super-silkworms. The super-silkworm is fifty per cent larger than the ordinary worm and the cocoon it makes is double the ordinary size and contains twice the quantity of silk thread. The reason for this is that the glands of the super-silkworm are larger, and the "Burbankized" leaves are so much more tender and nutritious than those of the mulberry. This tenderness causes the worm to eat more, hence the increase in quantity of thread. A single cocoon made by the super-silkworm will spin rather more than a mile of double strand silk thread. The product of 25,000 such cocoons would reel a thread that would encircle the globe at the equator.

The development of the Osigian Silktree is no secret. It is a simple grafting process and can be done by anyone familiar with such things. But the doctor has the ready-made super-silktree by the millions in his nursery in New Orleans, which make it unnecessary for farmers going into the silk business to take that trouble.

Neither is the development of the super-silkworm a secret. Dr. Osigian sells the eggs to anyone caring to buy. That, and the sale of his silktrees, is his business. But the coloring process he keeps to himself. He claims he can produce eighteen separate and distinct colors of silk by special feeding of the worms. I have not seen eighteen, but can vouch for at least half a dozen that I have seen. Not only this, but, the doctor tells me, *the progeny of silkworms producing red, green, blue, etc., will always spin threads of the same color as their parents.*

Dr. Osigian tells me he intends to keep the coloring secret to himself for a while yet—until he has proved to America the commercial benefit of this and his other inventions. "When this is done," he says, "I will make it known as a free gift to the people of the United States."

Japan is the greatest producer of raw silk in the world, and China comes next. The United States produces more manufactured silk than any other country, but is entirely dependent upon foreign countries for its

(*Continued on page 786*)

Leonardo da Vinci

By PROF. T. O'Conor Sloane, Ph. D.

IN the September number the life and achievements of Archimedes of the old-time Syracuse were described, and he was cited as the world's first great inventor. But now we come to a period between four and five hundred years ago, when Leonardo da Vinci (born 1452—died 1519) did his historic work. His father had four wives and a numerous offspring, and the position of his first-born, Leonardo, with the presumably rapid succession of stepmothers and half-brothers and half-sisters, is not supposed to have been a very happy one.

He entered, as a young man, the studio of the artist Verocchio, who, like the other artists of that day, was painter and sculptor, and practised other branches of more technical art as well, for those were the days of many-sided men. The story is told that the young student, Leonardo, painted an angel in one of Verocchio's pictures which so much surpast his master's work that Verocchio abandoned painting in color. This, like some of the other rather vivid stories in Vasari's "Lives of the Painters" is possibly fictitious; it is taken from this work.

Comparatively few of Leonardo's pictures are extant. They have suffered with the passage of years, or have entirely disappeared and been lost. Yet there are in existence today two of the most famous pictures in the world, which are his, "The Last Supper" and the "Mona Lisa" or "La Gioconda." The latter, it will be remembered, was stolen from the Paris museum some years ago, taken to Italy and afterward restored to its original place in the Salon Carré in the Louvre.

But it is another side of his character and another class of his wonderful genius that are to be touched upon here, for this unsurpast artist and sculptor (for such he was also) was one of the world's great inventors. His mechanical designs for all classes of machinery antedated by generations the work of the supposed modern inventors of the same things. There was absolutely nothing in the engineering field at that date which he did not touch upon. And the machines which he designed and left drawn and commented upon in his very voluminous memoirs could do excellent service in the shops of today.

He was greatly troubled by the fact that there was no prime motor in those days. The practical steam engine was not in use, altho in his sketches Leonardo shows the elements of a steam engine, which lacks only the condenser or even a jet of water to be periodically injected below the piston to constitute a single-acting steam engine. A jet thus employed, with simple gear to operate it, would give the Newcomen engine, which did good work in England for many years. This engine appeared centuries later than Leonardo's.

Accordingly he used manual power and animal power to drive his machines. Sometimes it would be a treadmill; in one case an animal and driver went up an inclined plane and descended in a platform or cage, elevator-fashion, and thus drove heavy mechanism.

A number of his inventions relate to war. Much of his attention in this line was given to the construction of cannon and small arms—some of the cannon he proposed to build up barrel-fashion, with hoops, because the powder of those days was far weaker than the present explosives. In his breech-loading guns the mount on the carriage and the elevating device in some cases are almost modern. One of his designs shows the screw breech block, similar to the present device.

The Edison of the Middle Ages--

In the War of 1870, the French brought into use the *Mitrailleuse,* a collection of rifle barrels bunched together, so as to discharge a quantity of small projectiles at once. But Leonardo was ahead of France in this respect. He arranged his barrels, parallel in some constructions and in other cases they were radially disposed, so as to cover a longer line in their discharge—and in still other cases he mounted them in sets on a rotating and sometimes on a rocking frame or block, so that one set after the other could be brought into action. He devised mortars for discharging bombs, and what is represented in one of his drawings, is a close approach to shrapnel.

In those days the walls of forts were scaled by ladders, so he got up an arrangement to push the ladders over, away from the wall, so that they would fall backward—undoubtedly greatly to the discomfort of the heavily armed soldiers who might be attempting to scale the walls. He had this all worked out in detail, even to the securing of the fulcra of his levers by a dovetail arrangement in the masonry. He also had chariots armed with the most vicious scythes, armed tortoise-like cars (something like the modern tanks), and a treadmill arrangement for discharging very powerful crossbows.

He also designed forts. These were adapted to withstand the methods of attack of those days, and are quite different, for that reason, from modern designs.

One example of his heavier engineering machinery is a clamshell dredger, which is not far different from what may be seen in use today, and which by a very ingenious arrangement of screws could be adapted for different depths of water. His knowledge of the multiplying of force by gear wheels and screws is excellently shown in one of his presses, which will produce an immense pressure—a long lever working a small pinion in its turn, meshing with a large gear wheel, which forces down the screw of the press, indicating an enormous power. In this line the printing press, coming right on the track of Guttenberg's invention of type, is shown in the illustration—almost a reminder of Benjamin Franklin's press of generations later date.

Then we find many other ingenious machines, such as the thread-cutting machine. Here we have lead screws such as are in use on large machinery, and the pitch of the screw being cut, is regulated by the changing of the gears as on modern lathes. He has shown the different gears lying on the floor, and his machine in some ways is almost more up to date than the modern lathe, for certainly the balanced travel of the die or thread-cutting tool, with the two lead screws, is a highly perfected type of construction.

There are any number of minor devices in line with mechanics due to him, such as the *lewis,* the well-known instrument for getting a hold on a block of stone for raising it. The instrument which we may call the "come-along" (borrowing an electrician's term) is termed by Leonardo *an instrument for opening a prison from within;* but the electrician uses his "come-along" for the more peaceful purpose of straining the wires taut on the poles. His drawings of chains for chain-drives are astonishingly modern, and the chains as he draws them would fit the modern bicycle or automobile. He even investigated the compass and constructed gimbels for keeping the bowl level, exactly as they are used today.

Another sketch of his shows a man with *water-shoes* gliding on the surface of the water, something which has often been attempted in recent times.

Flying machines excited great interest with him, and he made so many sketches of them in such varied designs that it is merely a question of choice as to which to reproduce. One of the most interesting ones is really the helicopter, but outside of that fact it shows an aerial propeller, and what has made the flying machine a possibility is an internal-combustion engine and the rapidly rotating aerial propeller. Leonardo possest the latter, but had no internal-combustion engine to turn it.

But Leonardo never departed from the idea of wing-beat, and in his drawings of flying machines the idea appears that he wisht to move the wings of the machine like a bird, and our aeronautical experts may yet succeed in making this type of machine fly.

Articles For "December"

The Fourth Dimension—What It Is, and What It Is Not.

Von Guericke, Torricelli and Pascal—Discoverers of the weight of the atmosphere and of apparatus for showing and measuring it—including the barometer.

Radium in the Treatment of Cancer. By Joseph H. Kraus.

The Truth About the Divining Rod. By Prof. T. O'Conor Sloane, Ph. D.

Do the Lungs Circulate the Blood—And Not the Heart? By George Anston.

Colloids and Colloidal Fuel—A recent development of an old chemical principle of immense economic possibilities, involving the use of coal dust and culm.

How Hollow Copper Statuary and Other Articles Are Made by Electrolysis. By Samuel Wein.

The Sun's Unknown Rays. By Rogers D. Rusk, M.A.

Some Fascinating Experiments in Chemistry. By O. Ivan Lee.

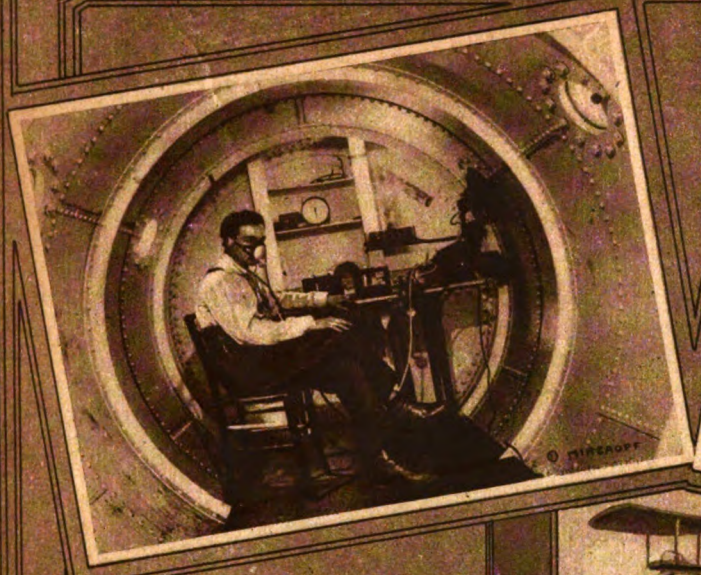
Easy Experiments in Glass Blowing. By Charles S. Wolfe.

The Sense of Touch—How We Perceive the Difference Between Hot and Cold, the shape of objects, etc., popularly explained.

New Motion Picture Machine for the Home.

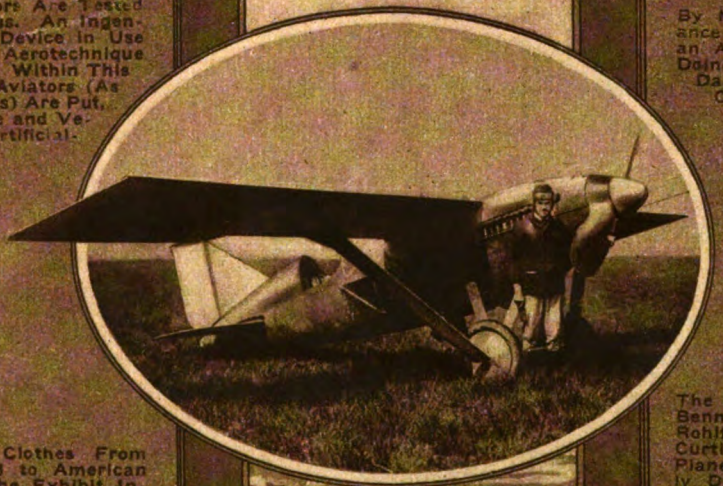
The Fastest Things in the World.

SCIENCE

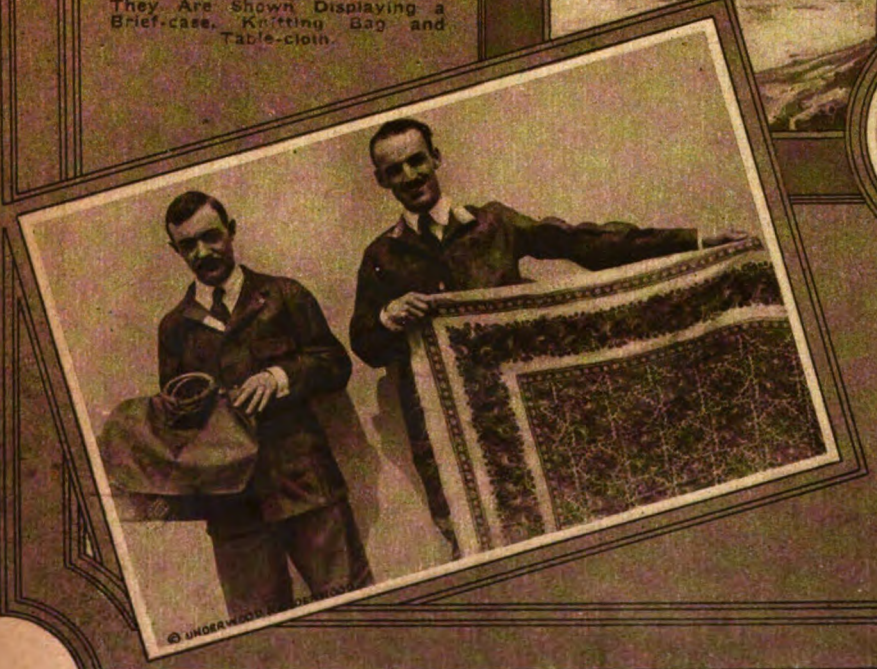


How French Aviators Are Tested For Altitude Fitness. An Ingenious and Unusual Device in Use at the Institute of Aerotechnique At St. Cyr, France. Within This Tunnel-like Affair Aviators (As Well as Their Planes) Are Put, and Exact Pressure and Velocity Conditions Artificially Duplicated.

By Means of Gages the Resistance of a Plane or Altitude of an Aviator Can Be Ascertained, Doing Away With the Great Danger of Death or Stupor Caused By Unusually High Altitudes When In Flight.



The Curtiss Entry in the Gordon Bennett Aerial Derby. Roland Rohlfs, Chief Test Pilot for the Curtiss Co., Is Shown With the Plane. The Plane Was Especially Designed for This Race and Is Said to Develop a Speed of 200 Miles an Hour.



Washable Paper Clothes From Austria Introduced to American Manufacturers. The Exhibit Includes Workmen's Suits, Tablecover, Collar and Cuffs, Laundry-bag, Wall Decoration, Twine and Other Articles. This Photo Shows Two Men Wearing Paper Suits. They Are Shown Displaying a Brief-case, Knitting Bag and Table-cloth.

The New Automatic Liquid Poison Gas Gun Now in Use in Paris. Puts One Asleep At Once. Being Used Against Bandits. In the Last Few Months There Have Been Many Hold-ups In the Paris Streets. The Latest Terror Has Been Taxi Bandits Who Get Into the Taxi Cabs As Passengers, Suddenly Hold Up the Driver, Rob Him and Then Steal His Car. The Latest Protection Against These Many Hold-ups Is This New Gun.

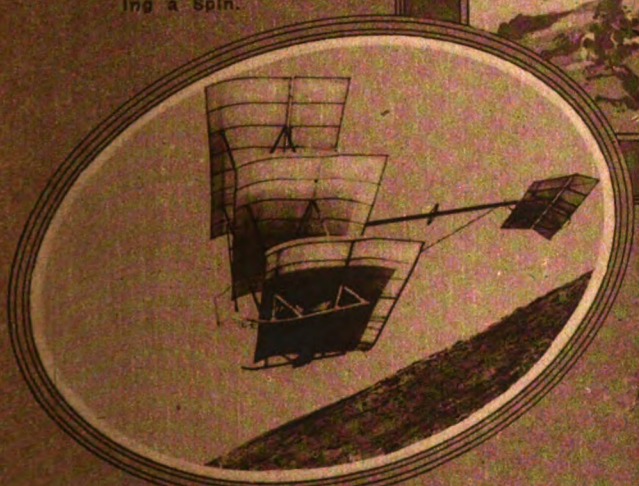
IN PICTURES

A Ford Agent in San Francisco Built An Airplane Model for Advertising Purposes. It is a Ford Chassis With An Airplane Body, With the Wings As Wide As the Motor Vehicle Law Will Allow. He Was Pinched By a Motorcycle Cop for Speeding and Tried To Get Out of It By Saying It Was An Airplane and Not Liable Under Ground Laws.

A Swiss Inventor, Emil Lowe, Who Recently Lost An Arm In An Accident, Determined To Overcome His Handicap in Driving a Car By Inventing a Device Which Would Enable Him To Steer and Run An Automobile With Perfect Safety. He Has Succeeded Admirably As the Photo Shows and Has Recently Received a License To Drive a Car After a Most Thoro Test of His Invention.

One Of the Strange Contraptions Recently Shown at the Military Circus Held In Chicago, Was a Double-headed Flivver With An Engine on Each End and So Arranged That the Two Drivers Can Go In Either Direction. The Photo Shows Two Soldiers Taking a Spin.

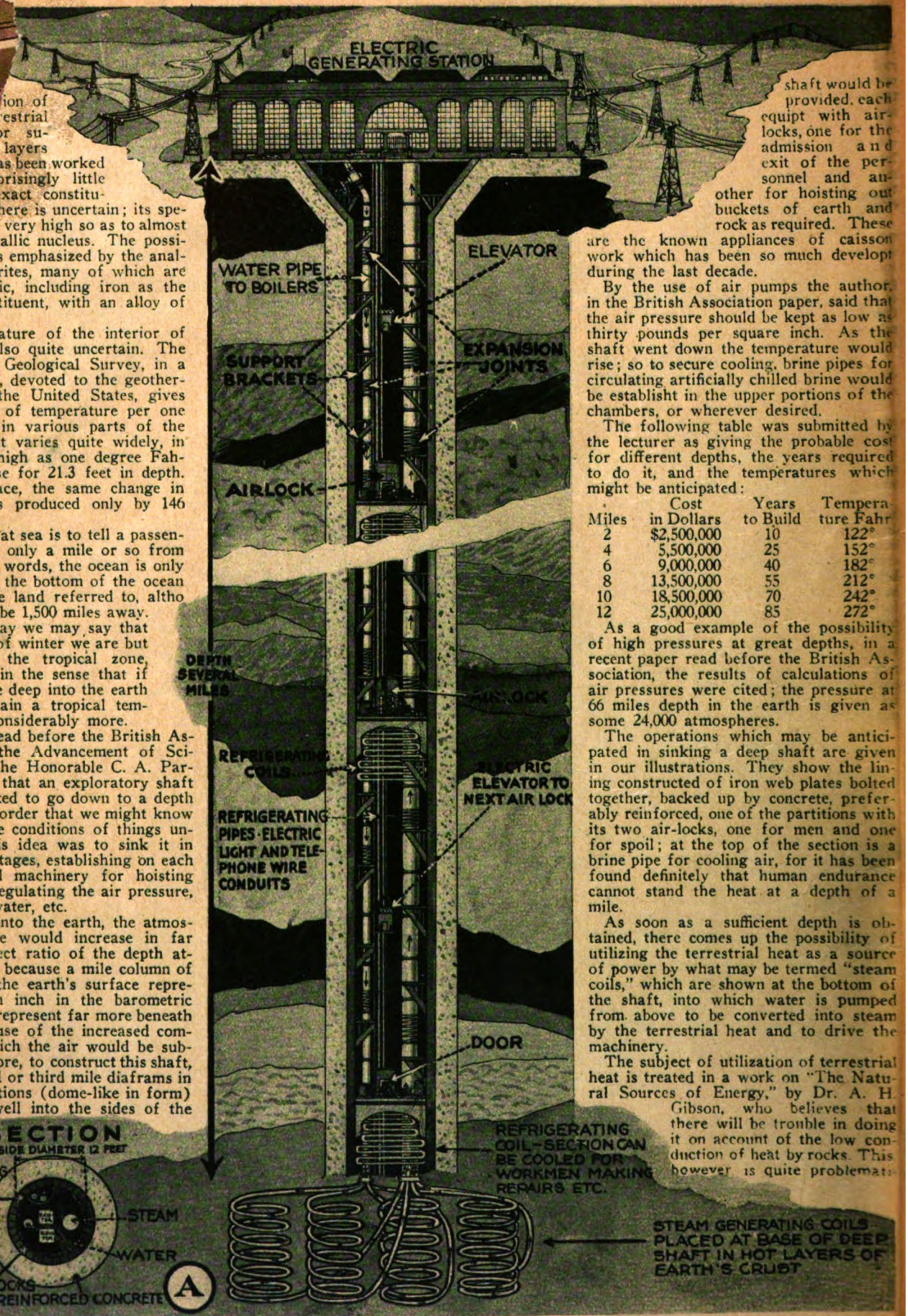
An Imperial Crown Made Instead of Glittering Gems Out of Thousands of Insects and Butterflies. The Effect Is Said To Be Most Colorful and Pleasing and To Suggest Varied Colored Precious Stones.



Frederick Richter Heuenstein, the Inventor of a New Motorless Glider, Proving the Practicability of His Invention in Germany. The Speed of the New Motorless Flying Apparatus is Dependent on the Velocity of the Wind.

pping the Earth's Heat

By PROF. T. O'CONOR SLOANE, Ph.D.



ion of
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cial layers
lobe has been worked
a surprisingly little
pth. The exact constitution of our sphere is uncertain; its specific gravity is very high so as to almost indicate a metallic nucleus. The possibility of this is emphasized by the analysis of meteorites, many of which are largely metallic, including iron as the principal constituent, with an alloy of nickel.

The temperature of the interior of the globe is also quite uncertain. The United States Geological Survey, in a recent bulletin, devoted to the geothermal data of the United States, gives the increment of temperature per one hundred feet in various parts of the country, and it varies quite widely, in one place as high as one degree Fahrenheit increase for 21.3 feet in depth. In another place, the same change in temperature is produced only by 146 feet depth.

An old joke at sea is to tell a passenger that he is only a mile or so from land. In other words, the ocean is only that deep, and the bottom of the ocean is taken as the land referred to, altho the shore may be 1,500 miles away. In the same way we may say that in the middle of winter we are but a mile from the tropical zone, probably less, in the sense that if we go one mile deep into the earth we would obtain a tropical temperature, or considerably more.

In a paper read before the British Association for the Advancement of Science in 1904, the Honorable C. A. Parsons proposed that an exploratory shaft should be started to go down to a depth of 12 miles in order that we might know more about the conditions of things underground. His idea was to sink it in one-half mile stages, establishing on each stage electrical machinery for hoisting out the spoil, regulating the air pressure, pumping out water, etc.

Descending into the earth, the atmospheric pressure would increase in far more than direct ratio of the depth attained. This is because a mile column of air which on the earth's surface represents about an inch in the barometric column would represent far more beneath the earth because of the increased compression to which the air would be subjected. Therefore, to construct this shaft, at every second or third mile diaframs in horizontal positions (dome-like in form) and abutting well into the sides of the shaft would be provided, each equipt with air-locks, one for the admission and exit of the personnel and another for hoisting out buckets of earth and rock as required. These are the known appliances of caisson work which has been so much developt during the last decade.

By the use of air pumps the author, in the British Association paper, said that the air pressure should be kept as low as thirty pounds per square inch. As the shaft went down the temperature would rise; so to secure cooling, brine pipes for circulating artificially chilled brine would be establisht in the upper portions of the chambers, or wherever desired.

The following table was submitted by the lecturer as giving the probable cost for different depths, the years required to do it, and the temperatures which might be anticipated:

Miles	Cost in Dollars	Years to Build	Temperature Fahr
2	$2,500,000	10	122°
4	5,500,000	25	152°
6	9,000,000	40	182°
8	13,500,000	55	212°
10	18,500,000	70	242°
12	25,000,000	85	272°

As a good example of the possibility of high pressures at great depths, in a recent paper read before the British Association, the results of calculations of air pressures were cited; the pressure at 66 miles depth in the earth is given as some 24,000 atmospheres.

The operations which may be anticipated in sinking a deep shaft are given in our illustrations. They show the lining constructed of iron web plates bolted together, backed up by concrete, preferably reinforced, one of the partitions with its two air-locks, one for men and one for spoil; at the top of the section is a brine pipe for cooling air, for it has been found definitely that human endurance cannot stand the heat at a depth of a mile.

As soon as a sufficient depth is obtained, there comes up the possibility of utilizing the terrestrial heat as a source of power by what may be termed "steam coils," which are shown at the bottom of the shaft, into which water is pumped from above to be converted into steam by the terrestrial heat and to drive the machinery.

The subject of utilization of terrestrial heat is treated in a work on "The Natural Sources of Energy," by Dr. A. H. Gibson, who believes that there will be trouble in doing it on account of the low conduction of heat by rocks. This however is quite problemat-

cal, and there is every possibility that steam can be produced if we once obtain a low enough depth. The contraction and expansion of the long pipes and tubing are to be provided for by long expansion joints plentifully placed along the pipe lines.

There would be apprehension of seismic disturbances, and while it may seem far-fetched, it is quite possible that intense radio-activity might be encountered from which the operators would have to be protected by heavy lead screens. Again, if the temperature was not high enough to make steam from water before the requisite depth was reached, a sulfur dioxide, ether or gasoline engine could be employed. This would mean low efficiency, but if it were possible to really draw upon the terrestrial heat the efficiency would be quite a side issue.

In one of the illustrations we show what may be termed a possibility, the heating of a house by terrestrial heat. Cold water descends thru a pipe coated with asbestos composition to a heating chamber at the bottom of a deep shaft. It is here warmed and by thermo-syphonic action ascends thru another asbestos coated pipe so as to force a flood of hot water into the house.

Variations of this method could be introduced by circulating steam in the same way so as to get a steam heating apparatus.

Should quicksand or very wet ground be encountered, the well-known freezing process would be available to freeze a zone, so as to exclude water and enable the treacherous soil to be treated as rock until the lining was in place.

A depth of 7,579 feet is the greatest that has been attained by man, and this was by drilling, so that the well had a diameter of but a few inches. No law explaining the increase of temperature with depth has yet been discovered. In the wells in which tests have been made 168.6 degrees F. have been found at a depth of 7,500 feet. It is (in round numbers) 44 degrees short of boiling. The well that attained this depth, the Lake Well, West Virginia, collapsed at the bottom where it had been left unlined, reliance being placed on the natural rock to hold its own shape. It is evident that the mere support of the wall at the sides of a twelve-mile shaft might entail considerable difficulty.

There is one peculiar feature to be encountered in this operation of sinking a deep shaft into the earth. The pressure of the air in the shaft would increase in far more than arithmetical ratio, so that the engineers would be, as it were, between two fires. In caisson work, air is pumpt in, in order to expel water by its pressure, and when three atmospheres are exceeded, the condition in the caisson is very severe for the workman; but in our deep shaft, without any pumping in of air, the air pressure will increase, so that if the great depths thought of by Mr. Parsons were attained, the problem would be not to maintain pressure in the different chambers, but rather to diminish it. But this again would involve the admission of water, as the atmospheric pressure would be reduced. If the water pressure in the rock and sand of the earth at these depths had any reference to its hydraulic head, as represented by the distance from the earth's surface, the pressure would be so tremendous that air pressure could not cope with it, without exceeding many times the power of human endurance. Roughly speaking, a head of two feet of water represents a pound pressure, so that a mile of water would represent about 150 atmospheres.

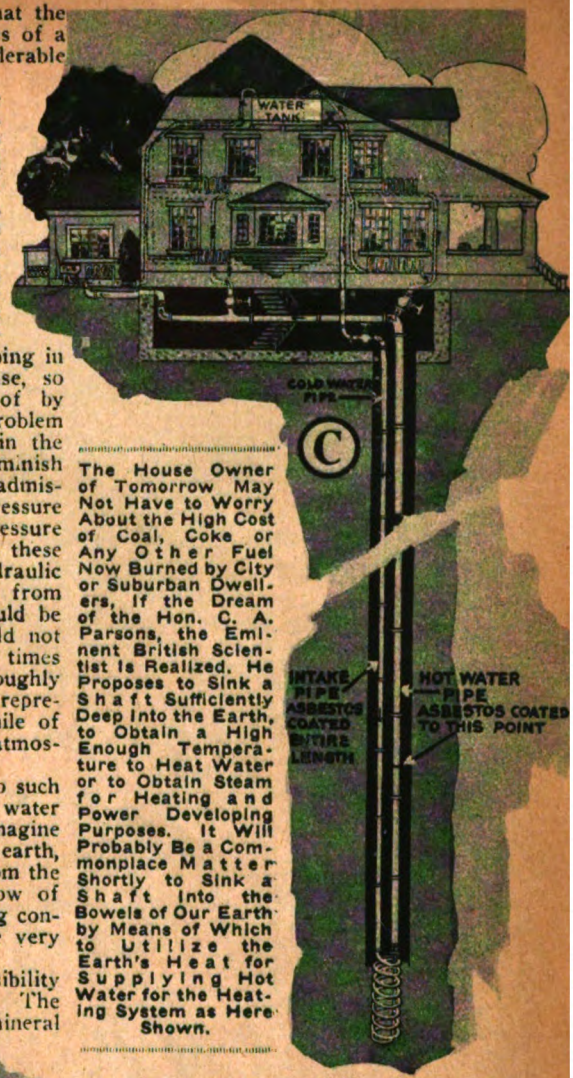
It is perfectly true that in mines, no such trouble is experienced because when water enters, it is pumpt out; but if we imagine a closed chamber, miles down in the earth, under pressure differing not widely from the hydraulic head, and with a large flow of water into it, the maintenance of living conditions within that chamber might be very difficult.

Allusion has been made to the possibility of manifestations of radio-activity. The great benefit attributed to natural mineral water, and which benefit in the popular conception at least is not present in artificial mineral water, has been attributed to the presence in it, of radio-active substances, so that when the water is imbibed, emanations may be taken into the system along with it. The presence of this radio-activity in spring water definitely indicates the presence of radio-activity in the crust of the earth. Therefore it is not going too far to indulge in the supposition that the phenomenon may be encountered at relatively high intensity, as unknown subterranean strata are penetrated.

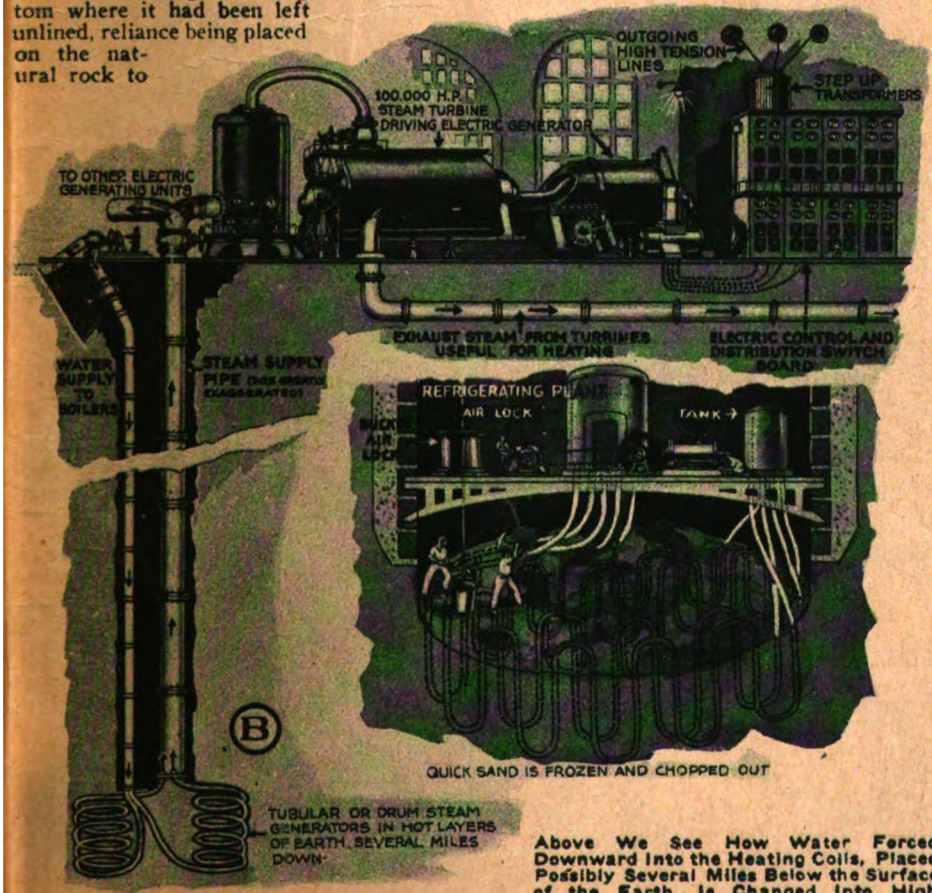
As we talk of the exhaustion of oil and coal, the most striking feature is the small depth of the earth's crust which we have been able to exploit,—and it is quite possible that the Parsons deep shaft might reveal sources of coal and oil unknown to us. But it seems probable that the presence of carboniferous substances is not to be looked for or anticipated at depths exceeding two miles, altho in our ignorance of the conditions, we do not know how deep down what we may term geologic ages may have formed their deposits on the earth's surface.

Little has been said about the lateral pressure of the rocks and it is far from certain that rock may not be encountered of so friable a nature as to threaten to crush in the sides of the strongest shaft which could be constructed. The whole subject of these uncertainties, possibilities and difficulties, would be worthy of treatment by a Jules Verne or a Rider Haggard.

Certain it is that the engineers of today are quite capable of sinking a shaft down into the earth far deeper than any so far constructed. It is only a few years since under-river tunnels were looked at with awe, even by engineers. Now they are mathematically designed and constructed.



The House Owner of Tomorrow May Not Have to Worry About the High Cost of Coal, Coke or Any Other Fuel Now Burned by City or Suburban Dwellers, If the Dream of the Hon. C. A. Parsons, the Eminent British Scientist Is Realized. He Proposes to Sink a Shaft Sufficiently Deep Into the Earth, to Obtain a High Enough Temperature to Heat Water or to Obtain Steam for Heating and Power Developing Purposes. It Will Probably Be a Commonplace Matter Shortly to Sink a Shaft Into the Bowels of Our Earth by Means of Which to Utilize the Earth's Heat for Supplying Hot Water for the Heating System as Here Shown.



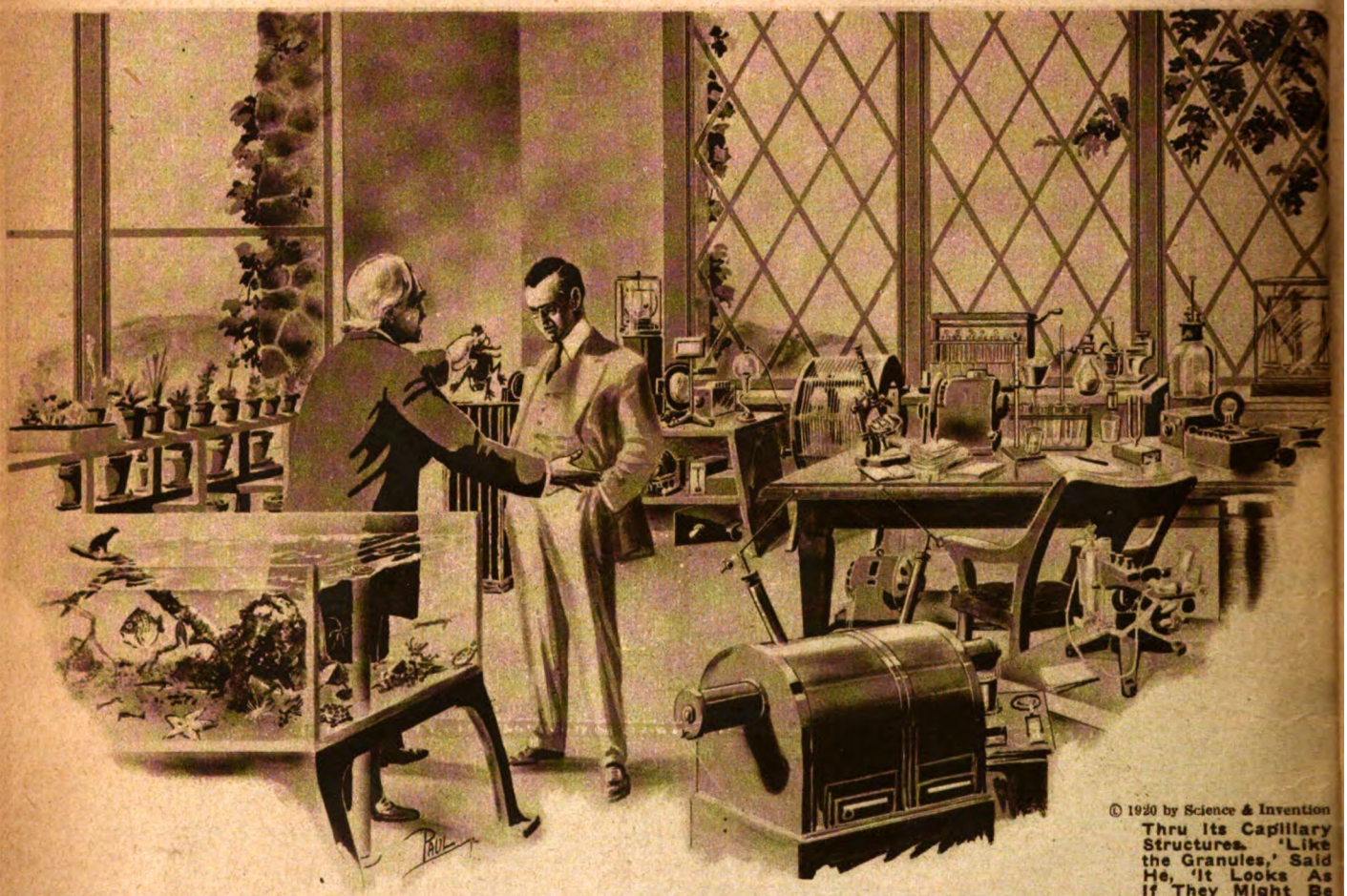
Above We See How Water Forced Downward Into the Heating Coils, Placed Possibly Several Miles Below the Surface of the Earth, Is Changed Into High Pressure Steam Which Is Carried Upward to Huge Electric Generating Units, the Power To Be Distributed Over Great Areas by Means of High Voltage Transmission Lines. The Lower Figure Shows Men Working on the Shaft Construction at Great Depths by Freezing the Quicksand and Working Under Air Pressure as in Building River Tunnels.

Dr. Pringle Discusses Life

By JOHN DE QUER

"LIFE is an electrical phenomenon," said Dr. Pringle in reply to my question as to what he considered life to be. "It is, as must be evident to every one, a manifestation of energy—a mode of motion, so to speak." He leaned back in his office chair and watched the ringlets of smoke from his cigar float away toward the ceiling. In a few moments he continued: "Yes, that is it, a mode of motion, akin to light, heat, electricity, magnetism, gravitation, attraction and repulsion; it is, an as not yet understood, co-mingling of atomic matter, and know what life is until we know what matter is, for life and matter are interdependent. They are in themselves not basic, but effects of antecedent causes. The answer to either the question, What is Life? or What is Matter? in the present state of our knowledge can be answered only speculatively. It is my opinion that scientists will have to cease their quest for an explanation of life in the domain of chemistry and mechanics, for this search has so far been fruitless and for the very good reason that life is associated with matter in a way not unlike that by which electricity is associated with a charged body or a live wire. It is in what happens in this vacuum tube, or in the blue flame which just now leapt between these two poles, that we must look for the doorway beyond which lies the source of all phenomena, material and dynamic.

"In order that we may come to a rational understanding anent the problem of life, I would suggest that we begin our investigation at either the lowest depths, or the highest peak which science has reached in its quest after the ultimate truth concerning the physical universe.



"He Walked Across the Room to His Aquarium, and Presently Returned With a Large Living Frog. Holding the Web Of the Creature's Foot, He Showed Me Its Blood Corpuscles Trailing After One Another In Perfect Chains Thru Its Capillary Structures. 'Like the Granules,' Said He, 'It Looks As If They Might Be a Sort Of Secondary Generator,—These Blood Cells. They Are Cutting Magnetism, Making Electrons—That's the Business Of Living. Life Is the Process of Generating That Particular Series Of Electrical Phenomena Which Enables An Organism To Survive.' . . ."

what, for want of a better name, may be called the proto-material forces." He paused in his conversation, whirled leisurely around and pulled a switch on a powerful electric transformer connected with an X-ray apparatus. A buzzing noise was the result. A few minutes later he closed another switch and a blue flame, or spark, leapt across a gap between two poles six inches apart. He let it flash until a pungent smell reached our nostrils. "Smell that?" he asked, and then, answering his own question, he said. "That is tri-atomic oxygen, commonly called ozone. It is due to a recombination of the oxygen atoms in the air, consequent upon a stream of electrons or, as they might be called, ether vortices, passing thru it."

Running his fingers meditatively thru his hair and methodically flicking the ashes from his cigar, he continued: "I have come to the conclusion that we will never

WE have in the past publisht a good many scientific stories which not only have been a source of enjoyment to our readers, but which have instructed them as well.

In the present story, Mr. DeQuer has managed to put into his story an unusual amount of scientific wealth that will be greatly enjoyed by everyone in quest of scientific knowledge.

As a matter of fact, Mr. DeQuer has come closer to explaining in popular language what electricity really is than any writer we know of.

While we personally do not endorse Mr. DeQuer's explanation of life, we think our readers nevertheless will find the story highly interesting.—EDITOR.

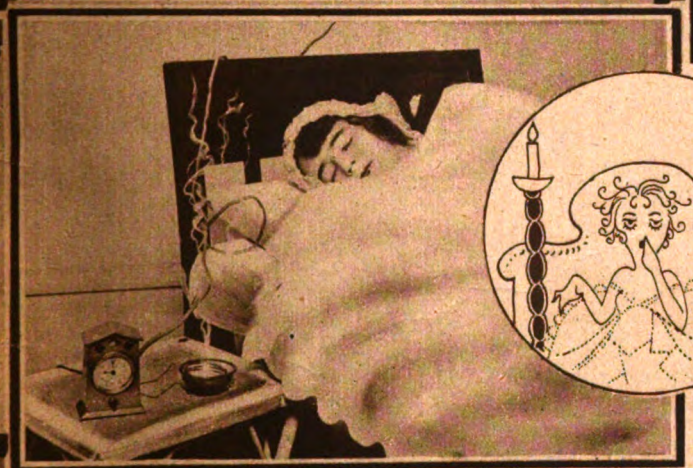
"The heights are approached by ascending the following steps. First, we deal with solids at ordinary temperatures. Notice, I say ordinary temperatures, for if we reduce the temperature, we follow the descending scale in which water solidifies into ice and ultimately air becomes fluid and perhaps, as we approach absolute zero, solid. But we are discussing the ascending scale. When we increase ordinary temperature but a few degrees, water turns to vapor and ultimately to gas. Increase the temperature still more and one after another the metals liquefy and ultimately, if the temperature is still further increased, volatilize and become gas. This law is like that of the Medes and the Persians, unalterable. It postulates that the physical state of matter, whether solid, liquid or gaseous, depends upon temperature. Many concrete things in nature obey this law. Such have their melting, boiling,

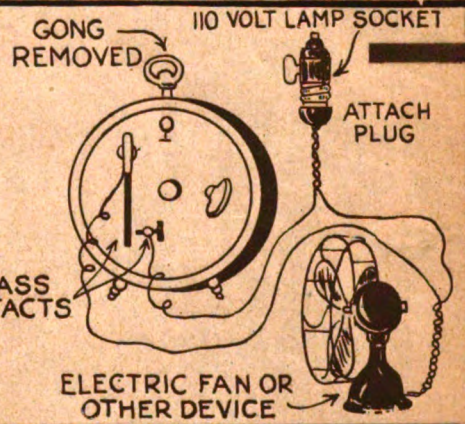
(*Continued on page 793*)

Awakening "de Luxe"

Not Pleasant, But Surely Effective, Is the Vibrator Method Of Awakening—a Clock Attached Properly To An Electric Vibrator Which Is Clamped To the Bed Will Waken the Most Scandinavian Farm Hand.

Sea Breezes Electrically Produced By An Alarm Clock and An Electric Fan Make One Especially Happy and Agreeable the Remainder of the Day.

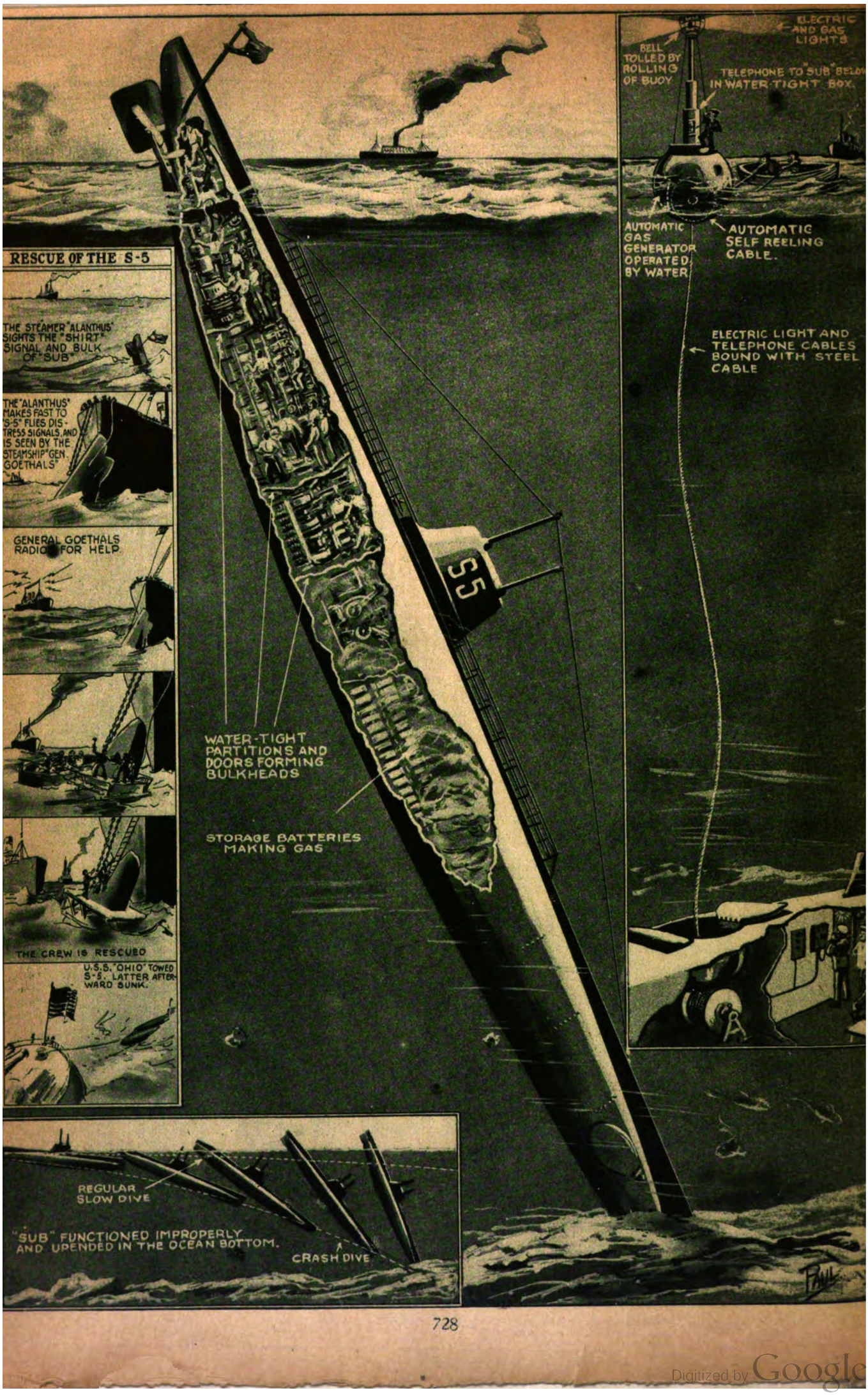




The Sense of Smell Is An Ideal Route By Which To Waken. A Clock Properly Connected to the House Current and Also To Incense Coils, May Be Electrically Started In the Morning So That One Is Wakened By His Favorite Incense.

An Electric Light Thrown In the Eyes Is a Pleasant Way of Being Awakened. A Little Clock Can Be Easily Connected To the Light. For Night Nurses, This Method Is Especially Good, As There Is No Noise In Connection With It To Awaken the Patient.

Let Music Waken You By Attaching To the Phonograph This Little Clock. It Has An Arm Which Releases the Record At a Predetermined Time.



When The "Sub S-5" Sank

Why Science Failed to Indicate the Plight of the S-5

LIEUT.-COMMANDER CHARLES M. COOKE, commander of the ill-fated "S-5," the submarine in which he and his crew were imprisoned for thirty-seven hours at the bottom of the sea off the Delaware Capes, gave the following vivid account of the disaster:

"We left Boston on what was to be a twenty-two-hour endurance run to Baltimore. On Wednesday, shortly after noon, in the ordinary routine of practise, the signal was given for a crash dive. We were about fifty-five miles east by south of the Delaware Capes. The "S-5" is to be suddenly submerged.

"The tanks were flooded, elevating rudders set at a slight diving angle and we commenced the dive. The vessel seemed to take to her new inclination with more than usual speed. In a moment one of the men from forward ran into the central compartment and reported the torpedo compartment was flooding. Water had also been made from overhead aft, and I realized that the forward induction vent had not been closed when we submerged and that we were being flooded thru the ship's ventilating system.

"I gave orders to close the valve, but attempts to do this had already failed, the volume of water entering preventing the men from operating it.

"This all was a matter of very few seconds.

"The vessel now inclined at a steep angles, despite the rudders being put at hard rise,' and in another moment the bow struck bottom with a shudder that ran thru the ship. The conning tower depth gage showed 170 feet.

"The men under Chief Gunner's Mate Fox were ordered from the torpedo compartment and the bulkhead doors between that and the battery compartment next aft were secured. There was already considerable water in this second compartment.

"Several tons of water rushed forward against the forward bulkhead and also what loose gear there was dropt down about us in an indiscriminate heap. The door between the central control compartment and the engine room had been closed, separating the engineering force and Lieutenant Fisham. The main pumps of the vessel were now put to work, but owing to the angle of the vessel, the gear about the suctions and other causes they availed nothing.

STORAGE BATTERY CAUSES CHLORIN GAS FUMES.

"The inclination of the vessel caused the electrolyte solution to pour from the battery jars, and this, now mingling with the bilge water rolling about the battery compartment, began to generate strong chlorin gas fumes which began to smoke and gag the men in that compartment and with me."

Professor T. O'Conor Sloane thus explains the action whereby poisonous gas was produced on the submarine "S-5."

"The batteries on the submarine 'S-5' were lead plate storage batteries. In the charging process the positive plate becomes coated with lead peroxide, produced, as batteries are now made, from the paste of red lead oxides, which is applied to the plate in the process of construction.

"In the forming and in the subsequent charging, the lower lead oxides on the positive plate are changed to the higher oxide, lead peroxide, PbO_2, and the plate assumes a chocolate color. Lead peroxide has two atoms of oxygen in the molecule, where the protoxide or litharge has but one.

"If hydrochloric acid reacts upon lead peroxide, chlorin is set free with the formation of lead chlorid; the liberation of free chlorin is due to the extra atom of oxygen in the lead peroxide molecule. When sea-water gets into a lead plate storage battery the sulfuric acid reacts upon the salt (sodium chlorid) in the water forming sodium sulfate and setting free hydrochloric acid. This reacts as described above, and chlorin, an irritant deadly gas of intolerable odor is generated. A small percentage makes air non-respirable. It can be guarded against by gas masks. Chlorin was one of the first poison gases used in the World War.

"In charging a storage battery, hydrogen gas is evolved, especially in the latter stages of the charging. Not only does this evolution affect the atmosphere by carrying sulfuric acid spray into it as the bubbles burst, making it very irritating, but if enough gas is evolved with insufficient ventilation, an explosive mixture of air and hydrogen is formed, which will be exploded by a lighted match or other flame.

"There have been some very bad explosions on submarines due to this cause.

"In the submerged submarine 'S-5' the crew suffered from chlorin gas and seem to have had no provision against it effects."

Commander Cooke continues:

"The battery compartment was abandoned, the water-tight door closed and efforts bent to open the engine room door against this head of water. We were in speaking communication with the after part of the vessel and with the co-operation of the engine room force the door was pusht open, several tons of water pouring down over the men in the central control room.

"This was several hours after the accident, and thru the good work of electricians the lights, tho diming, were still in commission. The men were all moved aft, which meant climbing hand over hand thru the ship, and the engine room door was again secured, shutting off the flow of deadly chlorin gas, and placing the whole crew in the three after apartments; the engine room, the electric motor room and the tiller compartment at the extreme stern.

"Knowing the depth of the water, I assumed there might be a reasonable chance of the ship's stern protruding above the surface, and, with that in view, the outside skin of the vessel was carefully sounded. We heard the waves lapping the side a few feet from the stern, and to prove our conclusion got a breast drill and a small bit and drilled an eighth-inch hole.

"All our strength was then directed to cutting out a hole thru the skin of the vessel with the tools at our command. Breast drills and ratchet drills were brought up from the engine room, and in the narrow space of the tiller room the men fought like heroes for their freedom and lives.

ELECTRIC DRILL SHOCKS CREW.

"To expedite the work, to which had been added cold chisels, hack-saws and hammers, a heavy electric drill, boring a three-eighths-inch hole, was brought into play. The men were all in soaking clothing and all of the power circuits that still worked were badly grounded.

"When the current was turned on the drill a large part of the power past thru the body of the man operating it, knotting his muscles, binding his arms to his side and subjecting him to excruciating agony. The men did not falter, one after another taking up the slow work, and held in his place by companions. This drill bored only four holes, working all Wednesday night. They were cut thru by saws without handles from one to another.

"At dawn Thursday as I worked at the hole, I saw a vessel pass some distance off, but did not notify the men, as it would have done no good. By that time we had a jagged triangular hole some six inches by five, shaped not unlike a high shoe cut thru the ship's skin.

"The men were by this time almost exhausted and, due to the vitiated air, could work only in one or two-minute shifts at the hole. Work was kept on, however, and a watch at the same time was kept for ships, two more of which past in the morning, but too far away to notice us for more than a piece of floating wreckage if they saw us at all. The hole did not relieve the bad air, very little air coming in, the bad air merely passing out.

PIECE OF CLOTH THE SIGNAL THAT BROUGHT HELP.

"A sailor's undershirt was rigged on to a length of brass pipe and put out thru the hole as an improvised distress signal. Toward noon a vessel appeared nearer and nearer, and our shirt was waved vigorously, using the pipe as a lever and the hole as a fulcrum. The ship moved toward us, apparently to investigate us, and as she neared I pulled the signal violently in and out and finally shouted with all the strength that remained. The ship, which afterward proved to be the *Alanthus*, came quite close, changed course suddenly and finally past out of sight ahead.

"After what seemed an interminable length of discouraging wait the *Alanthus* again appeared quite close and around our stern and the men's spirit revived. Presently we got a hail which we answered, and a boat came alongside. I talked to the men thru the hole and told them our situation.

"They brought water in buckets from the *Alanthus* which was poured thru the hole with a funnel and caught by us inside. The *Alanthus* then crept up close to us and Captain E. C. Johnson assured our upright position by making cables fast to our stern which were drawn up tight.

FRESH AIR PUMPT IN THRU HOSE.

"A wash-deck hose was raised to one of his deck pumps, led thru the hole and forced pure air down to us. This in a short time had a revivifying effect on the men who at this time had had nothing to eat or drink in about twenty-eight hours.

"A staging was floated alongside our stern and the *Alanthus* attacked us from the outside with what meagre tools she had for that work. Then the Pan-American liner *General George Goethals* came up and reinforced the Alanthus. Chief Engineer W. R. Grace of the *Goethals* brought over cold chisels, drills and hammers. This was Thursday evening.

"Mr. Grace worked himself at breast drills and chisels continuously for eight

(*Continued on page 786*)

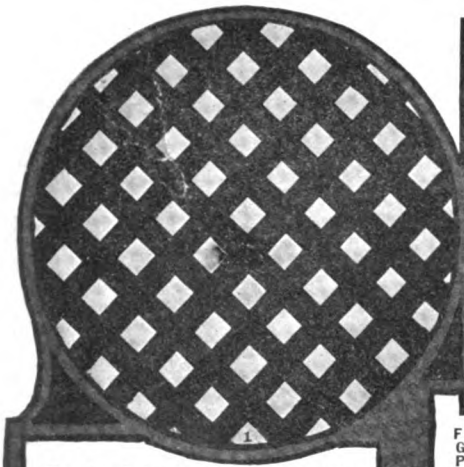


Fig. 1. Enlarged Section of a Half-tone Screen Placed in Front of the Photographic Plate to Break Up the Picture Into the Dots Composing Half-tones.

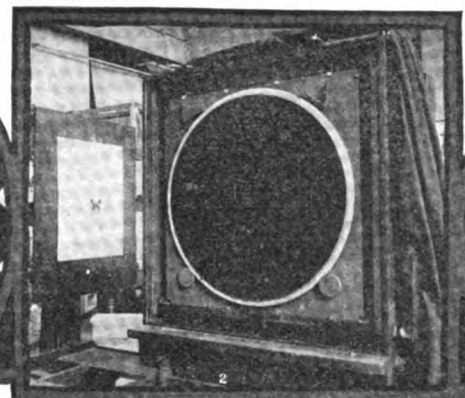


Fig. 2. This Shows the Rear View of the Giant Camera With the Half-tone Screen In Position Ready to Photograph the Subject, but Without Plateholder.

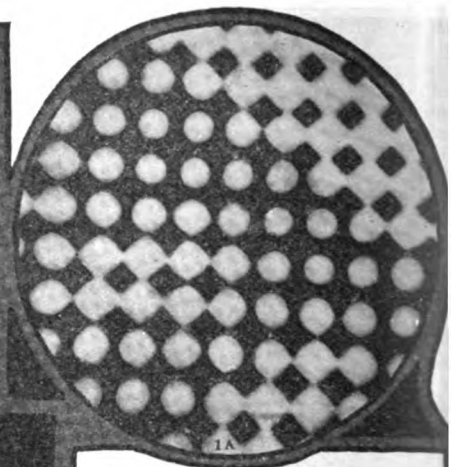


Fig. 1-A. This Shows a Microscope Enlargement of a Section of a Half-tone Negative.

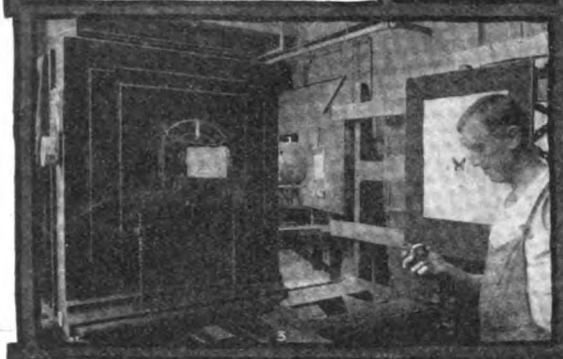


Fig. 3. View of Front of Camera Taking One of the Color Negatives of the Present Cover Subject. A Prism Is Used to Reverse the Image.

Fig. 4. A General View of the Vacuum Printing Frame for Holding the Object, and Electric Lamp in Operation Making the Print.

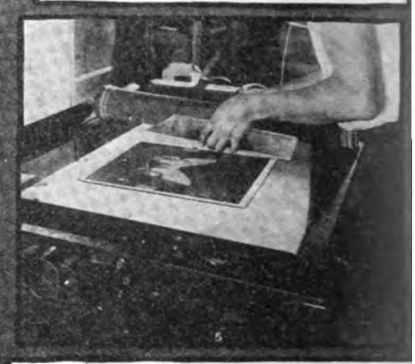


Fig. 5. Showing the Operator in the Act of Laying Sensitive Copper Plate on the Photo Negative. The Two Are Firmly Established in Contact by a Vacuum Pump.

What Makes A Magazine Cover

By CHARLES A. GROTZ*

THIS should be an absorbing subject to all who are interested in Art and Science. Thousands of people buy magazines month after month and look at the beautiful covers, but very few know what process is necessary to produce a million copies for an issue and all exactly alike.

THE CONCEPTION OF THE COVER DESIGN.

The first conception of a magazine cover is evolved from the mind of the Editor or Publisher. He must convey his idea to the artist, who makes the original painting. Especially in the case of a cover like that of SCIENCE AND INVENTION it is sometimes difficult to convey to the artist just what is in the mind of the Editor.

After the cover design is finally satisfactory to the Editor, it goes to the Photo Engraver where it starts its journey thru a process which is a combination of both Art and Science. This process is based on the fundamental principle of the three primary pigment colors in nature; namely, *yellow, red,* and *blue.* If these colors could be used absolutely pure, i.e., a yellow slightly toward a chrome, a red of a magenta shade and a greenish shade of blue, any color in nature could be reproduced by superimposing or mixing. For example, let us take our primary colors and mix them to secondary colors. If you superimpose yellow and red full strength, you get orange, yellow and blue produces green, and red and blue produces violet. These are called secondary colors, and with the different proportions of primaries you get the various shades of secondaries, such as scarlet, yellow green, blue green, various shades of purple, and if *all colors are superimposed* full strength, *you get black.*

THE FIRST STEP—COLOR PHOTOGRAPHY.

The first step in the reproduction is Color Photography. Here the "copy" is photographed on special color-sensitive plates thru *color filters,* which retain the particular color value wanted. These filters are orange, green and violet. These are the secondary colors which we get by mixing two primaries together, and if you will remember that all three primaries mixed together produce black, you will understand that, if, for instance, an orange filter is placed between the lens and the sensitive plate, the missing primary is blue and since blue and orange make black and a photographic plate is not sensitive to black, we are able to suppress all the blue values in the original drawing, while all of the red and yellow values will come thru and act on the plate, thus producing the *blue value negative.* If we use the green filter the missing primary is red, we produce the red value, and if we use the violet filter we produce the yellow value.

Now we come to another important feature in the photographic department, namely, that the negatives which we make must not only be color values but also what is known as "half-tone" negatives. We n now understand that we are making pl to be printed on typographic presses, since this method of printing will not us any intermediate tints, but only so it is necessary for us to obtain negat made up of dots or lines, the gradation ing produced by the dots being larger smaller. The larger dots naturally c more color than the smaller ones, so are able to get all the gradations of original. The large reproduction on cover illustrates this very well.

These half-tone color negatives are n by placing a screen or grating in fron the sensitive plate, so that when mal the exposure the light travels thru the l then thru the color filter which is us directly back of the lens, and then the screen to fall upon the sensitive p These screens are made up of parallel ings on glass. Two such rulings are mented together at right angles to other. This forms little square clear p on the screen thru which the light travel. Now the screen is not placed contact with the sensitive plate, but a s of about 1/16" is allowed between them when a powerful ray of light such as w come from the white parts of the orig forms a part of the image, the dots made small on that particular part of image while the middle tones are larger and on the shadows there wil little or no action. These screens are in various rulings from as coarse as

* *Of the Trichromatic Engraving Co.*

lines to the inch to as fine as 400 lines to the inch. The finer the screen the better the reproduction, but fine screens cannot be used on coarse newspaper stock so the proper screen must be selected to suit the printing conditions.

Figure 1 illustrates an enlarged section of a halftone screen.

Figure 1A shows a microscopic enlargement of a section of a halftone negative.

Figure 2 shows the rear view of the camera with the screen in position ready to photograph the subject, but with the plate holder not yet in position.

Figure 3 shows the front of the camera in the operation of making one of the color negatives, and here a word of explanation is necessary. It will appear as tho the camera is not pointing directly at the subject to be photographed, but seems to be shooting around the corner or at right angles. You will notice tho that the lens has a right angle prism in front of it, which has the effect of reversing the image on the negative much the same as if you hold a mirror at 45 degrees to the eye. You will be able to see things at direct right angles to your line of vision, but you will also see everything reversed from right to left. A prism is used so that a negative will read right, so that a plate made from this negative will be reversed, and the final print on the paper will thus be right.

OF all the covers we have printed during the past eight years, the present one probably is the most unique as well as the most original and instructive one of them all.

Not only is it unique but—so we have been assured by experts—it is the very first time in the annals of the engraving art that a three color picture has been made in this way.

The large butterfly as well as the small one are both identically the same. Take a magnifying glass and look at the small butterfly—any part of it. You will see hundreds of small dots in yellow, red and blue—the basic three colors used on all colored magazine covers. What you see here with the lens, you see exactly by viewing the big butterfly without the magnifying glass. The large butterfly then is simply an enlargement of the small one, printed so that you may inspect the whole color printing process, as it were, with the naked eye. Then by viewing the big picture from a distance of 15 or 20 feet you will see the colors properly blended just as you see the small one, when viewed normally one foot distant.

Next view the cover thru a REVERSED full extended opera glass at a distance of about three feet. The colors will blend perfectly. You will be surprised at the result.

To make the big butterfly, a set of three-color process plates only one-half inch square was first made. These miniature plates were then enlarged 16 times, which gave us the big butterfly.

The small butterfly on our cover has 133 "dots" to the inch, the big enlarged one has only 5½ dots per inch, a thing never attempted before by any color engraver. The coarsest picture made heretofore had 65 dots to the inch.—Editor.

PICTURE PRINTED ON COPPER.

After the negatives are made and have been finally tested for "register" and approved for proper color values, the job passes to the printing department, where *prints are made on copper* from the respective color negatives. The polished copper plates are coated with a special acid resisting enamel and the negatives are printed by powerful arc lights. This enamel is sensitive to white light and the clear dots of the negative; and these, which are finally to be the printing dots, allow the light to strike the sensitive copper plate, thereby making the enamel insoluble in water. After the prints are made, the plates are washed in running water. This removes all of the still soluble enamel from the plates, retaining only those portions which have become acted upon by light. The copper plates are then dried, after which they are subjected to an intense heat which makes the enamel absolutely insoluble in the acids which are used in finally etching or eating out the copper between the dots.

Figure 4 is a general view of the vacuum

(*Continued on page* 768)

Fig. 6 Left—A Finisher at Work Preparing the Copper Plate for Etching.
Fig. 7. Center—Routing Plates.
Fig. 8. Right—The "Proving Department" Where the Color Plates Are Printed.

Fig. 9. An Enlarged Sectional View of a Halftone Printing Plate. Various High Lights in the Shadows Are Obtained from Various Changes in the Size of the Dot, the Pitch of the Lines Remaining Constant.

Fig. 10. This Represents One of the Three Small Color (Yellow) Plates Used in Printing the Small Insert of the Butterfly on the Front Cover (Left).
Fig. 11. The Second or "Red" Plate. Fig. 12. The Final or "Blue" Plate.

Making Life-Like Animated Cartoons

By E. G. LUTZ

Process Described of Making Cartoon Figures That Move Like Living Beings

A NEW screen miracle has recently made its appearance. It is one that is distinctly different as it combines actual photographic views of reality with hand drawn animated figures. To elucidate by an episode of a recent film: The scene opens with the artist seated before his easel; he has just finisht sketching a whimsical little dwarf, a clown, or say, a comical pixie. Next, when the artist is called away from his easel this graphically rendered pen and ink pixie suddenly gives a slight tremor as if a vital force were agitating his body. Then he moves his head, shows a slight bewildering expression, bends a knee, moves his leg and wiggles his toes, and still further shows by his pleased countenance that he is surprised and delighted in being alive. Soon he tries his other limb and with a preliminary essaying of his joints walks off the paper to the cross piece of the easel along which he runs to jump to the arm of a nearby chair. Here, after first going thru a litle comic pantomime as if he were about to lose his balance, he proceeds to clamber down the side of the chair to the floor. Mind you he is the work of the artist's hand rendered in pen and ink and the background over which he moves is a photograph of reality, a somewhat mysterious procedure. We all of us know how the ordinary movie is made and the methods of creating animated cartoons no longer puzzle us. But how are the two combined?

Continuing the recital of the pixie's adventures, we discover him, no higher than the wainscoting, running along the floor close to the wall. As he approaches a table he climbs up a leg, scrambles to the top and then getting into some sort of mischief is scared and jumps to the back of a chair and then down to the floor again. His capers, as the story is prolonged, is only limited by the artist's powers of fantastic invention.

One of the things in a film fantasy of this sort that is noticeably different from the ordinary animated cartoon is the quality of the action, or animation, of the figures. It will be observed that they proceed in movements somewhat naturalistic,—photographic in fact, and yet the figures are drawn. That the aid of the camera was brought in to effect this is a safe conjecture as the movement is so life-like. This being so, the business of the remainder of this article will be in explanation of how it is accomplisht.

The story of a cartoon comedy is at first, of course, all planned in the manuscript, with the whole series of pantomimic action pretty well considered in detail. We will in our explanation confine ourselves to one incident only of this action and try to describe its working out from the beginning to the termination of the work when the film is ready for screening.

First a boy is found whose body proportions are those that we generally consider as proper to this imaginary creature, the pixie. That the boy be costumed as a pixie is not essential but if his dress comes near that of the little fantastic figure so much the better. Now this boy is placed before a movie camera and told to go thru the action phases wanted. He is to act, for instance, as described above,—the tremor as he feels the coming to life, the walking across the easel, jumping to the arm of the chair, his antics there, and then the sliding to the floor. It is all very simple, in the studio he merely walks along some timber placed across two boxes, jumps to the floor and goes thru a few queer postures there. For the clambering down the side of the chair, he is told to make his way down a pole in the studio, or perhaps to clamber down a tree trunk out in the open.

During all this performance the camera has been working and the agile boy has been taken on a film in the customary mode of studio procedure with the resultant negative used to make a positive print that could be projected on a screen in the usual method. But the positive is not used this way, instead it is threaded into the gearing of a patented apparatus for making drawings for cartoon films. This invention, that of Mr. Max Fleischer, is a machine by which he carries out a part of the work to produce his cartoon comedy of the clown that is drawn, dip by dip, from the inkwell, and then gambols and romps all over the screen, and as a punishment for some mischievous trick is poured back into the inkwell again. This arrangement of Mr. Fleischer consists of a projector that throws a film image upon a ground glass where it can be conveniently observed and traced. One of the features of this invention provides that only small sections—the miniature photographs—move slowly into place one at a time and not intermittently and rapidly as in the screen projector. When the film depicting the consecutive movements of the boy is placed in the machine, the artist with a sheet of paper over the ground glass traces the first position, then he operates the mechanism that moves the film and another phase of the movement is imaged on the glass which is also traced on another sheet of paper. This is followed by the third position and its tracing on a third sheet of paper. The rest of the film with its miniature photographs is proceeded with in precisely the same way until all of it, or selected parts, have been traced.

Perhaps you have seen one of the latest cartoon movies wherein the movements of a comic figure drawn by an artist are combined with a photographic view of a real object. The effect is very puzzling indeed, and the editors have been greatly interested in this development of animated cartoons—so much so in fact, that they have prevailed upon Mr. E. G. Lutz, a well known producer of this class of motion picture subjects, to write the present article describing how the trick is done.

Mr. Lutz is the author of the authoritative, and only book dealing with this subject entitled, "Animated Cartoons."

As the boy wore only ordinary dress, the artist changes his little sketches to conform to whatever style of grotesque array he has decided for the character. All this seems like going to a great deal of trouble involving an immense amount of labor, but when it is remembered that the most vexing matter in animating is sketching the sequence of poses that give the screen illusion of movement, this method solves a big problem for the artist. It becomes merely mechanical "copy-work"—and more important—the action is absolutely life-like.

Now that we have a complete set of drawings for the depiction of our particular pantomimic action, the next step is that of procuring the background. For this an ordinary photograph, a "still," of the easel chair, and surroundings is made of a size to fit the field of the animator's camera. This is put in its proper place and the photographer gets ready to arrange the series of animated pixies in their positions over the photograph. But the drawings that have just been completed are on paper and as that is more or less opaque, are of no use here as the opacity hides the photographic details. Had they been made on tracing paper, they would have been nearly available. Tracing paper was, in fact, what Mr. J. R. Bray, preferred and used in making moving pictures by his patent process of 1915. But tracing paper is translucent and only moderately transparent, and so has been discarded for celluloid. This material is now in common use in the craft.

The next step is that of re-tracing all the pixie figures on the surfaces of sheets of clear celluloid. This material, on account of its transparency, enables the artist to locate the exact positions of the sequence of drawings over their corresponding details of the photograph. After the tracings have been made in ink on this celluloid the outlines are filled in with paint,—white, or black, or gray, just as the artist wishes.

Now the artist, provided with a consecutively numbered series of celluloid sheets holding drawn figures, and a background consisting of a photograph of the easel chair, and surroundings, is ready for the camera work. In following out this he proceeds by putting the celluloids one at a time over the background as he turns the camera handle for the exposure. At the termination of this work, and that in the laboratory, he will have a positive film that when projected shows a pen and ink pixie going thru a series of actions over a photograph of reality.

Supposing, now, as an example of another kind of cartoon, that the desired effect is one showing an imaginary drawn character performing with a living creature? The making of this is easy to describe but an exceedingly laborious process to carry out. The pixie, as an illustration, is to jump on the back of a sleeping cat, who is to leap up and run across the room with the pixie perched like a dare-devil cowboy on his back. To bring this about a cinematographic negative is *taken of the cat* performing through the performance of jumping up and running across the floor. From this negative a certain number of enlarged photographs are made of a size to conform to that of the field under the animator's camera. This seems like a pretty big job, but as the action takes place rather rapidly, requiring only about five feet of film, and but every other photograph selected, it means only about forty photographs. These are used in the same manner as the artist uses his animated drawings, placing them in their numbered order under the camera and photographing them. The little pixie figures are made in a similar way as those for the scene with the easel. That is, drawn on celluloid, or perhaps cut out as paper dummies, and fitted in their proper places over the photographs. The result on the screen is that of a blended animation of photograph and drawings giving one a very puzzling illusion.

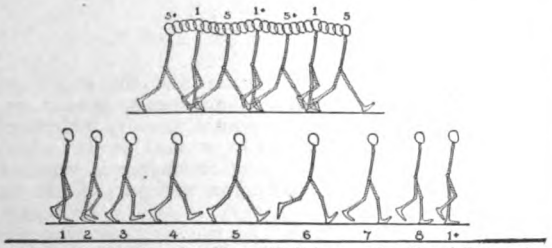
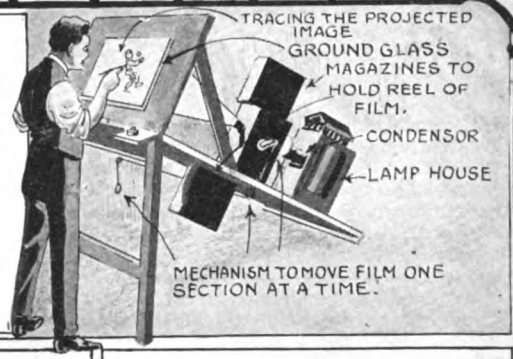


Diagram Study of a Man Walking,—the Head Describes an Undulatory Wave Motion as Is Made Evident.

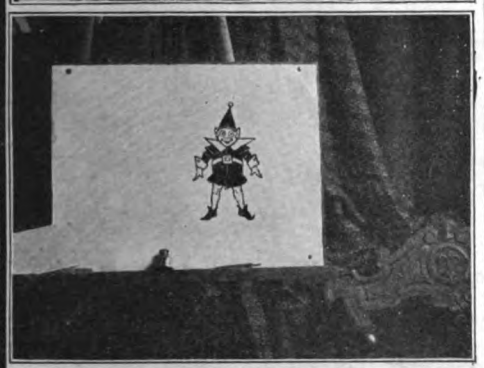
Projection Machine Specially Devised for the Projection of Animated Cartoons. A Person Is Photographed with a Movie Camera; the Positive Film Is Then Projected on a Screen and Then Drawn.



In the Six Pictures Above, We See One of the Most Important Stages in the Development of the Animated Cartoons Here Discust. The Three Top Poses Are Sketched by Means of the Projection Machine Shown Above, and Later the Three Lower Drawings of the Pixie in Costume Are Drawn on Celluloid Sheets Placed Over the "Action Drawings."

The Pixie or Other Comic Figure Is Drawn on a Celluloid Sheet, Which Is in Turn Placed Over an Actual Photograph of the Easel and Chair, as Shown at the Left.

In the Left Center Picture We See the Pixie as Photographed by the Movie Camera and Represented as Standing on the Artist's Drawing Board, Just After the Artist Has Completed the Figure and Has Laid Down His Pen.



In the Lower Left Hand Picture We See a Progressive Stage of the "Movie,"—Here a Celluloid Sheet Containing the Pixie Is Placed Over the Photograph of the Easel and Chair and in This Particular Position We See the Pixie Walking Toward the Leg of the Easel.

The Top Right Hand Picture Shows the Pixie (Drawn on Celluloid Sheet) Starting to Climb Down the Leg of the Easel. The Edge of the Celluloid Sheet Can Just Be Discerned, but in the Actual Movie This Is Hidden So as Not to Show, Leaving the Spectator Wondering How It Is All Done.

A Still Later Stage of the "Pixie and the Ink-Bottle" Adventure—the Pixie Here Being Shown Half-Way Down the Easel Leg. See Center Picture at Right.

Lower Right Hand Picture Shows the Pixie After He Has Slid Down the Easel Leg and Standing on Cross Bar, About to Jump to the Arm Chair.

Why We Remember Things

By William M. Butterfield

THE remarkable power of the mind to recall events, vividly portrayed, and thus bring to memory people, buildings, landscapes and the like has caused many persons to ascribe the faculty to some superior attribute of man. This is only partly true, for such impressions are caused by mechanical operations that are more or less common with all animals. To describe the hundreds of thousands of individual parts in the sense organs and brain, responsible for any mental sensation or impression had by an individual, and thus to make these mechanical operations clear to the reader, is, of course, impossible in a popular article of this kind.

Let us, therefore, consider this interesting subject in a less ambitious way. We will suppose, for the sake of illustration, we know of a person born without taste, touch, sight, hearing or smell. Such a misfortune will, perhaps, if we visualize such an individual, make us realize that sensation is really the part of our physical machinery that provides us with our understanding, or knowledge, as it is called, of the world around us. A very little consideration will demonstrate that a person without sensation can have neither impression, thought or recollection of the world or of themselves, for we shall find that we know nothing whatever of our own inner body, and that all of our knowledge, such as it is, *is of things outside of it,* hence, every bit of knowledge, thought, or recollection, must have come to us, or have been received by our senses.

The senses, therefore, in a separate, machine-like way, convey impressions to the brain, where other operations make records in a rather mechanical manner of each delivered message. In this fashion, ideas are formed of things, events, or of facts that are reached by the senses of the individual. To illustrate, let us take a rose; one learns its shape, color and size by the sense of vision, its odor by the sense of smell, and its texture by the sense of feeling. The original impressions, which are recorded and thus form a part of our knowledge of the flower, are said to be spontaneous, and the storage of all such ideas in this manner, spontaneous knowledge.

The storehouse of ideas we call the mind is situated in the brain, and it is plain to us that some form of mechanical fixing process must take place here to establish the above association of impressions, thus to enable us to know a rose when we see one at some future time. Indeed, such a development we know occurs, and the recalling of the spontaneous impressions, in part or whole, is what constitutes memory. Memory, when thus aroused, is said to be normal, but when an event or an act is recalled by an effort made for the purpose, it is recollection.

Let us observe a sense impression at work. We will take sight, the sense most responsible for the development of mind. In the drawings which we have prepared we show a dramatic incident in the life of a woman, seen in an attic store-room in the act of recalling the bygone drama shown in the opposite panel. The incident portrayed was an actual one in which two young people played their parts before the eyes of the young man's mother as she stood, paralyzed with fear, in an upper window of her home situated a short distance from the scene of the romantic adventure. In the center panel we show the mechanical operations that develop a spontaneous or original impression.

In early life most of our impressions are spontaneous, for the mind and body are developing together, and the ideas obtained, varied and undevelopt as they may be, form

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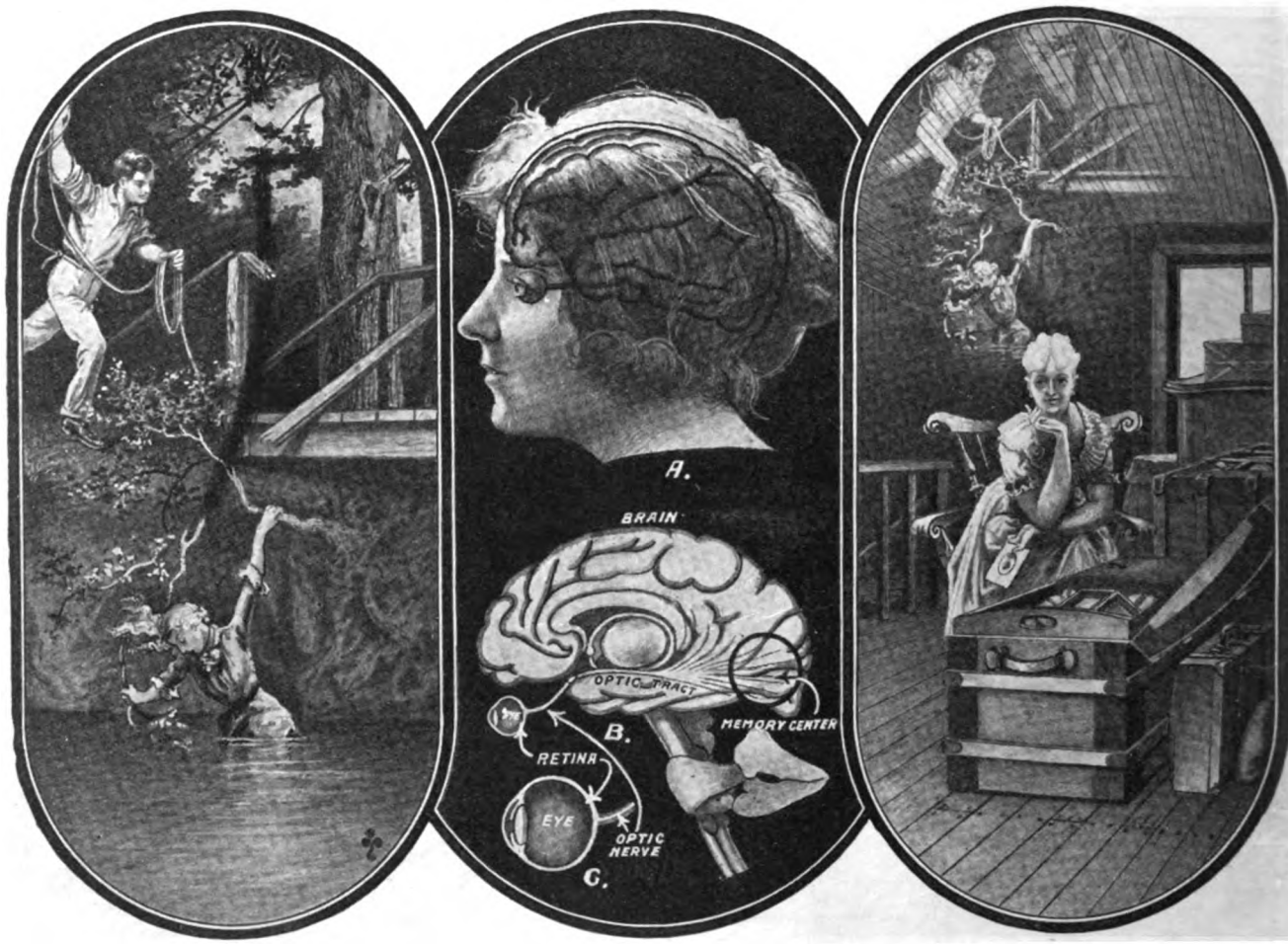


Recalling an Incident Which Happened Years Ago, Is Very Complicated When One Considers the Changes Necessitated in Impressing Such an Incident Vividly Upon the Recipient. The Accident Shown at the Left in the Above Diagram, Is Transmitted Thru the Lens of the Eye to the Retina, Where by Means of the Optic Nerve Tract, It Announces the Scene to the Brain. Here Various Nerve Fibers Transmit the Impression to the "Memory Center," Where Years Later It May Be Unconsciously Recalled, or Also Recalled at Will. What Changes in the Nerve Cells in the Brain Take Place, or How These Record, Is the Subject of Much Experimentation and Investigation. As Yet Nothing Definite Has Been Ascertained.

What Your Hands Reveal

By DR. W. de KERLOR

DID you ever stop to think that the hands by their shape, their motions, their lines and the thumb in particular formed an invaluable index to a Man's Heart, Mind and Soul?

Did you experience the feeling of warmth, truth and kindliness that came over you while you held a broad, masculine and substantial palm in your grip? And on the other hand, did you not get a feeling of reprehension or disgust when shaking hands with a "clammy," lifeless hand, very much like a dead fish's tail? Hands, like faces, have their own individual power of expression. They are the revealers of that mass of impulses which animate our unconscious selves. From cradle to grave, our hands instantaneously obey every thought of our brains, even before these thoughts have been grasped by other senses.

The new born babe instinctively pushes its fingers into its mouth, even before it utters its vocal protest against the pangs of hunger. It is unable to control the action of its hands when it attempts to grasp the objects it sees, for the simple reason that its sense of sight, here, interferes with the direct inspiration from the brain. And at the approach of death, the first signs to the watchers at the bedside that life has departed lie in the action of the thumb. Man in the primitive state used his hands to communicate with his fellows, even as savages do to-day. Before his invention of words, he invented the "language of gesture." A remnant of this is to be found, at the present time, in the Roman numerals I, II, III, IV, etc. In the early days of Civilization, when man lived closer "in tune" with Nature than he does at present, he expressed himself accordingly. He may, or may not have noticed the "falling-in" of the thumb at the approach of death, but at any rate he seemed to have observed the phenomenon, for in later years, as among the Romans, he used the gesture of "thumbs up", or "thumbs down" to express his defiance or to acknowledge his subjection when vanquished.

A celebrated divine, once called upon to give his definition of a Man, replied: "A man is a being capable of walking erect upon his hind legs, and possessing the prerogative of a Thumb." And, indeed the Thumb is the one distinctive mark which differentiates Man from the brute.

THE ART OF GESTURE.

The art of gesture, employed by the Greeks of three thousand years ago, placed them for all times as the greatest exponents of Art. They understood the potentialities of "hand postures" as a means to express grace and beauty of movement in the relationship of everyday life. As a matter of fact, all of the drawings left by the early Egyptians upon the walls of their Pyramid chambers and Temples express a far deeper meaning, based upon psychological mysteries which escape our understanding to-day.

Really, it must be confest that the Ancient Civilizations knew far more about the psychology of the hands than ourselves. Their writings are replete with references to them, both from the medical, psychological and prophetical points of view. The Mystery of Human Nature is and will always remain the most fascinating of studies; and any form of science or art which will bring us to a closer understanding of its hidden recesses cannot fail to be welcomed.

There are already many medical men who, to-day, use the human hand as an index to diagnosing the patients' inherent diseases. For by the formation of the nails, the finger joints, the skin, the red or white blotches formed upon the skin of the palm, as well as by the shape of the fourth finger they endeavor to ascertain the various tendencies to which man is liable. Paralysis, *locomotor ataxia*, throat and bronchial troubles, consumption, rheumatism, nervous ailments, blood disorders are now diagnosed from the hands. So much for the physical aspect of it. This aspect. alone, if fully described would fill a whole volume.

Th psychological aspect is that which interests us here, however, and upon which I shall dwell more fully.

Your Hands An Index to Your Mind and Life's Events

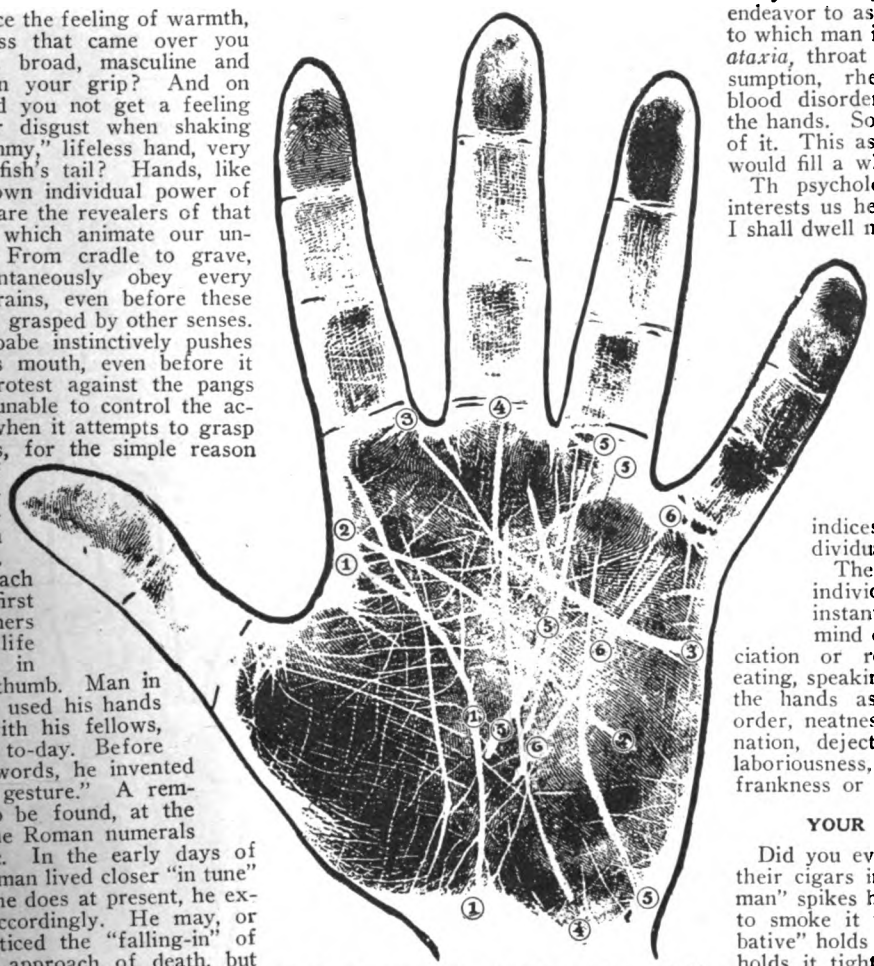


Chart Showing the Principal Lines of the Human Hand and Their Significance: 1—Vital Line or the Line of Vitality; 2—Cephalic or Head Line; 3—Cardiac or Heart Line; 4—Median or Fate Line; 5—Annular or Fame Line; 6—Auricular Line, Also Called the Literary Line.

The study of the hand is divided into three distinct phases:

First. Its motions as an index and in relation to the unconscious expressions of the Inner-self.

Second. Its formation as guide to health, temperament, character, and latent faculties.

Third. The structure of the lines upon the palm as indices to the evolution of the Individual Life.

The use and motions which an individual makes with his hands will instantaneously produce, in the mind of the careful observer, appreciation or reprobation. While working, eating, speaking, smoking and even sleeping the hands assume attitudes that convey: order, neatness, disorder, laziness, determination, dejection, refinement or vulgarity, laboriousness, self-control, nervousness, frankness or insincerity.

YOUR CIGAR BETRAYS YOU

Did you ever watch how some men hold their cigars in their hands? The "stingy man" spikes his cigar on a pin or toothpick, to smoke it to the last puff. The "combative" holds it in his fist. The "secretive" holds it tight. The "loose tongued" holds it by the tip of his fingers. The "bluffer' and self-contented holds it by the length of arm and fingers, in the intervals pulling large puffs from it.

Nationality above all things can be easily recognized in the gestures of the Italian banana-peddler, as in the east-side Jew of the "three ball" avocation, the Scotchman by his soberness and closeness of motion and the Irishman by his exuberant gestures. So also the Frenchman, and who cannot recognize a German a mile away by his "strafing," wave-like motion, and a spit on the ground, accompanied by his *"Schweinhund"* guttural.

Women of the Madonna, Sappho, Bacchante, Butterfly or Vampire type, each have typical motions and expressions of hands. Each bear their own stamp of vice or virtue, which make them an easy mark to the observer in drawing room, street car, or office.

The hand of the man "who serves," and the hand of the man "who commands" do not escape detection, either. There is the hand that compels and the hand that repels. You can "spot" them by just observing them.

Hands smooth and velvety to the touch, firm and normally warm indicate youth, health, consistency and fine sensibilities of the heart. Other hands, dry, bony or "raspy" to the touch show the lack of the finer sensibilities, a cold and calculative intellect.

It is thru the hands that the sensations of

A NEW ART

OUR readers are well aware of the fact that a man's character is now revealed easily by his hand-writing, a comparatively recent art. They also know that there is the art of physiognomy. Thus, the general contour and setting of your face, the shape of your skull, your forehead, all reveal the inner man. Our largest firms today select their employées by hand-writing tests, as well as physiognomy.

But did you know that the lines of your hands reveal your character as well? This is now an exact science, of which Dr. de Kerlor has made a life study. The new art has nothing whatsoever in common with palmistry, but is an exact science, just the same as the science of modern finger printing.—EDITOR.

Typical Human Hand with All the "Lines." This Hand Is Remarkable as It Includes All the Classical Lines Well Formed. The Subject Was Born in India, and Had an Unfortunate Love Affair at Twenty-One.

Left Hand of a Chimpanzee "Prince Charles." While the Heart Lines May Appear Human-Like, the Rest of the Lines Do Not Compare in Intelligence.

Hand of a Young Woman Showing Presence of Headaches and Impairment of Hearing and Sight, as Indicated by the "Head Line," Which Is Broken.

Indicating Consumption — Right Hand of a Consumptive Taken Three Weeks Before Patient's Death.

The Typical Hand of Lunacy. Note the Extraordinary Whirlpool Formation of the Lines in the Palm.

The Hand of Dramatic Love Affairs. Note the Small and Wide Thumb; Also the Widely Diffused Lines and the "Head Line" Which Is Far Too Weak to Regulate the Passions.

Right Hand Of the Congenital Idiot. Note the Very Short Monkey-like Thumb, Showing the Lack Of Self-control.

Extraordinary Hand—That of a Poor Girl of the Slums of London, England.

The Hand Of An Extraordinary Man—a Frenchman Noted for His Imagination, Authorship, Daring and Resourcefulness.

The Successful Hand. The Owner of This Hand Made a Fortune Thru the Sale of Inventions of His Own Making. The Successful Hand.

A Remarkable Palm Indeed, That of Mr. H. Gordon Selfridge, of Marshall Fields, Chicago, Who Raised Himself From a $5.00 Per Week Job to a Position Yielding Ten Million Dollars a Year.

Representing the Hand Prints of a Boy Two Years Old, Altho Hand Prints Are Not Always Considered Successful in Children, These Prove Otherwise.

Clear Thinking Is Exemplified In This Palm and Represents the Hand of a Clear-Thinking Man. The Line Formation Shows Inexorable Logic.

The Hand of "Dr." Arthur Warren Waite Who Poisoned His Mother and Father-in-Law for Their Wealth. Note the Short "Head Line" Denoting the Criminally Inclined Mind.

Sun; Newton who discovered the Law of Gravity; the philosophers Kant and Leibnitz; Voltaire "the Father of Revolution", Napoleon; and Washington the general, patriot and president all had big thumbs.

Monkeys have very small thumbs that hardly reach the root of the first finger. In primitive man, the thumb is thick and short. Murderers and criminal inmates have clubby short thumbs. Hence the expression: "a murderer's thumb." Often we hear, also: "he has crooked fingers." In this case it refers particularly to the fourth finger, which when crooked, nine times out of ten, belongs to the inherently dishonest, or crooked. So look out! If you do not believe it you should go and study the fingers of pickpockets, while you have the chance.

"Personal Magnetism," and that our cordial feelings toward our fellow men, find their articulate expressions.

When the palm is thick and hard to the touch it shows a prevalence of coarse instincts, when thick and flabby, selfishness and sensuality. When the palm is, in size, proportionate to the fingers and is firm without much elasticity, it shows: stick-to-itiveness, plodding and dutifulness. When elastic, but not flabby, it indicates: imagination, resourcefulness, reliability; when flabby and moist: laziness, procrastination and all its attending weaknesses.

As a rule you will find that the flexible, elastic hand, thick and warm, reveals a taste for sensuous pleasures, while the firm, hard hand is industrious and active.

When hollow it is a sign of love of action; when too hollow: tendencies to violent temper, and excessive love of arguments. When excessively flat, it reveals the "fatalist," one inclined to be ruled by circumstances without power or inclination to react. There are, however, many exceptions to the rule.

WHAT YOUR THUMB TELLS.

Before completely judging a man's character, you should look at his thumb; for the sign of superiority of Man over Beast is the thumb. And the sign of distinctiveness between man and MAN is their Thumbs. All great men, men of genius, men whose power of Individuality influenced the masses to Thought or Action, had large and powerful thumbs. Galileo, who discovered that the Earth Revolves round the

The thumb being in direct relation with the brain centres of Volition, naturally expresses the "dynamic" force in a man, his Will power. Its length will therefore determine the "quantitative and qualitative" conditions of the Will. The well balanced Will is found in a thumb that reaches the line formed by the first and second phalanges of the first finger. A forceful Will, by a slightly longer and larger thumb, while the very selfish and ambitious-willed man is detected by a thick, fat base of thumb, upon a hard, thick and callous hand. Not until the child develops its own power of Conscious Volition does it refrain from sucking its thumb. Idiots and microcephalics cover their thumbs with their four fingers. Those who have secrets to conceal do likewise.

But the Man of courage, fearlessness, independence of Mind, holds his thumb well out. The mean and timid hold it close to the side of the hand, while the stubborn has it curling back.

THE LINES OF YOUR HAND.

Speaking of—the much misunderstood—lines of the Palm, you will find on examination that approximately 85 per cent of the business organizing minds, clear thinkers, builders and engineers have straight, well defined and unobstructed Cephalic; otherwise called, the "head line." This same line in artists, musicians, actors, authors, orators: people of Imagination-and Moods, is slanting and wavy. Whereas, among the shy, diffident, nervous, deprest and melancholy, this line goes down the palm at a sharp angle. Among the discontented of the "Trotzky" type, the militant suffragette, the revolutionary of the hysterical temperament, the eternally dissatisfied, the "head line" does not only slant downward, at all kinds of angles, but is also intercepted by many breaks and loop-holes.

Where the Mind is untramelled by all kinds of non-essentials; where it is virile, creative and industrious, you will find a palm absolutely free from the cob-webs graven in the palms of the dissipated, the immoral liver, the "worry cuss," or the physically delicate.

The strong and healthy, clear-minded Man has a clearly lined hand. It stands to reason, since it is now a recognized therapeutical fact that Mind rules Matter. The sickly Mind has a sickly Hand, and vice-versa.

Men whose Successes in Life are all of their own making have unusual clear lined palms with forceful thumbs. But the politician or "diplomat" who thrives on the maxim, *divide et impera*, have palms strewn with a maze of detailed lines. They have so many things in their Minds to carry. . . .

(*Continued on page* 790)

Popular Astronomy

By ISABEL M. LEWIS, M. A.

Of U. S. Naval Observatory

Has the Earth an Undiscovered Moon?

SCARCELY a year passes that additions are not made to the long list of catalogued members of the sun's family. Usually the newly discovered body is a small planetoid possibly five or ten miles in diameter picked up by photography at a distance of one hundred million miles or more from the earth. Yet so thoroly does the astronomer canvass the heavens, so powerful are modern telescopes and so highly developed are modern methods of observing that it is probably safe to say that no undiscovered object even as small as fifty miles in diameter exists inside of the orbit of Jupiter or within four hundred million miles of the earth.

Tho the discovery of small bodies in close proximity to the planets is more difficult than the discovery of bodies of the small size against a dark sky, owing to the blinding glare of light reflected from the surface of a planet, extremely small satellites of the outer planets have been discovered close to their primaries.

The innermost satellite of Jupiter (Satellite V), discovered by Barnard in 1892, is only one hundred miles in diameter and lies so close to the brilliant planet (sixty-seven thousand miles from its surface) that it can only be seen by the most skilful observers with the most powerful telescopes. Phobos and Deimos, the two tiny satellites of Mars, revolve respectively 3,680 miles and 12,480 miles from the surface of Mars and it is estimated that Phobos, the brighter of the two, *is only ten miles in diameter.* To discover such a tiny point of light is a far more difficult feat than to find it again when the exact point at which to search for it has been predicted.

It must be remembered that in addition to being close to a brilliant planet the tiny moons of Mars are distant from the earth never less than thirty-five million miles while Satellite V of Jupiter is nearly four hundred million miles away at the nearest approach of the planet to the earth. Phoebe, the outermost satellite of Saturn, is two hundred miles in diameter and it never comes closer to the earth than seven hundred and forty-four million miles. Yet it is observable visually as well as photographically in the most powerful telescopes.

If such minute bodies have been discovered close to bright planets at distances of millions of miles from the earth, what is the probability that a body as small as one mile in diameter would escape the astronomer's watchful eye if it were a satellite of our own planet, Earth?

The power of the earth to hold a satellite against the force of the sun's attraction ceases at a little less than four times the distance of the moon from the earth or 930,000 miles from the earth's center. Beyond this point any object would yield to the superior attraction of the sun and forsake the earth to become a satellite of the sun, thus becoming itself one of the planets.

Now, any object one mile in diameter on the surface of the moon, can be made out with ease even with moderate size telescopes, while in powerful telescopes objects one-quarter of a mile in diameter are distinguishable. At the distance of the moon, then, any object a quarter of a mile in diameter could be picked up against a dark sky with a powerful telescope either by visual or photographic means far more easily than such a minute point of light as the satellite Phobos, ten miles in diameter and some forty or fifty million miles from the earth, bathed in the rays of a brilliant [illegible]net.

Certainly no object within the field [illegible] the earth's gravitational attraction as g[illegible] as one mile in diameter could elude the [illegible]ron-omer's eye under favorable observin[illegible]on-ditions.

An object ten miles in diameter [illegible]ne-half the distance of the moon, or [illegible]000 miles from the earth, would subtend [illegible] an-gle as great as that subtended by the [illegible]net Mars when near its opposition to the [illegible]arth and would appear to be fully as br[illegible]iant an object if viewed at night against a dark sky.

A moon *one* mile in diameter at a distance of 12,000 miles from the earth's center or 8,000 miles from its surface, would subtend the same angle, but it would always be lost in the earth's shadow at night, which at a distance of 8,000 miles from the earth's surface has a diameter only a few miles less than that of the earth itself. Yet when transmitting the sun in the daytime, a phenomenon which would occur twice a year, the little moon would easily be picked up as a black dot on the surface of the sun and it could be found in the twilight hours in low latitudes with the smallest telescopes.

We feel safe in concluding, then, that *there can exist no undiscovered object revolving about the earth as great as a mile in diameter within* 930,000 *miles of the earth's center* which represents the limit of its gravitational field.

There Is Hardly an Hour That Some Meteorites Do Not Fall Upon the Surface of the Earth. Of Course, We Do Not See Them During the Daytime for the Reason That the Sunlight Interferes, but During the Night We Often See Hundreds of Them Shooting Across the Sky, Many of Them Falling on the Earth in a State of Meteoric Dust. It Is Now Thought That These Meteorites Belong to an Old Satellite or Moon of the Earth, Which Broke Up when the Earth Was Still Young. When This Satellite Approached the Earth Over a Certain Critical Point, the Gravitational Tidal Stresses Disrupted It, and the Entire Satellite Was Broken Up Into Small Pieces. These Fragments Then Continued to Revolve Around the Earth in the Form of a Flattened Ring Similar to What Constitutes the Rings of the Planet Saturn Today, Which Are Mute Evidence of Some Former Disintegrated Satellites. Our View Above Shows How This Ring Would Have Looked Somewhere Near the Equator on Our Earth in Pre-historic Times, Looking South

Now there exists a critical point close to each planet's surface within which it is impossible for a satellite to exist intact. For a non-rotating satellite this limit is 2.44 radii of the planet (called Roche's limit L); for a rotating satellite it is somewhat greater as the centrifugal force due to axial rotation increases the tidal strains and causes the satellite to become disrupted at a greater distance from the planet than if it were a non-rotating body. The critical point also depends upon the relative densities of the planet and satellite and upon whether the planet is homogeneous thruout or not. At the breaking point the satellite is drawn out into a prolate ellipsoid of revolution with the major axis about four times the minor axis and satellites near the critical *limit* for their primaries should appear noticeably elongated in the telescope.

For Mars the critical point at which a satellite would break up is less than 2.70 radii of the planet—for Phobos is intact at this distance. For Jupiter the critical limit must be less than 2.55 radii which is the distance of Satellite V from Jupiter. The outer rim of the outermost ring of Saturn is 2.32 radii from the center of Saturn and so it comes well within the critical limit even for a non-rotating satellite.

The rings of Saturn furnish a good example of the dissolution of a satellite into minute meteoric particles and of the symmetrical distribution of the resulting particles in the plane of the planet's equator where the gravitational attraction is greatest owing to the equatorial bulge of the planet which results from rapid axial rotation.

It has been demonstrated mathematically that close satellites and meteoric rings *must* revolve in or close to the equatorial planes of their primaries and that they are gradually being drawn in toward the planets they encircle by differential attraction exerted upon them by the planet. Once inside the critical limit a satellite must be disintegrated into a ring of meteoric particles and be distributed symmetrically about the planet in the plane of its equator. The size of the fragments will depend upon the force of molecular cohesion. Iron fragments would be greater in size than fragments of surface rock for the molecular cohesion for iron is greater than for stony substances. The largest meteorites are for this reason the meteoric irons. Stony meteorites are more easily disrupted by tidal strains.

The majority of the satellites in the solar system *do* lie in or close to the equatorial planes of the planets they encircle. This is true of the two small satellites of Mars, of the five inner satellites of Jupiter (the four outer satellites being extremely small and distant from the planet), of the rings and seven inner satellites of Saturn and probably of the four satellites of Uranus and the single satellite of Neptune, tho the positions of the equatorial planes of these two planets is not known. It is *not* true for our own moon which lies in an orbit highly inclined to the earth's equator but then it is believed that our own moon is unique in its origin owing to its great size relative to its primary, the earth. Certainly in the light of the above facts it is impossible that the moon was ever torn from the side of a fully formed earth—for being within the critical limit at the time of the rupture it would have been reduced to meteoric particles by tidal strains and distributed about the earth's equator in a meteoric ring.

Since all near satellites are gradually being drawn in toward their primaries, Phobos the inner satellite of Mars and Satellite V of Jupiter, which are now close to the critical limits for their planets, will doubtless be ruptured at some future day and gradually transformed into meteoric rings similar to the rings of Saturn. Moreover the rings of Saturn also are being drawn in toward the planet by inter-collisions of particles and tidal forces and are being gradually absorbed by Saturn. It is quite possible that other planets have in the past possessed rings that have been absorbed gradually in the course of the millions of years that have elapsed since the planets were first formed.

Is it possible, then, that the large meteorites that are continually striking into the earth's atmosphere are remnants of a meteoric ring that once encircled our own planet in its equatorial plane? Also, is it possible that a ring of meteoric matter is still encircling our planet within the critical limit at a distance say of 4,000 miles from the earth's surface? If so what are the chances that such a ring of meteoric fragments would be visible from the surface of the earth?

Owing to the curvature of the earth's surface no object revolving about the earth in the plane of its equator could be seen north of 60° North Latitude or south of 60° South Latitude. A glance at Diagram II will make this clear. At 40° North or South Latitude an object in the plane of the equator 4,000 miles from the earth's surface could never appear at a greater altitude above the horizon than 22½° and no object within 1,222 miles of the earth's surface *in the equatorial plane* would appear above the horizon. At 30° N. or S. Lat. an object 4,000 miles from the earth's surface in the plane of the equator would attain an altitude above the horizon of about 36°. At night a ring of meteoric matter, assuming it were existent within the critical limit for the earth, could not be seen because it would lie entirely within the earth's shadow. In the day it would

(*Continued on page 777*)

View of the Planet Earth in Pre-historic Times as Seen From the Moon. This Phase Shows the Earth When "Full," the Sun Illuminating the Entire Half of the Globe. Here We Also See the Supposed Pre-historic Ring Surrounding the Earth, Which Ring Is Made Up of Fragments of a Shattered Satellite, Which Scientists Now Believe Existed When the Earth Was Still Young. This Ring In Time Disintegrated Entirely, the Fragments Falling Upon the Earth In the Form of Meteorites. There Are Still Small Portions of This Ring Left, and From Time to Time These Pieces Fall Upon the Earth and We See Them as Shooting Stars.

Phonograph Prize Contest

IN our July issue, we announced our *Phonograph Prize Contest,* which has now come to a happy conclusion. As is usual with our prize contests, the present one too may be termed a huge success, judging by the thousands of entries received by the Editors. It has indeed been a difficult task for the judges to assign the prizes, because so many real good ideas were received.

As announced in our July issue, the purpose of the contest was to devise something *useful* that can be done with your phonograph outside of using it for playing records. We felt that a valuable machine that is only used at an average of one-half to one hour a day could be used for other purposes as well, and in this, our judgment was right, as is amply proved by the thousands of ideas that flooded our offices. Over 4600 entries were received, and of course most of them were duplications, or ideas that had been publisht and known before.

In awarding the prizes, the judges have been guided mainly by the *utility of the device.* For that reason the first prize was awarded to Mr. Ralph C. Moses, because he showed us how we may construct a simple fan that can be used for various purposes, such as cooling the room, drying your sister's or wife's hair, and other purposes. Besides, it fulfilled our conditions ideally, namely, that the device should be readily attachable to the phonograph without marring it up, or using screws, etc., to pierce the wood.

Right here we would say that many entries were received for fans of a similar nature, but not one of them had the clever constructional features of Mr. Moses' fan, and none were quite as simple and as efficient to the minds of the judges.

On the opposite page we illustrate some of the devices which have been awarded prizes, as well as those having received honorable mention. We could publish a magazine three times the size of SCIENCE AND INVENTION if we were to describe and illustrate all of the devices that were submitted. We will, however, content ourselves with enumerating here some of the good ones that were submitted. These ideas, however, did not seem to us very practical and for that reason neither prizes nor honorable mention were made, altho we admit that there are some good ideas among them. Here is a partial list:

Beverage mixer; toy dancing device; wireless coil tube winder; attachment to operate motion picture machine; wireless rotary spark gap attachment; phonograph burglar alarm,—this device is supposed to scare the burglar by operating the phonograph as soon as the door is opened and the burglar enters. We are afraid, however, that most burglars would be wise to the device immediately, and let the phonograph play on; stereoscope motion picture device; blower and air blast attachment, operated by the phonograph motor with flexible rubber tube going to sound box; the air blast blows off the dust as the record is played—a good idea but rather complicated; shoe polishing attachment; roulette game; panoramic lighting device operated by the turntable; advertising schemes whereby merchandise is placed on the turn table in show windows to attract passers-by; knife sharpener; attachment to operate sewing machine; telegraphic code teaching device; attachment to operate miniature dynamos; cream whipper; yarn winder; ring toss game with pegs on revolving disc; electrically lighted Christmas-tree holder; electrically operated phonograph stopping device; storage battery charging appliance in connection with dynamo (?!!); power transmission attachment; alarm clock and bell sounding attachment; small cabinet phonograph with revolving fan made of paper strips to be placed on dining table to chase away flies! Then we have the automatic phonograph lighting device which lights the record spot-light as soon as the cover is lifted. Several good omnigraph devices also were submitted. There was a very good idea of a static machine built right on to the phonograph, using the record itself as the revolving pla . of the Whimshurst machine

The humorous element was of course not lacking as usual. Mr. Riza Young of Detroit, Mich., probably takes the cake by making an attachment to rock a cradle by means of a crank attachment on the turntable.

Frances Fogarty of Cornwall Landing, N. J., comes forward to move the phonograph out in the kitchen with which to operate a dish washer, telling us minutely how it is all done. But we doubt if many people would like to have their Victrola in the kitchen.

Now for the prize winners:

Announcement of Prize Winners

FIRST PRIZE $25.00

Utility Motor Attachment.

By Ralph C. Moses, Gideon, Mo.

The drawing shows a small utility motor attached to a phonograph, to which the power is transferred by means of friction between the power wheel of the motor, which is either made of rubber or of felt so as to eliminate slipping, and the turntable of the phonograph.

The power wheel is attached to the shaft of the motor by means of a metal collar and setscrew centered in the wheel, as shown in the drawing.

By lengthening the shaft the power and speed of the motor may be increased or diminished at the option of the operator, or the power may be controlled by the speed indicator on the phonograph. When the power wheel of the motor is moved towards the center of the turntable it gives the motor more power but less speed, but as the power wheel is moved towards the outer edge of the turntable the power is diminished and the speed is increased.

Besides a fan attachment for the motor, a small emery wheel for sharpening knives, etc., may be attached in the same way as the power wheel and fan are attached. A buffer may also be attached for polishing silverware, etc., and many other uses can be made of the small friction motor as are at the option of the operator.

The felt-lined spring clamp makes it possible to secure the motor to the phonograph firmly, and without marring the instrument in the least.

SECOND PRIZE $15.00

Razor Blade Sharpener.

I hereby submit to your "Phonograph Contest" an idea which I know will be appreciated by the *"hairy sex."* In the drawing will be seen a thin board (wood or fiber) or even an old phonograph record will do. I use a strip of felt a little wider than the ordinary safety razor blade. On this felt a mixture of very fine pumice powder and oil is placed. Do not make the mixture too thin or it will fly all over. In the drawing is also shown a leather strip used to "hone" the blade.

The holder is constructed of ribbon brass ⅝" wide bent over lengthwise into "U" shape to fit the blades; it is as long as the blade. The wire is of brass, the top of which is ground to the thickness of a phonograph needle and is fastened to the strip with solder. This holder will make the sharpener practically automatic. All that is necessary is to fasten the arm with a string or wire in a steady position over either the felt or leather and crank the machine and "letergo."

FRED SKROTZKI.

THIRD PRIZE $10.00

Chimes or Dinner Gong.

A Chimes cut from ¾ x 1-16" steel.
B Spring.
C Hammer.
D Wood disc ¼ to ½" thick.
E Pins, nails or screws.
F Weighted base.

A "record" or wood disc can be used in place of ordinary record. Pins engage spring hammer and as they pass release it, allowing hammer to strike chimes. Position of pins determines melody.

A. G. KALMBACH.

HONORABLE MENTION.

Cleaning Brush.

There are devices on the market for cleaning records, but none that I know of do their work while the record is playing. By means of a simple clamp, two thumb screws and a little brush, rigged up as shown in the figure, the sound groove of a record is cleaned free of dust just before the needle passes thru it, thereby insuring a perfectly clean record at all times, without trouble of any sort, such as wiping records. The hairs of the brush must have a proper stiffness to remove dust and not mar the record or produce sound.

J. LOUIS LENORE.

HONORABLE MENTION.

Bagatelle Game.

In this game the centrifugal force created by the rotation of a disc placed on a phonograph make the balls rotate and climb from the center to the outer edge. The disc is provided with numbered recesses into which the moving balls fall.

To play the game. Each player selects balls of one or two colors according to the number of players. The balls are shaken up in a pot and poured round the inner rim. The phonograph does the rest and is stopt when the balls cease to move and count is made according to their position and recorded on a cribbage board or otherwise.

CHAS. H. NEWTON.

HONORABLE MENTION.

Sound Distorter.

I have found much amusement for myself and friends in drilling a hole thru a record from one-half to three-quarters of an inch from the center and using THIS hole for the post of the machine instead of the one in the center. The effect of playing a record in this manner, especially if it be a love song, is highly amusing.

F. G. SWARTZ, D.D.S.

HONORABLE MENTION.

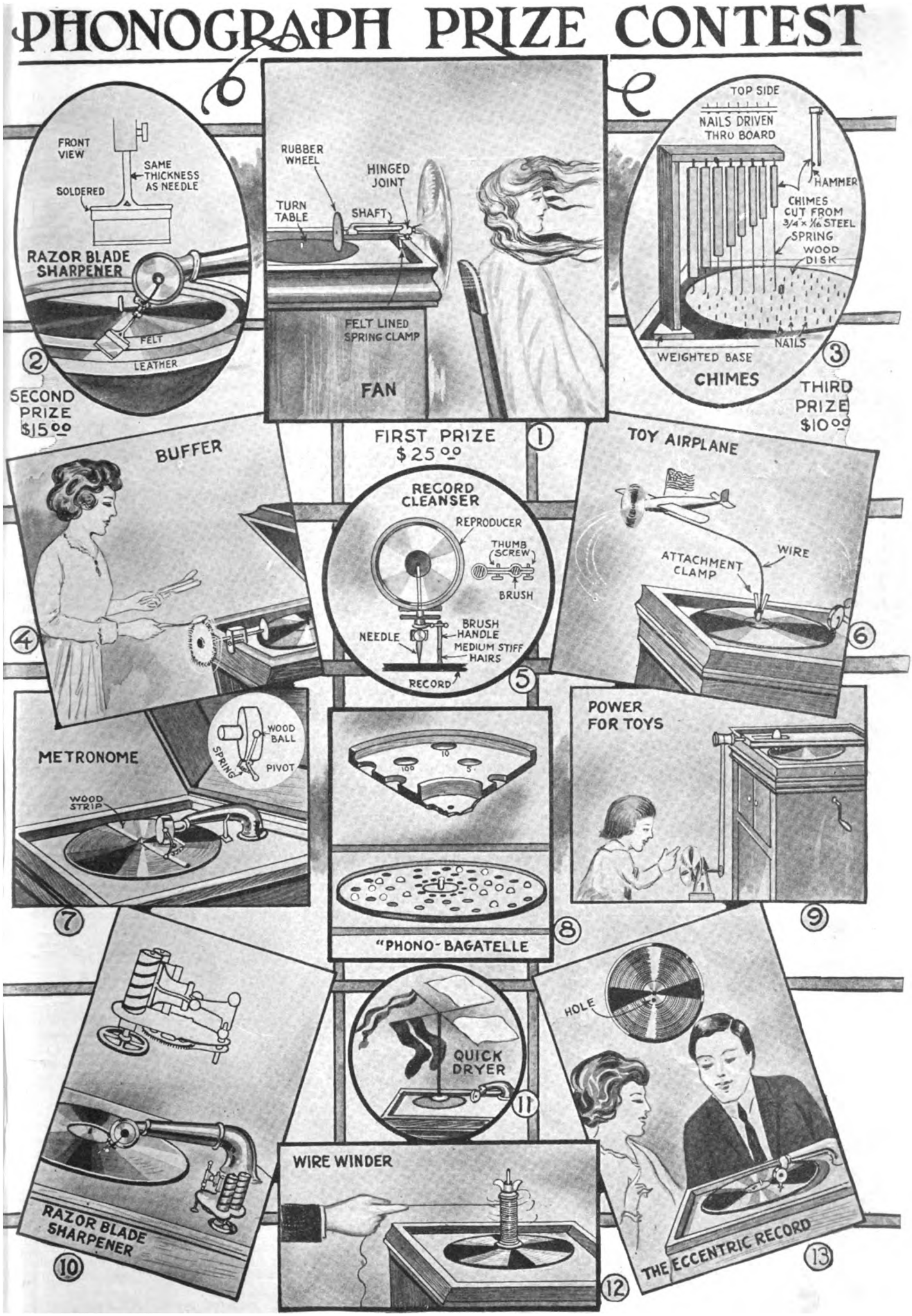
Buffing Wheel.

The device is for polishing silver spoons and in fact any silverware about the house. It is simply a friction wheel running on the turntable. The other end of the shaft mounts a small buffing wheel made from several discs of cloth clampt together.

A padded clamp holds the shaft firmly to the edge of the phonograph.

(*Continued on page 772*)

PHONOGRAPH PRIZE CONTEST

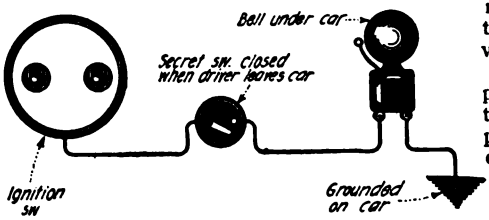


MOTOR HINTS

FIRST PRIZE $25.00.
AUTO THIEF ALARM.

After his car which was "locked" had been stolen from the front of Wanamaker's Store in Philadelphia, the winner of the first prize came to the conclusion that automobile thieves in the proverbial words *"Like love, laugh at locks."*

Our illustration shows an alarm which our correspondent thinks will defy the best



A Secret or Hidden Switch, Connected With a Large Electric Bell Under the Car May Prevent Its Theft.

of thieves. He placed under his car a large electric bell and his ignition switch wires have this bell connected in circuit with them.

In a secret place there is a second switch. If this is closed, nothing can take place as long as the owner's switch is open, but if a thief desirous of stealing the car, closes the ignition switch, the bell rings and attracts everybody. Our correspondent says that he has tried it on public streets, and the minute it starts to ring, all eyes are turned his way.

[As a little suggestion, it seems to us, that to make the story more complete, he should have been arrested for stealing his own car.—Ed.]

Contributed by
CHARLES E. ST. CLAIR.

SECOND PRIZE $15.00.
SIMPLE SUBSTITUTE FOR A "FUELIZER."

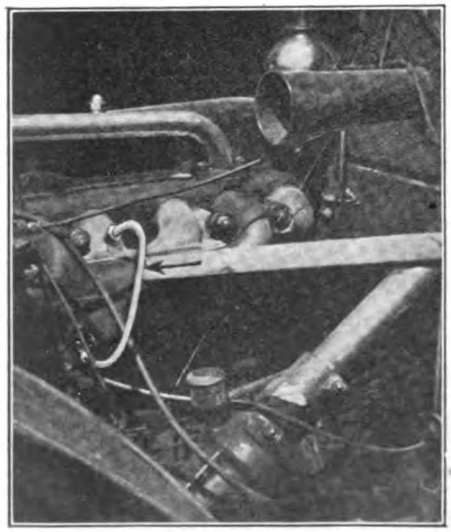
Our illustration shows the device whose inventor has been awarded the second prize. He terms it as a substitute for a gasoline *fuelizer*. A small caliber piece of copper tube is connected to the exhaust manifold and leads directly to the intake manifold.

The tube is made as short as possible to save heat and the user is advised to cover it with sheet asbestos so as to keep the exhaust gas on its way to the intake manifold, at as high a temperature as possible. Of course, there is a certain danger of igniting the gas before entering the cylinder.

This writer says that tests which he made indicate a reduction in fuel of about 8 per cent, and he found that in starting on cool mornings, the operation of the car was much smoother and quicker. Our illustration makes the construction of this device, very clear. A dash adjustment for regulating the flow of the exhaust gas to the intake manifold, is said to be an advantage in some cases.

It was found that in throttling down, especially in very hot weather, there was a temporary lag in operation, indicating a poor mixture, and by closing the suggested cock, the mixture could be enriched.

Contributed by H. T. KRAFT,
Ass't Aero Engineer, Goodyear Akron Air Station.



A Simple "Fuelizer" Substitute Formed by a Piece of Copper Tube Connected to the Exhaust Manifold and Leading Directly to the Intake Manifold.

$50.00 IN PRIZES
Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

FIRST PRIZE	**$25.00**
SECOND PRIZE	**15.00**
THIRD PRIZE	**10.00**

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor. "Motor Hints," care of this publication.

RECHARGING "RUN DOWN" IGNITION BATTERY.

Sometimes a careless motorist leaves his ignition switch closed or the lights burning or perhaps finds a "shorted" wire which results in his battery being discharged. He usually discovers this accident when he wishes to use his car. He will then call a service station for an expensive repair man to bring him out a charged battery so that he may use his car. All this expense and inconvenience can be eliminated by the following method.

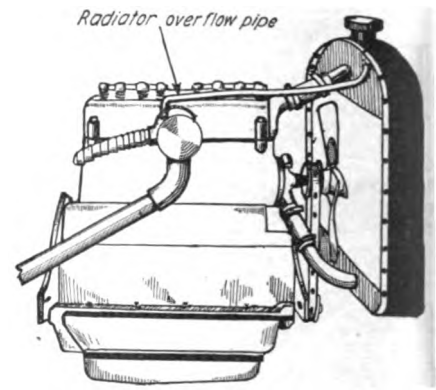
Have a neighboring motorist drive his car beside your own and connect his battery to yours. This can be done with a short piece of lampcord. Loosen the terminal bolts on both batteries, being careful not to push the leads out of the terminal lugs. Remove the insulation from the ends of the wire and wind the bared wire around the bolts; then tighten down. The motor will readily start if the connections are tight. The positive post of one battery should be connected to the negative post of the other. When the motor has become "warmed" up, carefully loosen the bolts, being careful not to break the connection between the discharged battery and the running motor. Remove the lampcord and tighten bolts. If your generator is working properly, a few hours' driving will put your battery back into shape.

Of course, this method would be successful only when the battery has become discharged from conditions arising outside the battery. The author has successfully started automobiles by the above method.

Contributed by NILES HAGELSHAW.

THIRD PRIZE $10.00.
CARBON PREVENTER.

The object of this device is to prevent the deposition of carbon in the cylinders of a gasoline engine. The contributor proposes to introduce the lower end of the



A "Carbon Preventer," Formed by Introducing the Lower End of the Radiator Overflow Pipe Into the Hot-Air Suction Pipe.

radiator overflow pipe into the hot-air suction pipe. This suction pipe should rise as it approaches the carburetor, so that any condensed water will run away and nothing but steam or water vapor will enter the carburetor.

The end of the overflow pipe in some engines may be run to the hot air casing surrounding the exhaust pipe. The effect of this would be to convert any water present, into steam, and economy in gasoline resulting from increased power is claimed for this arrangement, in addition to the elimination of carbon in the cylinders.

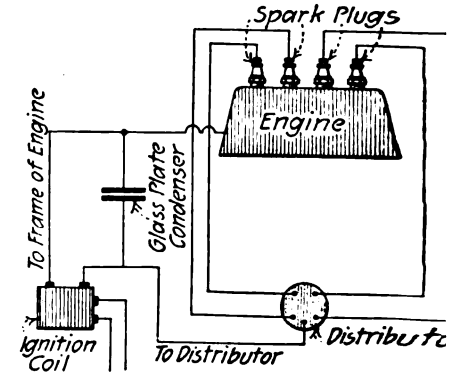
By either of these arrangements a certain amount of water vapor is drawn into the mixture, so as to produce the desired effects.

Contributed by WALLACE C. MILLS.

IMPROVED AUTO IGNITION SYSTEM.

I present herewith a diagram of my automobile ignition system which is the Atwater Kent system, as shown in the diagram.

I connected a glass plate condenser, made of four plates 5 x 3", coated on both sides with tin-foil, across the secondary lead



The Contributor Claims That He Obtains Much Hotter Spark With Condenser Connected Across the Secondary Wires, as Indicated Here.

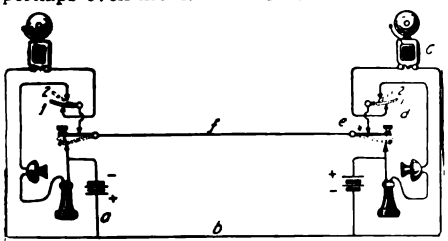
which gives a much hotter spark. This device proved very efficient on my "Pullman" car, I get more power and more miles per gallon of gasoline.

Contributed by RUDOLPH YOUNG

Telephone Wiring

By G. L. HOADLEY, M. E.

PEOPLE nowadays look upon the telephone as a necessity in the home. The housewife uses it for "visiting"; for reminding her husband at the office to perform certain shopping duties during the lunch hour; for giving orders to her groceryman; and for divers other purposes. The people in the country use it perhaps even more. In case of sudden sickness or accident, the doctor can be summoned quickly—and many times a life is saved by prompt action. As a quick means of securing aid in case of fire, robbery, etc., its protective value is unquestioned. As a time saver between the house and barn, garage or other buildings on the farm—or as a means of communication between the vestibule or janitor's room and the tenants of an apartment building, its value is not so generally appreciated, but its usefulness can be easily shown.



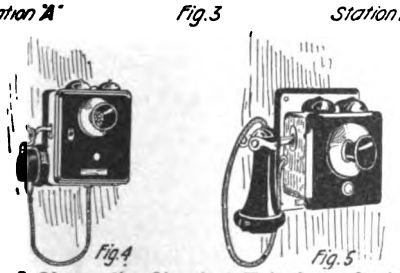
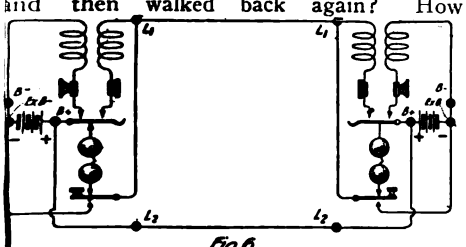
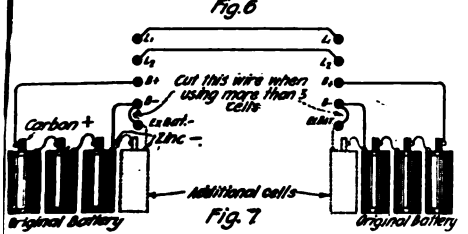


Fig. 3 Shows the Simplest Telephone System With Ringing Circuits,—Which Represents a "Series" Telephone, Without Any Induction Coils. Figs. 4 and 5 Show Two Types of Wall Telephones for House Use.

How often, when at work in the barn or garage, have you gone back to the house for something forgotten or overlooked—and then walked back again? How often has your wife gone to the barn to find you for some important matter—and then walked back again? How often have you, Mrs. Housewife, chased down three or four flights of stairs to get the janitor to fix a faucet or to tell him to give more heat—and then walked back again? Do you enjoy climbing stairs? Is the time you spend in these trips of no value to you? It is a safe bet your answer is "No".





Diagrams Showing Connections of Battery and Induction Coils in Common Type of House Telephone. The Transmitter is Connected in the Primary Circuit of the Induction Coil, and the Receiver in the Secondary Circuit.

How to Install Telephones

A telephone line, illustrated in Fig. 1 and Fig. 2, leading from the house to the barn, garage or other buildings puts a quick stop to this useless waste of time or energy. An intercommunicating phone hooked up to an existing bell system in an apartment building gets quick and efficient service from your janitor, does away with precious time lost in talking to pernicious agents, peddlers, and other undesirables.

Wiring:—The average person is apt to look upon the telephone as being too complex for him to understand. He is apt to feel that only an expert can install a phone successfully. You or your fourteen-year old boy can put up an interphone outfit in a couple of hours. You do not need experience to perform the work satisfactorily. Simply follow the directions given later.

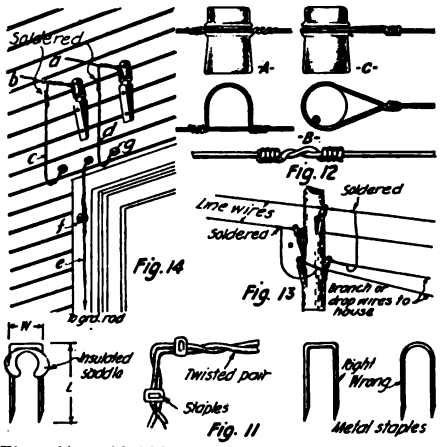
Systems:—There are two main classes into which telephone systems may be divided; that done by the owner of a building and that done by the telephone company. Under the first-mentioned class should come the installing and wiring for any phones required in the building only; between buildings; for a short line between your home and a neighbor; and for extension bells. Under the latter comes the installation of outside commercial telephones by the local Telephone Co. and private branch exchanges.

Fig. 3 shows perhaps the simplest type of an interior phone system between two parties. Reference to the figure shows the signaling as done with two batteries, double contact push-buttons, and ordinary doorbells of the vibrating type. Removing both receivers from the hooks closes the circuit through the transmitters, receivers, and batteries. In connecting up the two batteries be careful to avoid having them "buck" each other when the talking circuit is made.

Operation:—To ring Station B press the double contact pusher at Station A down to dotted position 2. Current may flow then thru wires a, b, bell c, hook switch d, e, f, and back to Station A battery, thus ringing Station B bell.

Talking Circuit:—Removal of each receiver from its hook allows the hook switches to rise to dotted position 2, breaking the lower contact and making an upper contact. At the same time, removing pressure from the push-button at Station A allows the pusher to assume its former position 1. Current then may flow from the positive pole of the battery at Station A through wires a, b, Station B battery, receiver, transmitter and hook switch, and upper pusher contact, e, back through line wire, f, Station A pusher, hook switch upper contact 2, transmitter and receiver to negative pole of battery, thus completing the talking circuit.

Two Party Commercial Set:—Fig. 4 and Fig. 5 show typical interphones of the wall type made by two of the leading manufacturers. The outfit consists of two such instruments and is suitable for a private line between two rooms in a building, and for house to barn or garage, where distances do not much exceed 1,500 feet. Either station can ring and talk to the other. Fig. 6 shows a *wiring diagram* for the connections of the Western Electric set and Fig. 7 shows another diagram for installation purposes. Three dry cells are sufficient to operate this set satisfactorily for distances up to 750 feet, using No. 18 B. & S. gage copper line wire. Between 750 feet and 1,000 feet an additional cell is required; and 5 cells at each Station are necessary between 1,000 and 1,500 feet.



Figs. 11 to 14 (Above) Show the Simple Practical Details to Be Followed in Running Telephone Wires Both Inside of House and Out-of-doors.

Installation:—To fasten the wall phone set properly to a brick, cement or stone wall, drill holes into the wall at the proper location for the screws. Then plug the holes with wooden plugs and fasten the wall set to them with wood screws. Use dry wood for these plugs and make certain the plugs are large enough to hold securely.

Lightning Arresters:—Fig. 8 shows a type of arrester suitable for use where there are no neighboring power or lighting circuits. Fig. 9 shows a typical arrester

(*Continued on page* 804)

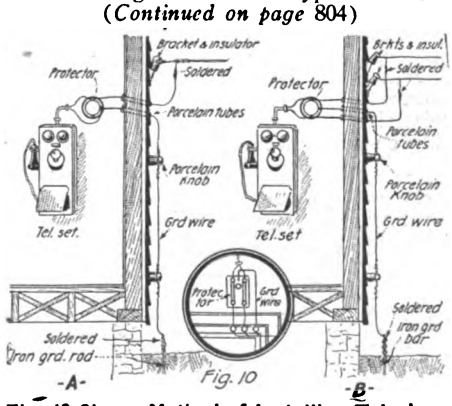


Fig. 10 Shows Method of Installing Telephone in House, Together With Lightning Protectors and Ground Wire for Both Grounded and Full Metallic Systems.

Blind Now Read By Musical Sound

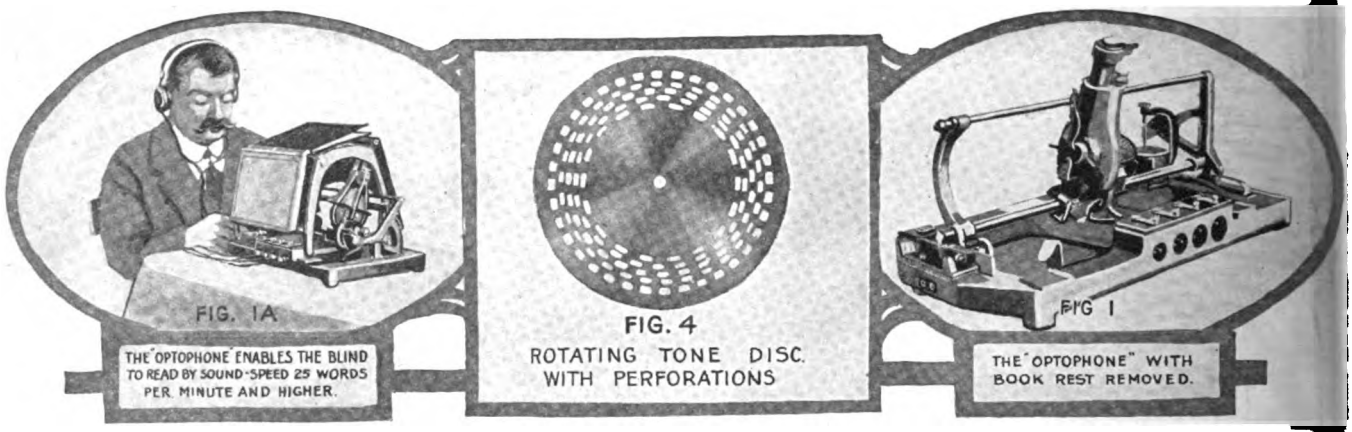


FIG. 1A
THE OPTOPHONE ENABLES THE BLIND TO READ BY SOUND-SPEED 25 WORDS PER MINUTE AND HIGHER.

FIG. 4
ROTATING TONE DISC WITH PERFORATIONS

FIG 1
THE "OPTOPHONE" WITH BOOK REST REMOVED.

"Optophone"--Combining Optics and Selenium--Is Now Available, Whereby the Blind May Read--by Sound Code

THE Optophone, the invention of Dr. E. E. Fournier d'Albe of London, has been modified and developed by an electrical engineering concern of Glasgow, Scotland. Its purpose is to enable the blind to read ordinary printed matter—such as books or newspapers. This is accomplished by producing in a telephone receiver series of musical notes forming tunes or musical motifs, representing the various letters as these are past over by the instrument in traversing a line of printing.

Up to the present time the only means available for enabling the blind to read have been raised type systems, such as Braille and the Moon, adapted to be read by the sense of touch. These methods are subject to considerable disadvantages, such as the necessity for having specially printed, expensive and bulky books and the consequent limited amount of literature available, and the difficulty of acquiring the necessary sensitiveness of touch, especially by adult blind persons.

These disadvantages are overcome by the *Optophone*. It renders all ordinary printed works, including type-written matter, available to the blind. It depends not upon the sense of *touch*, but upon *hearing*, which is usually quite sufficiently sensitive with the majority of blind persons, and reasonable facility in reading by its use can be attained after comparatively few lessons.

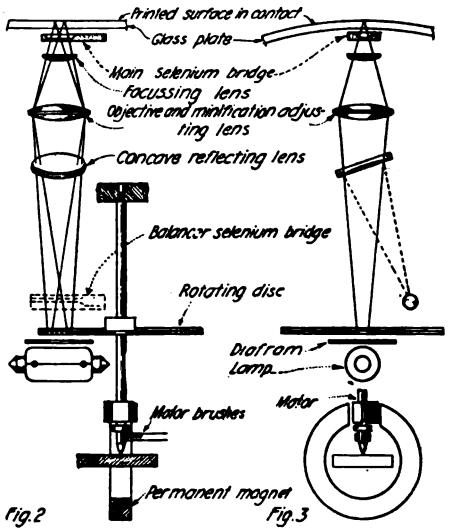
SELENIUM SOLVES THE PROBLEM.

The instrument depends for its action upon a remarkable property of the chemical element *selenium*, the electrical conductivity of which in one of its physical forms (grey crystalline) varies greatly in accordance with the amount of light to which it is exposed.

If a telephone receiver (essentially an instrument sensitive to changes in electrical currents) is connected in series with an electric battery and a porcelain tablet having on its surface two separate conducting lines of grafite connected together or bridged over by light-sensitive selenium, a current will pass thru the telephone, and *the current will vary as the lighting of the tablet is varied.* The prepared tablet is called a "selenium bridge." When flashes of light are thrown on to the selenium bridge at a rate of 256 per second, the current will rise and fall at that rate and the telephone will sing out the note C (middle C of the piano). If the pulsations of the light are at half that frequency, that is, 128 per second, the telephone will sing out C an octave lower, and with 512 pulsations per second, the C one octave higher and so on. The telephone can therefore be made to sing any tune by the proper succession of sets of pulsations of light applied to the selenium bridge.

In the Optophone a selenium bridge is exposed to successions of sets of light pulsations, which vary according to the forms of letters as these are past over in traversing a line of printed type, each letter being indicated in the telephone by a characteristic motif comprising successions of single notes and chords. Printed letters are thus translated by the Optophone into a *sound alphabet*, which can be readily learned.

Figure 5—This Illustration Shows the Various Tones Used in the "Optophone," Each Tone Having a Different Frequency and Forming Together, What Is Called a "Scala." The Position of the Scala With Respect to the Type Lines Is Here Clearly Illustrated.



Figures 2 and 3—Illustrate Diagramatically the Optical and Selenium Cell Arrangement, as Well as the Position of the Rotating Tone Disc and Its Motor in the "Optophone,"—the Instrument That Enables the Blind to Read by Sound.

ARRANGEMENT OF THE OPTOPHONE INSTRUMENT.

The arrangement of the Optophone is illustrated diagrammatically in Figs. 2 and 3. The printed page to be read is placed face downward on a glass plate supported on a suitable stand. Beneath the plate is a tablet of porcelain pierced with an aperture to permit the passage of light upward and so through the glass on to the paper. The upper surface of the tablet—around the aperture—is prepared as a sensitive *selenium bridge* and connected up to a battery and a telephone. The selenium bridge receives only light reflected from the page. The light used is obtained from a small straight filament electric lamp placed beneath a rotating disc perforated with small holes arranged in five concentric circles near its edge. This disc is illustrated in Fig. 4. For the sake of clearness and simplicity in the diagrammatic arrangement, Figs. 2 and 3, the lamp is shown immediately below the rotating disc. In the instruments now being made the lamp is so arranged, in conjunction with a reflecting prism and cylindrical lenses, that an image of the filament is produced in the plane of the disc, radially across the circles of holes.

The disc is kept in rapid rotation by means of a tiny magneto-electric motor driven by current from small secondary cells. Above the disc there is an optical system which throws on to the paper an image of the lamp filament as it would be seen thru the perforations in the disc.

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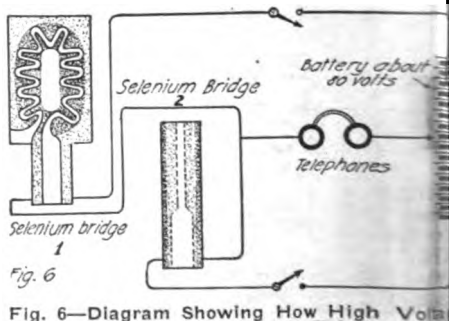
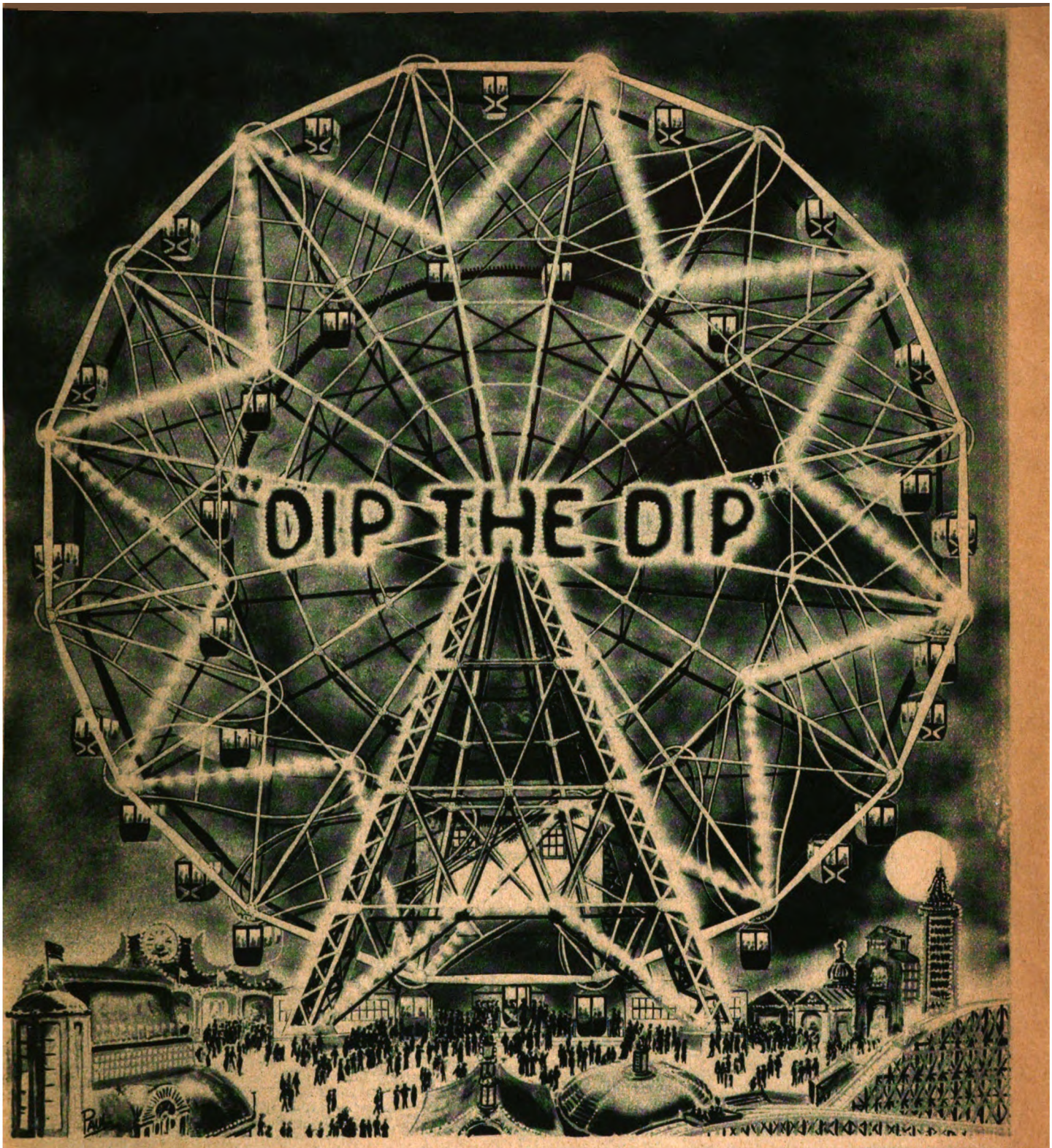


Fig. 6—Diagram Showing How High Volt Battery Is Connected Up to Telephone Receiver, In Conjunction With the Main Selenium Bridge and the Balancer Selenium Br



Next Summer, Visitors to New York's Playground, Coney Island, Will Be Amused by This Giant 150-Foot "Dip-the-Dip" Wheel, Which Combines All the Thrills of the Scenic Railway, the Ferris Wheel and the Chute-the-Chutes.

Coney's New Topsy-Turvy Wheel

By I. KUTTNER

IMAGINE that you are making your first visit to Coney Island, New York's greatest amusement resort, via the boat from the Battery that takes you down the bay and gives you a dash of the angy salt sea air. Also let us imagine hat this is a night boat, so that you will experience the full pleasure of seeing Luna Park and Steeplechase all decked out in their myriads of electric lights, ablaze against the black mantle of night.

You've just left the pier at the lower end of New York City and are sailing along happily on your way. After you have progrest for several miles your attention is arrested by a mammoth illuminated star on the horizon—clearly outlined against the sky. As you approach the Island, the giant star rapidly increases in magnitude. Before long your eyes begin to ferret out the details of this mammoth display which evolves itself into a huge, revolving wheel carrying the star with it, across the center of which there flashes the legend "DIP-THE-DIP," and as you gaze in wonderment at this greatest of great amusements afforded by the world-famous "Coney" you can hardly rest until you get there and make your way toward it.

You have mastered your nerve by this time and have made up your mind that no matter what the charge may be, you are

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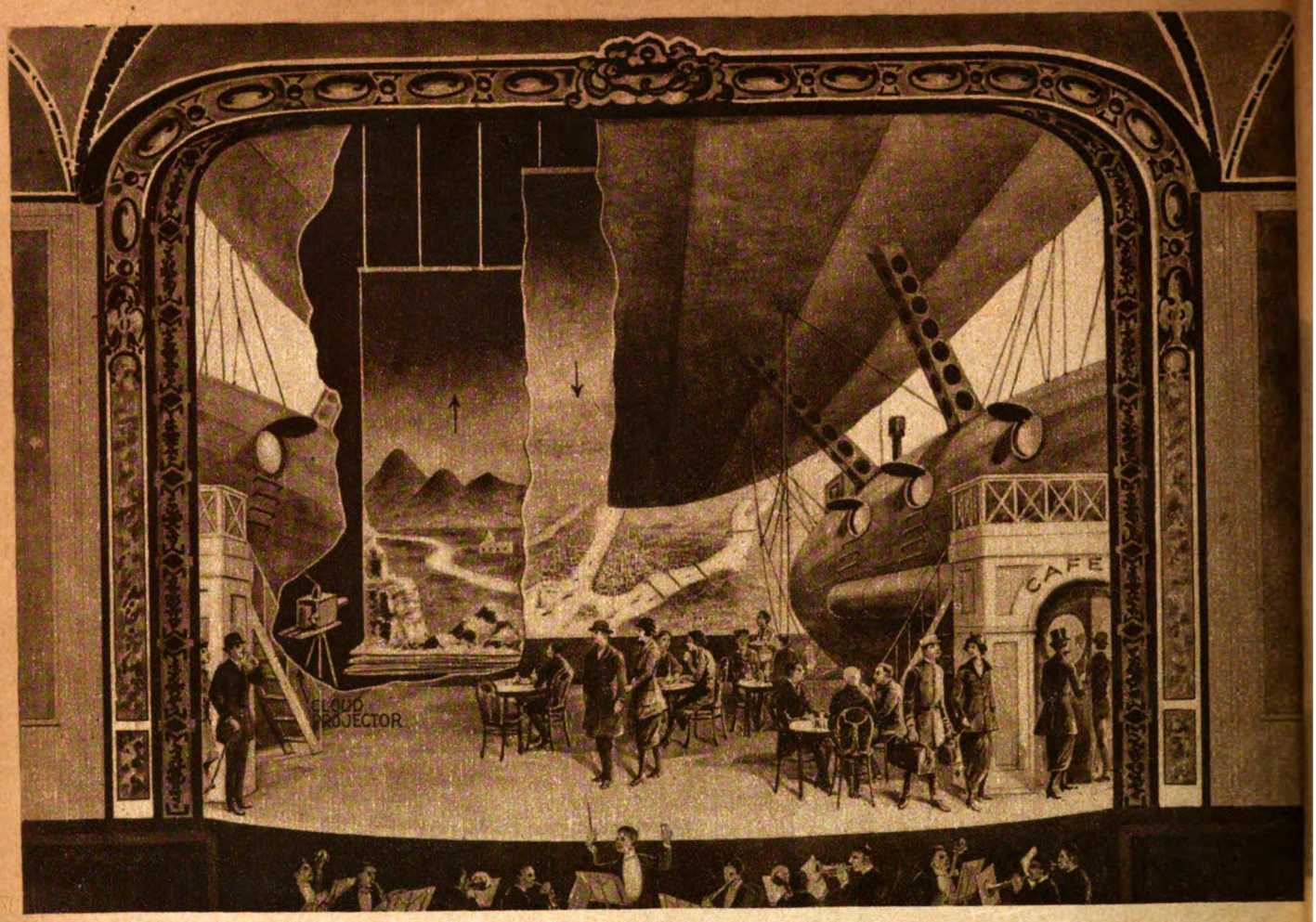


A Wonderfully Realistic Airship Scene Appears In a Recent New York Theatrical Production—George White's "Scandals of 1920" in Which Dainty Ann Pennington Is the Star. The Audience Is Given the Effect of An Airship Rising Above New York City, the Ship Later Becoming Lost in a Storm, and Finally the Sky Brightens Once More and a Mexican Scene Comes to View or Rises as the Airship Settles. The Manner in Which This Is Done by Means of Two Extra Long Back Drops Painted With the New York City and Mexican Scenes Is Clearly Shown in the Illustration Above. To Give the Effect of the Airship Rising the Front Curtain Is Slowly Lowered. For the Storm Scene the Stage Is Darkened Almost Completely While the Dark Portion of the Curtain Appears and Overlaps With a Similar Dark Portion on the Rear Curtain, and When the Scene Is Illuminated Once More the Audience Beholds the Mountains of Mexico Coming Into View.

Science "Stars" In New Plays

Lightning Scene Changes and Realistic Airship That Appears to Fly

QUITE startling, and clever indeed, is the airship scene from the George White's "Scandals of 1920," starring Ann Pennington, a recent metropolitan production. In one of these scenes we see before us the two rear gondolas of a gigantic Zeppelin, suspended from the gas bag above by appropriate structural aluminum trusses; the ropes also being suspended from the gas bag above and are ostensibly used for the regulation of the various devices.

The execution of this scene is such that all the construction faithfully resembles the remarkable Leviathans of the air. The scene of action takes place between the two gondolas. At the right hand side is a cafe which has many worthy members, including Mr. William J. Bryan, who enter for something stronger than 2.75, after the three-mile altitude has been reached. Even the height which the dirigible attains apparently makes the actors groggy.

Now comes the strange part of the play. The propellers are heard to whirr, while the background scenery, containing a bird's-eye of New York City, moves away or downward rapidly as the Zeppelin reaches a very high altitude. The audience actually imagine that they are on a giant airship flying upward. The illusion is well nigh perfect. Finally, the Zeppelin reaches the three-mile level and the "cafe" is opened—and while the clouds roll by, the actors get their fill of liquors, while the long suffering audience looks on.

A storm now breaks and the scenery is only lit up by the intermittent flashes of lightning, and above the roar of the thunder the Captain shouts that they are drifting off their course. At last the ferocity of the storm subsides and the airship "descends," and the passengers find themselves in a new country, namely, that of Mexico.

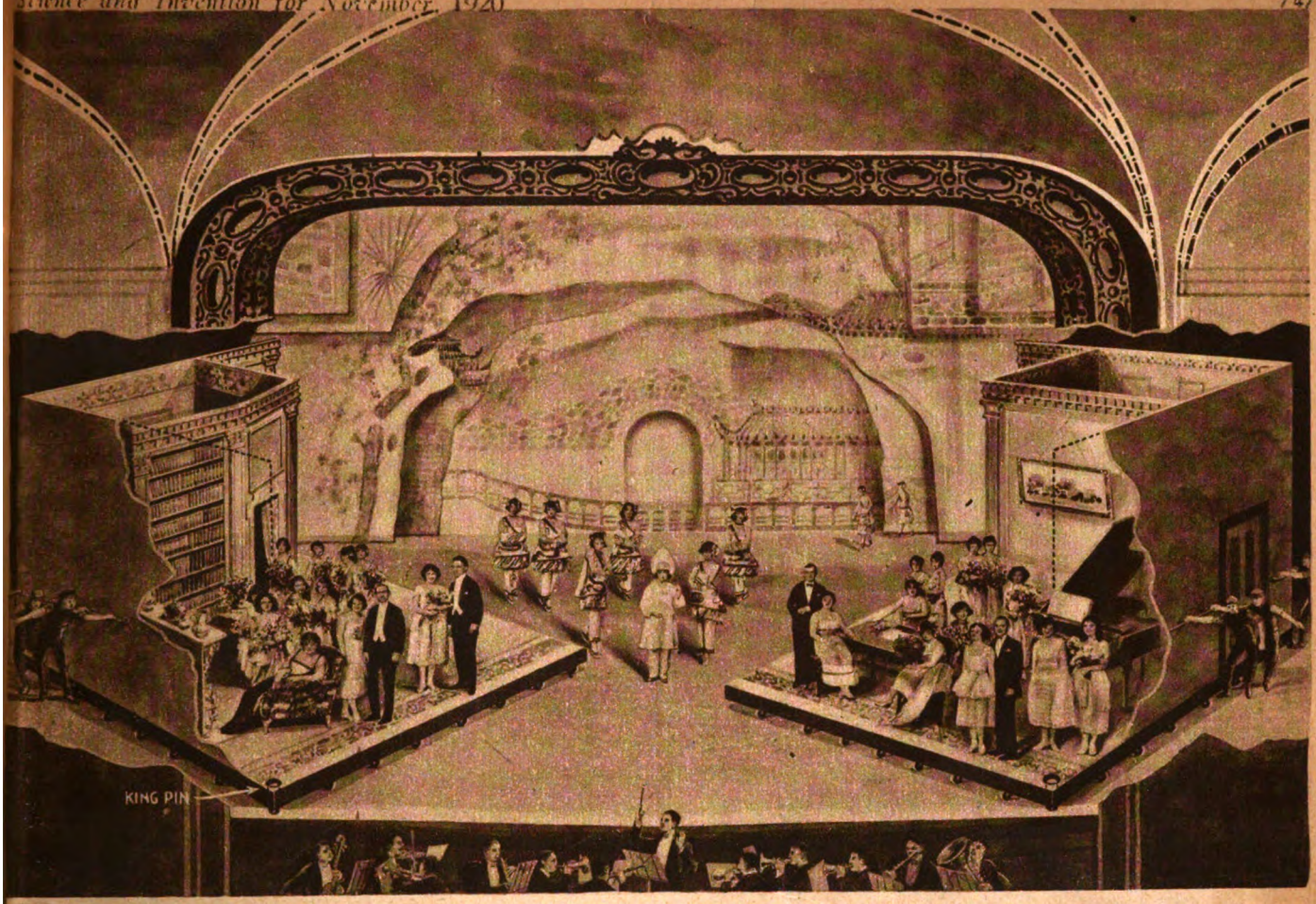
How the entire scene change has been effected in four seconds can be readily explained in a few words. The airship and and other scenery in the front, as can be seen in our illustration, is painted on canvas. On the background between the two gondolas is painted a bird's-eye view of New York. This background is twice as high as the portion viewed by the audience. The clearest detailed view is toward the bottom; then Brooklyn lies above it and this enveloped in more or less of a fog; even this detail gradually dies out until at the top of the drop the scene is completely black. Behind this drop is placed a second drop similarly painted, except that a scene from Mexico occupies the most important position, with the top part of this drop also blackened.

When everything is set, the action proceeds rapidly by allowing the first drop to be lowered gradually and slowly. At first the audience imagines that it is passing over New York, then Brooklyn, and finally the fog commences to show while the detail is lost; the lights gradually go out and clouds are projected on the first background from behind the stage, giving an unusual electrical effect of moving clouds.

Even these darken as the storm approaches and lightning flashes illuminate the setting at short intervals. Meanwhile the first drop has been lowered to the greatest extent which the scene will allow. Between one lightning flash and another, the first backdrop is suddenly released and cords holding it in place are unclamped. No change seems to have taken place, at least, not from the audience's point of view, but now the second backdrop occupies the position held by the first, and as the second scene is gradually raised and the lights turned on, Mexico comes into view.

Finally the airship is landed and the occupants come out to an entirely different scene and even the atmosphere seems to have changed, while the action takes place in the country of internal commotions.

Another astonishingly quick change of scenery is being exhibited at the Central Theater in New York City, in the play



n Astonishingly Quick Change of Scenery—in Fact, the Quickest on Record—is Made in Another New York Theatrical Production ntitled "The Poor Little Ritz Girl." The Heavier Set of Scenery is Mounted on Two Pivoted Platforms Which Roll on Felt-covered all-Bearing Roller Castings. A Squad of Stage Hands Quickly Pull the Two Halves of This Scenery Set Back and Out of Line With e Proscenium Arch as Shown Above. The Scene Changes from a Massive Interior With Real Book Cases and Books, Tables, Piano, tc., Within Two Seconds to a Beautiful Japanese Garden Scene. The Lights Are Extinguished for This Short Period, Leaving the udience Gasping in Wonderment at the Miraculous Change in Such a Short Time. Part of the Scenery for the Garden Scene is Lowered from Aloft.

e "Poor Little Ritz Girl," where an en-ely different method is employed. As own in our diagram in this scene, the tire stage set is mounted on two movable ltforms which open like doors rotating out two giant "king pins" mounted at the rners. The secondary stage is moved out noiselessly on 95 felt covered, ball-aring, roller casters. This scene is so nstructed that there is no fraud to the ge settings, whatsoever.

Everything has been built solidly and not opt up or simply painted on canvas in y way whatsoever. There are real books on the shelves and an open hearth with swing logs is found on the left hand side. At the right is a large and massive piano.

The total weight upon the stage is a little over five tons, and yet none of this is shifted in order to allow for the rapid change at the opportune moment. Even the actors and actresses retain their places. Within two seconds, this scene changes to a Japanese Garden. The lights go out, the stage splits in half and each half is rotated outwardly, while simultaneously, eight drops are let down from the gridiron above the stage to occupy the place formerly occupied by the library.

These drops are mostly made up of silk gauze, beautifully painted and bolted together permanently, so that they descend as one. Two seconds on a stop watch for a scene change such as this is a remarkable undertaking indeed.

At the end of the last act the audience gets an insight into the "workings." Just before the final curtain is rung down and just as the chorus music reverberates at the final note, the stage in full view of the audience splits into two parts, each section receding from view, one side to the left, the other to the right.

The entire company of some 50 persons thus vanishes into space inside of two seconds, right under the eyes of the dumfounded audience.

Throw Away Your Eyeglasses!

How to avoid wearing glasses was exined at the annual convention of the erican Osteopathic Association in Chio. The most spectacular feature of the vention was the first public demonstrah of the newly discovered method of treat- the eyeball osteopathically, for the purse of correcting errors of refraction. Dr. nes D. Edwards of St. Louis, the discovr of this technique, gave a demonstration. He claims that it is possible to avoid the of glasses in 90 per cent of cases, if treatment is begun early enough. The he treatment he has discovered will cure arge percentage of cases of glaucoma, ich heretofore has been classified by dical oculists as an incurable disease. Incipient cataracts, retinal detachment, iritis, crosseyes, conjunctivitis and optic nerve atrophy have responded to this technique.

With the exception of the specific and malignant diseases, which should be carefully differentiated, Dr. Edwards claims almost every morbid condition of the orbital cavity can be considerably benefited, if not entirely cured. Finger surgery is what the doctor calls it, as the osteopathic operation is performed by inserting the carefully prepared finger in the orbital cavity and adjusting and manipulating the eyeball. Dr. Edwards says he has never had any bad results or postoperative discomfort. In fact, he says there is a sedative effect from this seemingly harsh yet scientific treatment.

A French invention described in the American press some months ago, involves the principle of applying physical pressure to the eyeballs for myopia or elongation of the eyeball. The machine just mentioned for the treatment of myopic ailments of the eye comprises two spherical cups, one of which fits over each eye so as to press against each eye-ball. These cups are mounted on two rods which are under spring pressure and which pressure can be adjusted and increased as the treatment may require. The technique for applying this method of coaxing the eye-balls back into their normal condition consists of applying this machine to the head and putting pressure on the eye-balls periodically.

"Applied Chemistry"

By CHARLES S. WOLFE

THE flickering, cold beams of their electric hat lights dancing weirdly on rocky cavern wall and ceiling, the five gazed in awe on the spectacle before them.

A short silence fell, each busy with the task of stabilizing his architecturally acrobatic brain as gigantic air castles soared skyward.

At last, in a voice that he strove to make calm, Small spoke, the sound reverberating fantastically in the tunnel.

"And so you see, gentlemen," and in spite of tremendous effort that voice trembled, "my Indian did not lie. Our hunt is successful. Here is an abundance of gold."

Archer, the geologist, spoke without taking his staring eyes from that amazing vein. "Without an assay, I can say with no fear of exaggeration that the world knows no other vein that can compare with this. Boys, we are plutocrats."

Benson, soldier of fortune and rolling stone, turned to Small. He was probably the coolest one of the group. "Old man, I apologize for what I have thought. When you rounded up the four of us in that hotel lobby in Mexico City and sprung that dying and grateful Indian's tale on us, I was sure the old heathen had been delirious. I only chipt in my ante and came along for the fun of the thing. I never expected this."

"Nor I," Brown, the stranded traveling salesman was feasting still doubting eyes on the bulging pay rock, "I put in my share to help an American who was down on his luck in this outlandish country. Great Lord, Professor, would you have thought it?"

Their attention called to him, all turned to the middle-aged, bald-headed scholar who made the fifth member of the party. For a long time he did not reply. They waited expectantly. Finally he sighed. "Maybe Mrs. Groin will leave me alone in my laboratory now, and I'll get a chance to do a little work," he said, and it came from the bottom of his heart.

The walls hurled back their laughter, as, the spell broken by the unexpected viewpoint of the pedagogue, they flung their packs to the cavern floor, and prepared to tackle the many tasks that lay before them.

"You boys go to it," Brown called, kneeling before the packs. "All I know about rocks I learned in thirty days which I won on a D. and D. (drunk and disorderly) charge. I'll take your word for all results. And while you're working I'll cook."

"Admirable suggestion." Professor Groin was flourishing a hammer. "We will be very hungry when the reaction sets in. Archer, shall I sample for you?"

Archer, tenderly drawing from their swathings chemical glassware, called a warm assent. "Go to it, Groin, old top. Something tells me that you are going to be a regular ace in this game."

Groin paused, a fragment of rock from the rich ledge in his left hand. "I am not wholly unfamiliar with the principles of metallurgy," he said, modestly, "altho this is my first excursion into the field, so to speak. Most of my time has been spent in the laboratory. I only came down here to get away from Mrs. Groin."

Brown, mess gear spread before him, paused to remark sarcastically, "You picked a nice, quiet locality."

Groin sighed, and attacked the ore vigorously. "To me it seems quite peaceful," he replied, pathetically.

Benson, his hands on his hips, stood e in the middle of the floor space, his roving restlessly here and there, in manner of a man who is seeking someth which eludes him.

"Fellows," he said, slowly, "listen to I don't know anything to speak of a mines. This thing is all new to me. B do know one thing. I've knocked a a bit, and I've been in some damned corners. And I'm subject to—a hu Every time that I'm threatened with da I get a feeling . . . I can't describe you. I just get it, that's all. And I've it right now—strong."

They all gazed at him uncertainly. one raised a ridiculing voice. There an earnestness in those tones that ca conviction. Finally Small spoke.

"I don't see anything threatening ar here, old fellow," he began, "I—"

(Continued on page 806)

". . . Groin Dropt to His Knees Before the Little Hole. 'Out With the Lights.' He Snapt, and Silently Benson Obeyed. He Could Hear Groin Fumbling in the Darkness. Then Came the Scrape When the Professor Arose. The Single Flickering Beam From His Now Carefully Shaded Electric

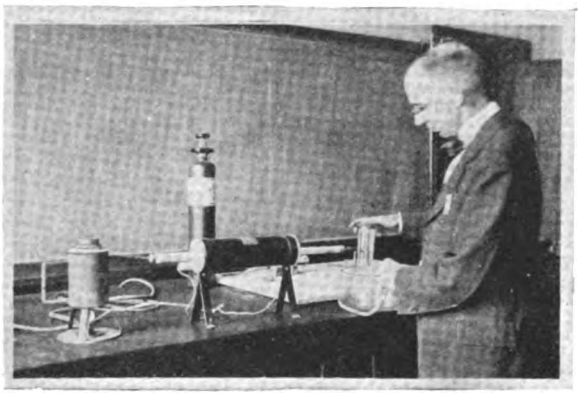
Torch Revealed
Moving Slowly A
From the Spot Where the Bottles Stood, Meth
ically Laying a Train of Bagging Strips Al
'Bagging Soaked in Acid,' He Explained She
the Cavern Floor.
—'The Fuse' . . ."

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

Fire and High Temperature Experiments Including "Thermit"

king Quicklime in Home-Made Electric Furnace.

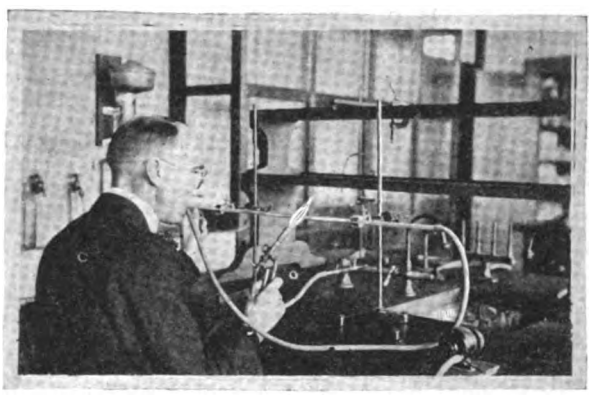


Preparing Hydrogen by Passing Steam Over Hot Iron Filings in an Electric Combustion Furnace.

Ignition of "Thermit" Giving Molten Iron at 3,000 Degrees Centigrade.

At Left:—Burning Iron Wool in the Oxy-Hydrogen Flame. The Cylindrical Tank Contains Oxygen.

At Right:—Making a Joint by Sealing Two Glass Tubes Together. A Delicate but Valuable Experiment.



ROM the days of the *Cave man* to the present moment, the mastery of fire and the attainment of high temperatures have been indispensable to progress in the arts and industries. its aid primitive man cooked his food, hioned his implements and lighted his e. The glare of the open camp-fire d wild animals within his range. Very dually thru his experiences with fire acquired a rudimentary knowledge of arts of pottery, glass-making and the allurgy of the simple ores. With each ance in the degree of heat obtainable in furnaces, have come additional triumphs science and new commercial processes. alchemist in his vain endeavor to trans- e the baser metals into gold, knew no ier temperature than that obtained from burning of good beech wood. Then e coal and gas with the forced draft, to followed by the oxy-hydrogen blowpipe, electric furnace, thermit, the oxy-acety- torch and the explosion of cordite. peratures rivaling those of the sun are within our grasp and subject to our trol. In this article we shall take up e of the sources of high temperatures experiments that can be performed with r aid.

he Oxy-hydrogen Blowpipe: For three- rters of a century the oxy-hydrogen vpipe represented the acme of high tem- ature attainment. The heat of its flame used for glass-working, for making ficial gems, for melting platinum and rever the "highest" temperatures were uired. Its construction is shown in Fig. As will be noted, the oxygen passes thru the inner tube and the hydrogen thru the outer one, the two gases mingling at the nozzle and burning with a fierce heat.

In the absence of a cylinder of comprest hydrogen ordinary illuminating gas may be used with excellent results and in place of a hand blowpipe an ordinary blast lamp will be very satisfactory. A cylinder of comprest oxygen, however, will be indispensable and this can usually be had in any city from companies that use it for welding purposes.

Having wired the rubber tubing securely to the cylinder of oxygen and to the blast lamp, turn on the hydrogen gas and light it. Then very gradually admit oxygen to the blast lamp and regulate the supply of gas and oxygen until you have a small blue flame.

Into this flame thrust the end of a nail or long iron wire and note the vigorous shower of sparks. If this can be done in the dark the effect is exceedingly brilliant. To protect the table from the falling globules of molten iron place beneath the lamp a sheet of asbestos paper or a layer of sand.

The Limelight: First don a pair of smoked glasses. Grasping a piece of quicklime with a pair of tongs hold it in the oxy-hydrogen flame. Almost immediately the quicklime will be heated to brilliant incandescence—dazzling in its brightness. Not so many years ago before the use of electricity had become so universal, the calcium light was the sole source of illumination for stereopticon pictures and the stage. From this latter use comes the familiar expression of "being in the limelight."

It will also be found interesting to try the flame upon other substances such as aluminum, copper and various minerals.

Sealing Glass Tubing: To make a successful joint by sealing together two pieces of glass tubing is a rather difficult operation but frequently one of very great practical importance.

For this purpose either gas and hydrogen may be used or gas and comprest air. For obtaining comprest air a small blower and electric motor are essential. A foot bellows may of course be used but it is never as satisfactory. Instead of the blast lamp a small hand blowpipe, or brazing torch, will be necessary.

First see that the ends of the two pieces of glass that are to be sealed are squarely cut. Then clamp each to a ringstand and bring them into perfect alignment with the ends about a quarter of an inch apart, as shown in Fig. 2. On the opposite end of one piece of the pieces of tubing place a short piece of rubber tubing and clamp it tight with a screw clamp. On the corresponding end of the other piece of glass tubing connect a three-foot length of small-bore rubber hose and take the end of it in the mouth. Now start the blowpipe and reduce the flame to as small a size as possible. First soften the ends of the glass tubing thoroly and evenly and then very carefully bring them together. With the fine needle-like flame of the blowpipe quickly and skillfully soften the glass about the joint, being careful to soften it uniformly about the whole circumference. If the glass sinks in at any point very gently blow thru the rubber tubing held in the mouth. If a bubble appears at any point use very gentle

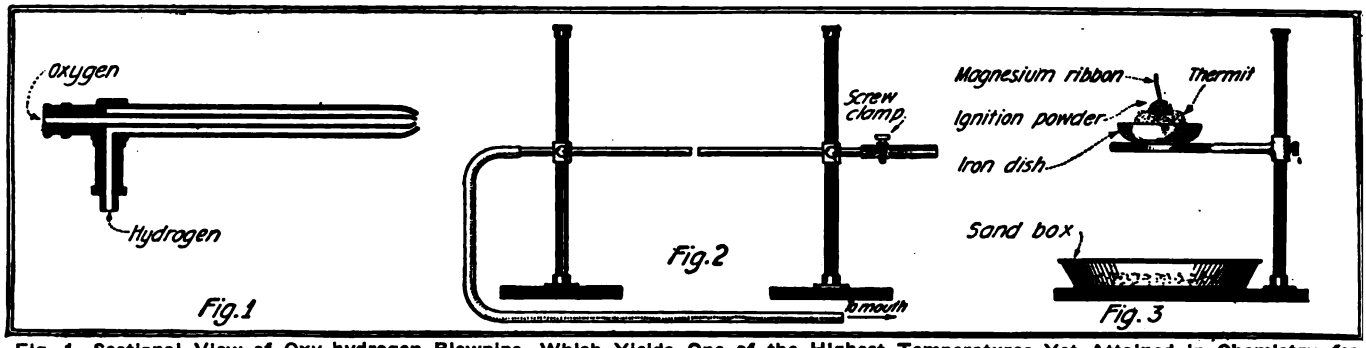


Fig. 1—Sectional View of Oxy-hydrogen Blowpipe, Which Yields One of the Highest Temperatures Yet Attained in Chemistry for Welding, Brazing and Analytical Work. Fig. 2—Showing Two Pieces of Glass Tubing Clamped in Position for Sealing, as Illustrated in One of the Accompanying Photographs. Fig. 3—Apparatus Set Up for Experiments with "Thermit," Which Produces One of the Highest Temperatures Known. Street Car Rails and Many Other Steel and Iron Junctions Are Welded by "Thermit."

suction. The object should be to leave the glass as thick as possible at the joint and slightly larger in diameter than the glass on either side of it. If this can be accomplished the joint instead of being a weak spot will actually be stronger than the rest of the tubing.

A little patience and persistent practise will bring success and skill.

Thermit: Among the most notable triumphs of high temperature achievement is that of *thermit welding.* If you go into the locomotive repair shops of any great railway terminal you will find men wearing large, colored glasses at work tapping white-hot molten steel at a temperature of 3,000 degrees Centigrade from a conical vessel into a sand mold built about the broken parts of some locomotive drive wheel or portion of the frame. These men are employing the "thermit" process and this disabled locomotive will be ready for service within twelve hours after its arrival in the shops. Furthermore, the welded part will be stronger than it was originally.

But what is thermit? The name suggests heat and this is the meaning of the term. Soon after the production of aluminum and the determination of its properties in 1854, it was discovered that, if this metal were heated with one of several metallic oxides, a chemical change of explosive violence would take place, liberating vast quantities of heat and blinding light together with the molten metal at a temperature much higher than its melting point. One of the first metals experimented with was iron and the result was the production of the superheated, liquid metal at nearly double the temperature of molten steel.

The thermit mixture consists of aluminum dust and iron oxid and the chemical change which takes place is exprest by the following equation:

$$2Al + Fe_2O_3 = Al_2O_3 + 2Fe.$$

Homemade Thermit: These high temperatures may be easily produced in the home laboratory and very striking demonstrations carried out.

Mix about equal quantities of aluminum dust and red iron oxid, or ordinary rouge, and place the mixture in a small iron or tin dish mounted on the ring of a retort stand, as shown in Fig. 3. Beneath it place a small box containing an inch-layer of sand. In a little depression in the top of the mixture place a half teaspoonful of ignition powder, made by mixing equal parts of magnesium dust and powdered potassium chlorat, and into it thrust a short length of magnesium ribbon.

Light the magnesium ribbon and with great rapidity the reaction will spread thruout the mixture, producing intense light and liberating white-hot molten iron, which will melt a hole thru the iron dish and flow in a stream of dazzling brilliancy into the sand box below.

Melting a Hole Thru a Sheet of Iron Beneath Water: A unique variation of this experiment consists in arranging apparatus as shown in Fig. 4. In the bottom of a good-sized battery jar place a 2-inch layer of sand. On this layer of sand place a small tripod covered with a thin sheet of iron. Fill the jar two-thirds full of water, set it on the base of a retort stand. On the ring above place a folded filter paper containing a mixture exactly like that used in the previous demonstration. Upon igniting the thermit the molten iron will drop thru the water and striking the sheet iron will melt a hole thru it.

Thermit Welding: Obtain a 2-inch length of hollow tiling about an inch and a half in diameter and place it on a sheet of soft iron or steel about a quarter of an inch in thickness. Fill the tile with a mixture of thermit with ignition powder and magnesium ribbon at the top. Upon ignition the molten iron will run to the bottom and fusing with the sheet of iron beneath will weld upon it a boss which cannot be removed by the most vigorous hammering. It will be noticed, too, that the sheet of iron has been softened clear thru.

Electric Furnace: Still higher temperatures than any already described are obtained with the electric furnace. Electric furnaces are of two kinds—*arc* furnaces and *resistance* furnaces. Either type of furnace can be made by the amateur but the former more readily than the latter, principally for the reason that the Nichrome wire necessary for the resistance furnace is controlled by patents and it is practically impossible for anyone other than a licensed manufacturer or an educational institution to obtain it. Resistance furnaces, however, of both the combustion and the crucible types can be purchased, and they will b found exceedingly useful.

Making an Arc Furnace: The material necessary for this furnace are fire clay asbestos fiber and water glass. A mixtur of these ingredients will quickly dry an harden into a fireproof mass of low hea conductivity.

First select a box about 8 inches long an 4 inches square. Bore a hole a little abov the center of each end just large enough t take a standard arc light carbon. The mix some of the fire clay, asbestos fiber an water glass until a doughy mass is obtained and pack a layer one inch thick in the bot tom of the box, forcing it down as firml as possible. Now insert an ordinary glas tumbler in the center of the box and thrus two wooden pins the size of light carbon into the holes at the ends. Around thes pack as tightly as possible more of th mixture, completely filling the box. Se Fig. 5. Smooth off the top and fill i the cavities with a mixture of fire clay an water glass alone. In similar manner mak a cover of the same size and about an inc thick. Place the box and contents togethe with the cover in some warm place, prefe ably on the top of a furnace and allow the to dry for several days. At the end of th time the box may be broken away and th tumbler and pins removed. The rough ap pearance of the outside may be remove by retouching with a little fire clay an water glass.

Now insert in the holes at the ends tw electric light carbons to which stout piec of copper wire have been securely fastene With a suitable resistance in series the fu nace may be connected directly to a hous lighting circuit. Upon striking the arc b bringing the carbons together and th slightly separating them, a blinding ligh and intense heat will be obtained.

Try its temperature by placing in the a pieces of various metals, lime, quartz, et In a small fire clay crucible placed into th cavity just beneath the arc, metals may b melted and fusions made.

Producing Hydrogen With the Combu tion Furnace: If your laboratory affords *resistance furnace* with a silica combustio tube, a number of very interesting exper ments may be performed.

(*Continued on page* 814)

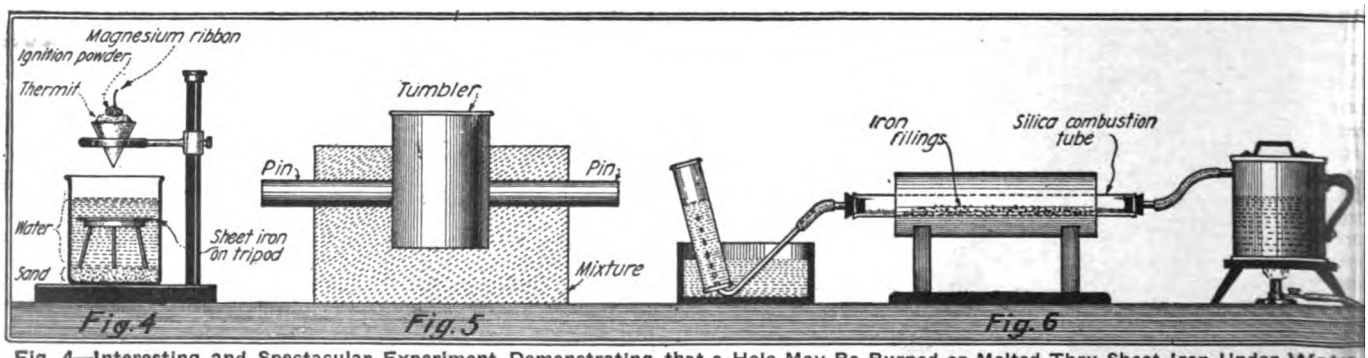


Fig. 4—Interesting and Spectacular Experiment Demonstrating that a Hole May Be Burned or Melted Thru Sheet Iron Under Water. "Thermit" Is Used in This Experiment. Fig. 5—Extremely Simple Plan for Constructing an Electric Arc Furnace Employing Two Arc Lamp Carbons for Electrodes. Fig. 6—Making Hydrogen by Passing Steam Over Hot Iron Filings in an Electric Furnace.

THE CONSTRUCTOR

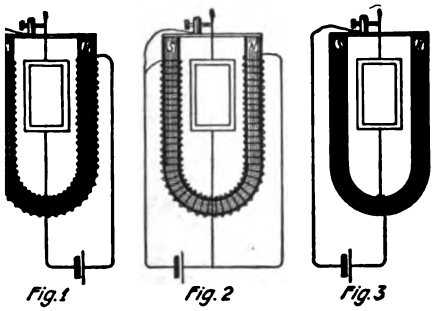
Constructing a Demonstration Motor

By C. A. CLARK

THE accompanying diagrams and photo show a simple form of electric motor which I have used considerably in emonstrating the principles of motors to igh school classes in physics and which tudents of electricity will find of interest, am sure.

To operate the motor with a permanent iagnet field, the horseshoe type steel mag-et is mounted in an upright position as shown in the drawing. A powerful magnetic field is induced between the north and south poles, as we know. In this field is supported in a freely rotating manner the armature, which is formed of several turns of No. 14 B. & S. gage bare copper magnet wire. A piece of wire 28 inches long is sufficient usually. The armature turns are held together at A and B with a few turns of silk thread, or fine insulated copper wire.

The upper bearing is made of hard rubber or fiber, and the lower bearing of brass or copper with a cup-shaped depression formed into it, in which the pointed end of the armature wire may rest, and also to make contact with one side of the circuit, as is evident from the diagrams. The upper end of the armature is bent slightly so as to make contact once in every revolution with the contact brush held in the brass side-screw shown. This motor will operate at high speed on one cell of battery. Those wishing to experiment with or demonstrate the principle of the series and shunt wound motor, may do so by substituting a soft iron bar of the same shape as the horseshoe magnet, the legs of which are wound with cotton covered magnet wire, or simply annunciator wire, using about No. 18 or 20 gage wire for the purpose.



iagram at Fig. 1 Shows How to Connect p Field Coil and Armature to Make a Series Motor.
ig. 2—Shows Connections for Shunt Wound Motor with Wound Field and Armature.
ig. 3—Shows the Simple Connections for sual Form of Demonstration or Toy Motor, aving an Armature of Several Turns of ire and a Simple Field, Composed of a teel Horseshoe Magnet with No Coils Wound Upon It.

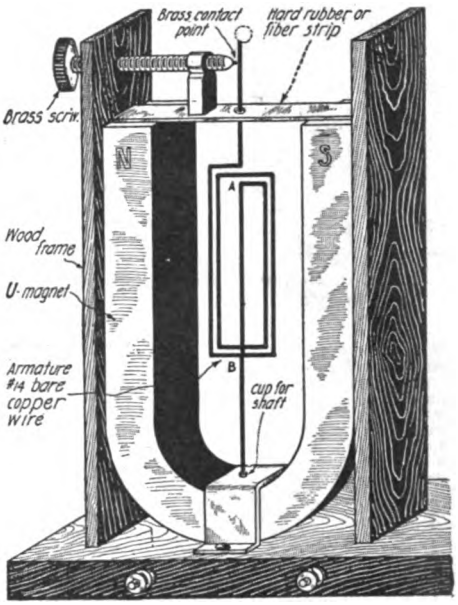


Illustration to the Right Shows How Author Constructed the Simple Demonstration Electric Motor Which Will Prove of Interest to All Electrical Students. It Operates on the same Principle as the Larger Motors Which Run Our Trolley Cars and Various Other Machinery and Devices.

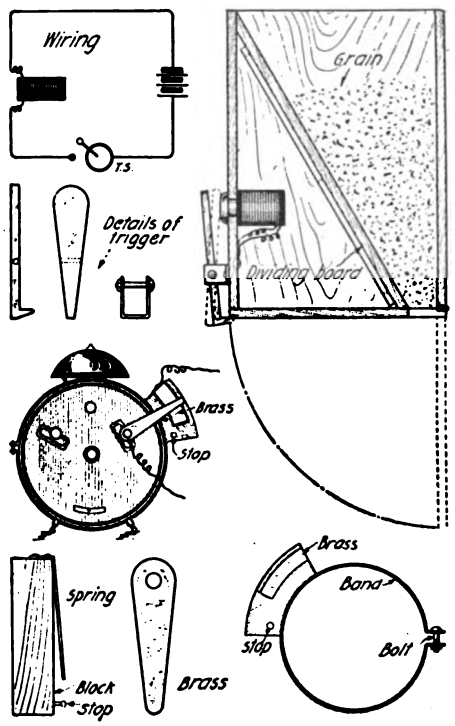
Electrically Operated Poultry Feeder

By GEORGE E. PERKINS

WHEN keeping poultry and it is necessary to go away for the day, arriving home late at night, it either eans that the birds lose their evening meal the neighbors have to be troubled with eeding them. A feeder that will autoatically feed the birds at a predetermined our does away with all this bother and it n be used even when at home, as the hopr can be filled in the morning when feedg and at night the chickens will be fed at y hour decided on. The following deribes such a feeder:

A box is made in the shape shown, with hinged door at the bottom and a thin oard dividing it into two parts. This is done r two reasons, first to prevent the grain om running too fast and second to take e weight off the trap door, for if the en-e weight of the contents was allowed come on the door it would require an tra large magnet to trip the device.

The tripping device consists of an electro-gnet, which attracts an iron armature, hich has a hook at the end to hold the or in place. When the magnet is ener-ed it attracts the armature pulling the ok from the door, allowing it to open and e grain to flow. The magnet may be tained from an old bell or telegraph inrument or else made from a soft iron re ⅜" dia., by 3" long, wound with 14 ers No. 20 cotton covered magnet wire. he grain dropping from the hopper strikes cone shaped tin deflector, which is tened to the hopper by means of two ap irons, and is spread in a fairly large rcle, thus allowing the hens to get it without crowding.



When You Wish to Go Away, but Still Do Not Wish to Deprive the Poultry of Their Regular Meal, This Alarm Clock and Electric Switch Arranged for Dumping the Grain at a Predetermined Time, Is Just the Thing. A Few Dry Cells Furnish the Necessary Power for Actuating the Elecro-Magnetic Trip on the Bin Door.

The time switch which operates the device is easily made and can be used for a number of uses other than this device. The principal part consists of an ordinary alarm clock. To the top of the key that winds the alarm spring a binding post, taken from a discarded dry cell, is soldered. This is used to hold the switch blade and also for a connection for the wiring. A block of wood is cut to the shape shown and a flat piece of brass is fastened to it as shown for the second contact. This piece should be allowed considerable spring, so that the blade when passing over it makes good contact. A screw below the spring acts as a stop for the blade. This block of wood is clampt to the side of the clock by means of a band of metal drawn tight by a bolt.

The action of the device is simple. The alarm is set in the ordinary manner, with the switch blade in a vertical position. The hopper is filled with grain, the trap door being held up by the hook. When the hour for which the alarm is set arrives the blade passes over the brass spring, as the key which holds the blade commences to revolve, the circuit is completed, the magnet energized and the armature attracted, tripping the door and allowing the feed to flow. After passing over the spring the blade is stopped by the screw and as it is not in contact with the spring no current is used except for the second in which the blade is passing over the spring.

The clock and battery may remain in the house or the clock with the battery may be contained in a box located near the hopper. The clock may be used the same as usual when it is not in service as a time switch.

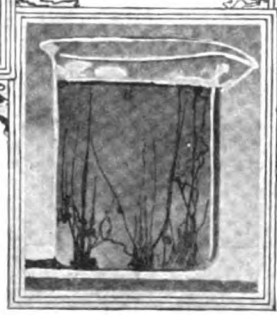
The Chemists' Flower Garden

By DR. E. BADE

IF science continues to advance as rapidly in the future as it has in the past, man will not depend upon methodical Nature to produce life. Chemistry will supplant her and with the aid of diabolical mixtures it will be able to produce living things. Why should we plant seeds, patiently wait for germination to take place, coddle and care for the delicate seedlings, only to have them killed by the frost, burned by the sun, or mown down by the hail, when the chemist can produce and deliver the finisht product to the consumer?

These and similar baseless opinions are often heard among all classes of people. But it is an absolute fact that plants can be produced artificially, altho not as the fantastic hopes of the most enthusiastic optimist have pictured. That which science has produced resembles the plant in appearance, grows and develops as one, has twigs, leaves, and protuberances which closely resemble fruits. *But the vital spark of life is absent.* They are as dead and as cold as the stones themselves. The divine touch of giving life to inanimate things has not yet been given to man. But science can produce seeming life. A seeming life so realistic that the uninitiated are dumb with wonder.

The Chemical Plant Structure Shown Below Resulted From Dropping a Small Crystal of Cobalt Nitrate Into a Portion of Water Glass Solution, Formed by Mixing Two Parts of Sodium Silicate to One Part of Water.



By Dropping a Chemical Seed Into a Clear Transparent Liquid, the Seed Begins to Germinate After a Few Seconds. The Plant Above Resulted From a Crystal of Aluminum Sulfate Dropt in a Water Glass Solution Diluted with Water.

Such an effect can be produced with the chemists' flower garden. A chemical seed dropt into a clear transparent liquid *begins to germinate after a few seconds of expectant watching.* The impossible has been accomplisht. *Spontaneous germination* is a fact! But watch! Already a long shoot has been developed, it grows momentarily longer, it stops, seems to hesitate, when suddenly a protuberance is formed. The fruit! Another shoot has meanwhile reached the surface of the liquid, begins to spread, and a leaf or two has been developed.

The Jar Shown Below Contans a Chemical Tree Grown From a Manganese Sulfate Crystal.

Center View Shows a Typical Chemists' Flower Garden, While the Lower Picture Shows Chemical Tree Grown From Cobalt Nitrate.

The liquid used is ordinary water glass slightly diluted with water. (Two parts of sodium silicate to one part of water.) For seeds, crystals no larger than one half or one quarter of the size of a pea are taken of the following substances: Cobalt nitrate, a red crystal which slowly changes its color to a chlorophyl green as it grows; nickel nitrate which produces fine laminated tendrils with lightning like rapidity, manganese sulfate which produces protuberances from which other shoots make their appearance, and ferric chlorid which develops thick gnarled twigs and thin laminated shoots from which leaves soon begin to grow. Aluminum sulfate, which are white crystals, form thin delicate shoots in the liquid.

The Specimen of Chemical Plant Growth Shown Below, Resulted From Dropping a Crystal of Ferric Chlorid Into a Beaker Containing Some of the Water Glass or Sodium Silicate and Water Solution. Some of the Prettiest Growths Imaginable Result.

The Vessel Shown Above Contains a Very Beautiful Specimen of Chemical Plant Growth, Formed by Dropping a small Crystal of Nickle Nitrate Into a Beaker Nearly Filled with Water Glass Solution. It Is Surprising How Quickly This Grew.

A number of these crystals placed into a tumbler of the liquid soon begin to sprout and the heterogeneous mass with its various colored bands, threads, knotty twigs, and leaves give a fine example of marine plant life among the corals.

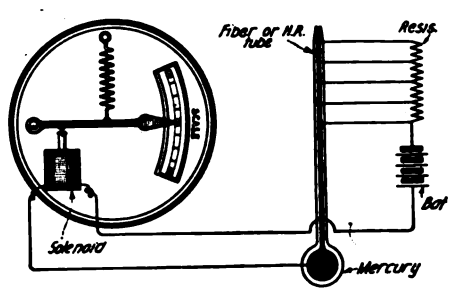
All the plants which have been produced with these chemicals are one-celled just as are the plants of the ocean.

Automatic Temperature Indication

Herewith is a description of an automatic temperature indicator which I have found useful. A glass tube of the desired length is obtained; about eight inches is the right length. It should have an internal bore of about ⅛ inch. A bulb is blown on one end by means of a Bunsen burner flame. A scale is now made for your thermometer. Place the tube against the scale in the position in which it will be permanently placed. Now determine as accurately as possible the temperature of the room. Then pour enough mercury of the same temperature into the tube till it rises to the height on your scale corresponding to the temperature of the room. Scratch on the glass tube this exact point and pour out mercury. This will help in mounting.

We will assume that you wish to have your indicator show all temperatures between seventy and eighty degrees in two degree increments. On your tube then mark off with a file five places corresponding to the divisions of your scale between seventy to eighty degrees.

At each of these places seal a short platinum wire so that the mercury will make contact with these wires as it rises and falls in the tube. A wire must also be sealed in the bulb.



Simple Form of Electric Thermometer, the Temperature Being Indicated by the Successive Positions of the Needle, Actuated by the Solenoid Magnet Coil.

The indicator is made in the following way: A piece of wood circular in shape and about ¼ inch in diameter is procured. A diameter of three inches is about right.

An indicator arm is mounted so that it free to move back and forth. A solenc is mounted so that an arm moves dow ward when the current is turned on. spring is mounted on the upper circle of t base. The diagram will explain this a rangement better than words.

The top of the thermometer tube is l open. It must, of course, be kept in an right position.

The hook-up is given in figure. T pointer will, when at rest, point to 70 grees or the lowest temperature on y indicator scale. A low resistance coil connected between the thermometer points.

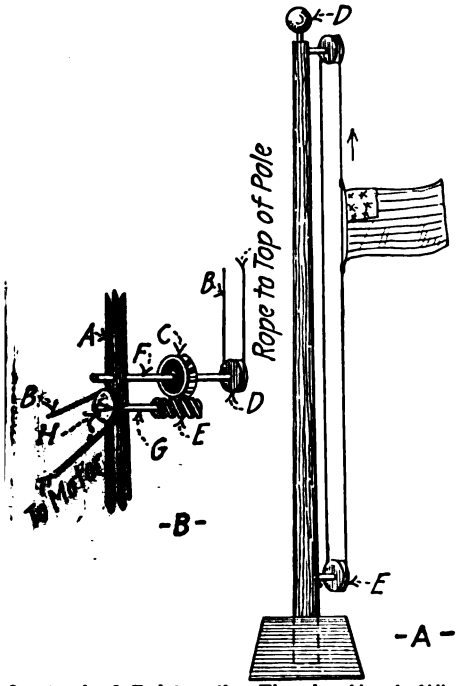
Some little experimenting will be quired to accurately calibrate the inst ment.

I use my instrument to tell me when "hot-house" is getting too warm. The th mometer is of course placed in the h house. The "indicator" may be placed a where. Thus you can tell the temperat of a room in one part of the house, dc in the basement, etc.

Contributed by BURT CLARI

RAISING THE FLAG "BY MOTOR."

Here is an idea that might interest some patriotic experimenter. It is an idea for raising and lowering "Old Glory" by motor. Fig. A shows a method of fixing the flag to the pole. Fig. B shows how to



Instead of Raising the Flag by Hand, Why Not Raise It by Motor? The Gearing Required for the Purpose Is Simple, and the Motor Power Required Is Quite Small in Most Cases. By Balancing the Flag with a Weight, However, the Power Required Will Be Small.

arrange the gears. The flat gear C and pulley D are placed on the axle F. The axle G has a worm gear meshing with gear C. The pulley H is connected by belt B to the motor.

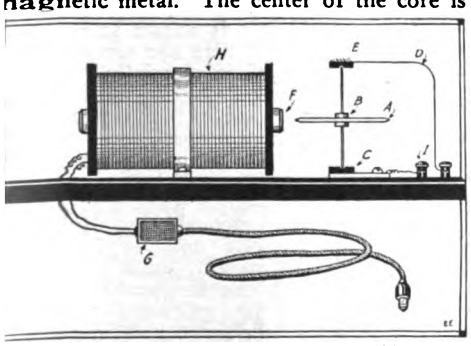
Of course any system of gears can be used. If no reduction is desired, the motor can be placed where pulley E is in Fig. A. If no pulleys can be had, a pin or nail can be used in place of pulley D in Fig. A. The pole can be of wood.

If the gear system shown in B is used, the ratio can well be twenty to one.

A SMALL SYNCHRONOUS MOTOR.

Upon a base about three inches long is mounted a brass support, D, with 3 screws, . It is made of a strip of brass bent at where the screws go in, at the top bearing, and the bottom bearing, where only one hickness is drilled and a small piece of glass is inserted between the upper and ower thicknesses. This makes a good earing.

An electro-magnet, H, is fastened to the ase with a piece of brass or other non-nagnetic metal. The center of the core is



he Simplest Form of Synchronous Alternat-g Current Motor Is Probably the One Here own. Altho Small in Size and Power, It ay Be Used for Many Scientific Laboratory equirements Such as for a "Time Shutter," Et cetera.

ranged a little above the armature, so it ill not bear so heavily on the bottom earing. The core is about ⅛ inch away from the armature. A small transformer is used (this motor cannot be run with batteries) to run the motor. The armature is a piece of clock-spring or other hard steel, A, about 2 inches long. A hole is punctured for the shaft, which is a large sewing needle, E. The armature is fastened on the shaft with an eraser, B, from the end of a pencil. It is cut in half and forced on the shaft. The steel armature is magnetized by a horse-shoe or other magnet.

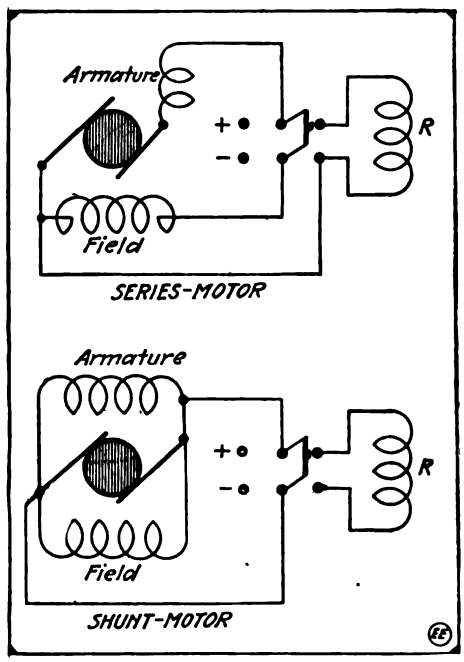
To start the motor turn on the current and give the shaft a twist. You may not be able to make it do much for the first time, but after a while you will be able to make it go any one of two or three different speeds.—Contributed by

THEODORE D. PECK, Jr.

ELECTRIC BRAKE FOR SMALL MOTORS

Often it is necessary to have a motor stop immediately as in the case of a rotary spark gap. This is best accomplished by the use of an electrical brake very simple to construct. For small motors the resistance "R" should be of 60 ohms value or more, accurately obtained by experiments. When the motor is to be stopt the power switch is drawn out and thrown in on the opposite side. The counter E. M. F. developed by the armature is taken up by the resistance "R" and the motor is brought to a quick stop. Connections for two kinds of motors are shown in the diagram.

Contributed by MONTE COHEN.

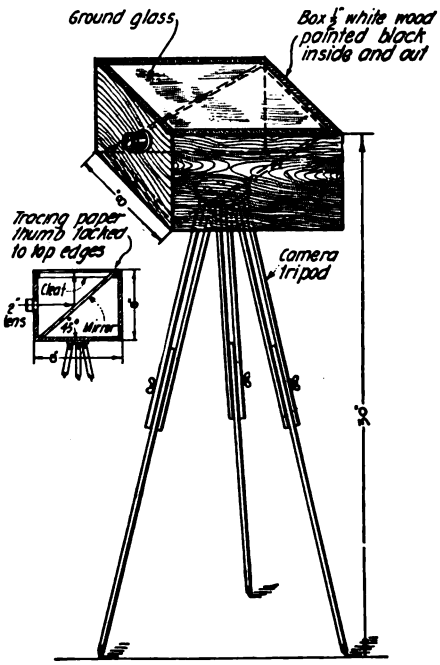


One of the Most Powerful Brakes Available for Stopping Electrical Machinery Is the "Electro-Dynamic" Brake, and the Method of Adapting It to Series and Shunt Motors Is Shown Above.

ENGINEERS' PERSPECTIVE OUTLINER.

In checking up perspective work and complete layouts of factories, and any work in fact, a great help is to have a tracing of the outline as is existent. Make a box of ½" white wood 8"x8"x8" (bottom only), insert a cheap lens, adjustable or not, and fix in place a piece of good mirror glass, set at 45° and held in place by thin strip of wood and glued fast. Set in the top a piece of ground glass flush with top. Use old camera tripod and screw fast to bottom. A small pocket level laid on top glass will simplify the leveling of the box. Place the instrument in position so that the object is shown on the top glass; stretch across the top a piece of tracing paper (oiled paper), and sketch off the object, after which, in completing the drawings this sketch of the general outline will serve as a help to all engineers and draftsmen. The principle is the same as a camera "finder".

Contributed by P. P. AVERY, M. E.



Herewith Is Illustrated a Simple and Accurate Form of Perspective View Outliner for Engineering and Other Sketches, the View or Object Being Thrown Up by the Lens on to the Ground Glass Screen, Over Which the Tracing Paper or Cloth Is Secured.

MUSIC ELECTRICALLY

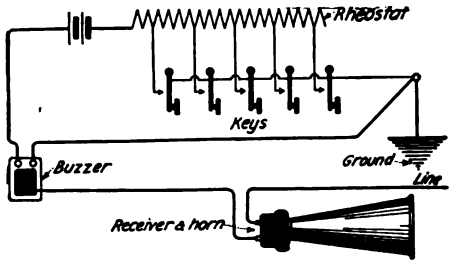
Radio Bugs, wake up, for here is something new to put your wireless instruments to, or some of them at least. Suppose you were reading and your wireless instruments began to play music. Ten to one you would stop reading and listen to them. You can do this if you have a mind to, and still have your wireless instruments with very little trouble.

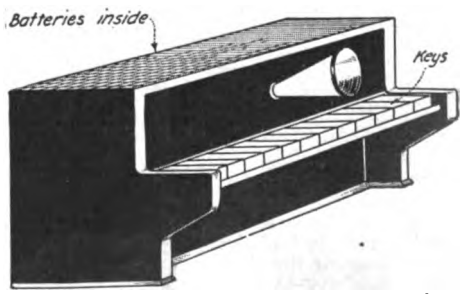
This is a new sport. Instead of sending messages you send your friend music over the telegraph line, and he sends you music back. It is very entertaining.

Pictures show clearly how it is done. The following instruments are used: rheostat, receiver and horn or head-set, buzzer, batteries, and keys which are home-made, or else use old doll piano.

Tap rheostat as in diagram to get different notes and pitches.

Contributed by H. SCHLIESTETT.





By Means of a Graduated Resistance or Inductance Used in the Way Here Shown, Musical Notes Can Be Sent by Wire or Wireless, in Connection with a Buzzer Used as a Generator.

Electrical Machinist

By H. WINFIELD SECOR

NO. 12—CONSTRUCTION WORK DETAILS.

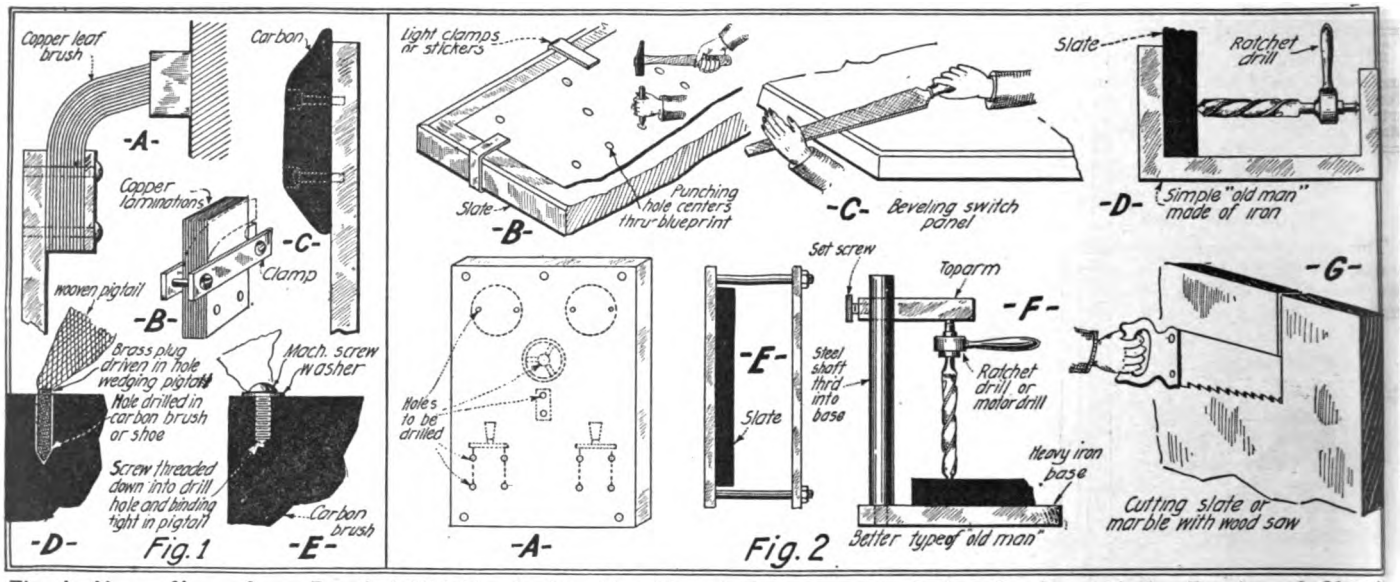


Fig. 1—Above—Shows Some Practical Wrinkles In Attaching Pig-tail Connections to Carbon Brushes and the Forming of Circuit Breaker Multiple-Leaf Contacts. Fig. 2—Illustrates Some Practical Details Met With In the Construction and Drilling of Slate and Marble Switchboards.

SEVERAL hints of practical value and useful to the man who has to do the work are given below. At Fig. 1 several wrinkles are shown, covering carbon brushes and multiple-leaf contacts on circuit-breakers. Figs. A and B show a multiple-leaf brush for circuit-breakers and other electrical switch gear, and the method of clamping the leaves while they are filed true on their face and then bent to the desired shape. Usually the outside sheet is of heavier copper, polisht or buft up and lacquered, which serves to help hold the contact leaves in their curved form. The end of the multiple-leaf contact where it bears against the brass or copper contact block on the base of the switch, as shown at A, must be filed very evenly and carefully, in order that all of the leaves shall touch the block.

At C is shown the method of attaching carbon break blocks to circuit-breakers. D and E, Fig. 1, show two methods of attaching woven wire pig-tails to carbon brushes by means of a block driven into a pig-tail down into a drill hole, or else threading a screw into the pig-tail after being pusht into a tight-fitting hole.

BUILDING SWITCHBOARDS.

Some practical shop wrinkles followed in building slate and marble switchboards will probably be found of use by the electrical machinist and several suggestions in this direction are clearly illustrated at Fig. 2.

At Fig. 2-A a typical layout for a small lighting plant switchboard is indicated. At B is shown a very good method of laying out the holes that are to be drilled thru the switchboard. Here a blueprint, which is often furnisht with apparatus to be mounted on a switchboard by the builders, is laid out on the face of the slate or marble slab and is best anchored in its proper position by means of paper stickers or light clamps. When it has been properly set, and the holes to be drilled finally decided upon, they can be prick-punched thru the paper with a steel punch and a hammer.

Where holes are to be accurately drilled, such as those for accommodating the studs of voltmeters and ammeters, knife switches, etc., which applies to practically all switchboard work in general, it is best not to attempt to drill the large full-size holes required at first, but to drill all of the holes thru the panel from the prick-punch marks with a small drill about one-eighth inch in size. Where very great accuracy is desired in the spacing of the holes it is good practise to drill the hole with increasing sizes of drills, until the largest drill necessary is finally brought into play. This method will also be found valuable in drilling holes accurately thru metal. Always drill the holes in switchboard plates or marble panels from the front—that is, the polisht face or the one having a bevel around its edges —and not from the back, as invariably when the drill comes thru the stock a piece will be broken out. Water can be used as a lubricant in drilling or cutting slate and marble.

It is difficult to bevel the edges of large size switchboard panels with a file, unless a jig is made for the purpose, so that the bevel can be cut evenly; but on small panels the operation can be carried out with a coarse file, as at C, Fig. 2, the bevel being finisht off with a sandpaper block.

D and E, Fig. 2, show a simple and also a more substantial method of providing an iron support frame between which and the switchboard panel to be drilled a ratchet drill can be placed in order to obtain the necessary pressure to pierce the stock. Such drilling frames are frequently called *"the old-man,"* and a typical old-man is shown at F, Fig. 2. This type has an adjustable arm which slides along an upright standard formed of a piece of steel shafting threaded or riveted into the iron base plate.

These drilling appliances will be found of the utmost value, and, in fact, are of great importance on outside jobs, shop work and in the factory, where switchboard panels have often to be drilled.

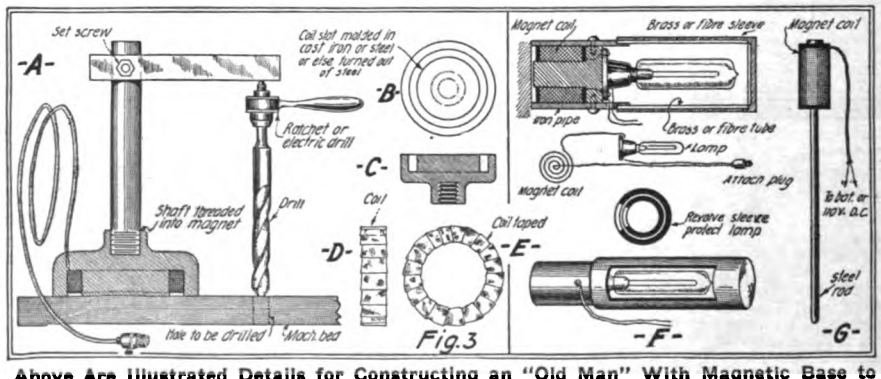
At Fig. 2-G an operative is shown cutting a slate panel with a wood saw. An old wood saw is generally employed for the purpose, and water is constantly applied while the cutting operation goes on. If a buzz saw is used in the shop for the purpose it should have fairly coarse teeth, as if the teeth are too fine they will fill up so rapidly that the saw will simply heat and not progress thru the stock. This remark applies to slate, marble and soapstone panels.

ELECTRICAL HELPS FOR THE MACHINIST.

A magnetic old-man is shown at Fig. 3, A, B, C, D and E. There are many locations, especially in drilling holes in difficult positions on various machines, away from the shop or in the factory, where this device will be found extremely practical and useful. Not only is it convenient, but it will save time frequently lost by the machinist or his helper looking for bolts.

The working details for building this magnetic old-man will be readily obtained from the drawings. The design of the base

(*Continued on page 800*)



Above Are Illustrated Details for Constructing an "Old Man" With Magnetic Base to Hold It In Place While Drilling Operations Are Carried On, and Also Details for Constructing a Magnetic Base "Trouble Lamp" As Well As a "Search Rod" for Removing Steel Particles From Drill Holes.

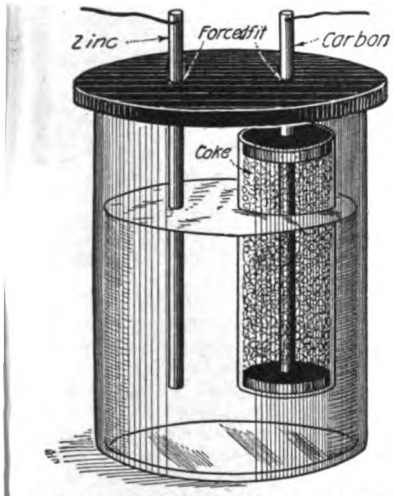
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; Second Prize, $3.00; Third Prize, $2.00. The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

A CHEAP BATTERY.

The materials needful for the battery are a rod of zinc, a piece of arc light carbon, two round pieces of wood about three inches in diameter and half an inch thick,



Experimental Wet Cell Having a Zinc Pole and a Carbon Pole Surrounded With Coke.

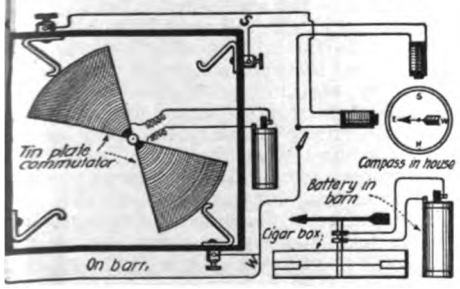
a little powdered coke, and some flannel. the diagram the way in which the parts are assembled is shown. The round pieces wood have holes in them large enough admit the carbon. The flannel is tied ound the carbon. Often it has been filled e a bag with coke; this should be tightly ckt into place. The zinc and carbon ds can be supported by a cross piece of ood with two holes resting on the top the jar. Wires are attacht to the ends. the two rods. Finally fill the jar about o-thirds full with a solution formed of ree ounces of sal ammoniac to half a llon of water.

Contributed by
S. LEONARD BASTIN.

A WIRED-UP WIND VANE.

The diagram shows quite clearly all connections, and the only problem to conquer the winding of the coils; also, when putting in new batteries, be careful not to change the polarity.

Contributed by ESTEN MOEN.



An Electric Wind Vane Constructed From a Compass, a Two-pole Switch, Two Magnet Coils and a Battery

SECOND PRIZE, $3.00

"WIREFENCE" TELEGRAPHY.

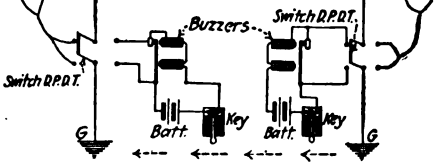
QST! QST! QST! Hello! fellow "bugs." Hope there won't be too much QRM when you read this. Did u kno that wirefence telegraphy is "coming in"? It is.

In the country we are often far apart, but I believe I have now spanned the difficulty and the "Country Bugs" may hold communication and practise code between themselves, even tho they may be two or three miles apart. This is not merely a suggested experiment, but a tried system. A fellow "Bug" and I, about two miles apart, have been racking our "cocos" for some time to find a suitable telegraph system that would not drain the purse on account of the H. C. W. (High Cost of Wire). So I have finally discovered the following cheap and simple means.

To most amateur experimenters I believe the diagram will explain itself, but I will help out by describing and explaining the system.

As per the subject of this article you will likely infer that a wire fence has something to do as a medium of connecting stations, and so it has, as you will soon see.

Most farms now have wire fences surrounding and dividing them. So with few connections between stations a continuous connection may be had by connecting joints and corners with telephone wire, after points have been scraped bright. Connecting two fences on opposite sides of the road may be done by passing a wire under the road



"Wirefence" Telegraphy Is Quite Common In the West, Where Long Wire Fences Are Used To Separate the Great Cattle and Agricultural Tracts.

thru a culvert or sewer pipe where convenient.

As per the diagram all that is used in sending the signals is a common buzzer, key and battery of one or two dry cells. A high frequency buzzer, like the Radiotone, is much better than the common buzzer. Receiving equipment is simply a set of phones of low resistance, preferably of about 75 or 80 ohms, altho wireless phones will do; but the low resistance phones respond much louder.

For convenience a D. P. D. T. switch is used to transfer from *sending* to *receiving* and vice versa. A good ground, such as used for wireless, is important for longer ranges than two or three miles.

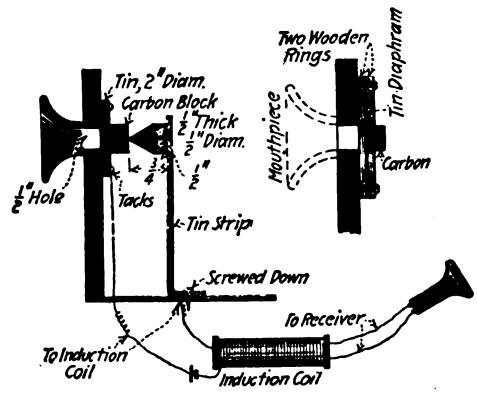
Altho the fence is grounded to some extent in many places, it does not hinder the signals from coming in perfect and strong.

Contributed by
RALPH D. STURIN, de 8AJ.

THIRD PRIZE, $2.00

MAKING A SENSITIVE MICROPHONE.

Take a cigar box and cut a hole ½ inch in diameter in the back of it. Then get a piece of tin 2 inches in diameter and glue a piece of carbon ½ inch thick and ½ inch in diameter on it in the center and then tack



Simple Experimental Form of Microphone—Particularly Sensitive When Used With An Induction Coil.

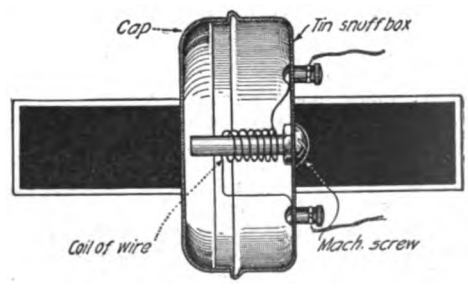
(best to evenly clamp with a second wooden ring) the tin with carbon over the hole in the box. Now take a pointed piece of carbon as per illustration and glue it on a strip of tin that is long enough to reach from the base to the center of the hole; then assemble as the diagram shows.

Contributed by
THEODORE FORTENBAUGH.

A "TIN BOX" TELEPHONE RECEIVER.

First procure a clean snuff box made of tin (A-1) and drill or punch a hole in the bottom, ⅛" in diameter. Into this, fasten a stove bolt with two burrs, one inside and the other outside, and have the end of the bolt just a fraction of an inch from the cover. Now insulate the bolt and wind on some fine magnet wire, about No. 34 to 36 B. & S. gage. Bore two more holes and insert a pair of binding posts, and attach the two terminals of the coil. Now put on the cover and she's "O. K." Simple, eh?

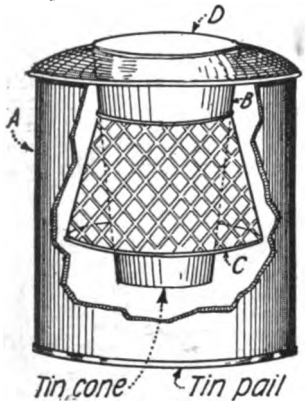
Contributed by ESTEN MOEN.



Ever Want a Telephone Receiver In a Hurry? Here's How To Make One—and All You Need Is An Iron Stove Bolt, a Tin Can With Cover and Some Magnet Wire.

AUTOMATIC ICE CREAM FREEZER.

Herewith is a description of a freezer I made last summer which produces a fine ice cream or ice, without turning or stirring. Take a candy pail, the size depending on the builder's requirements. Now get some heavily tinned plate and make a cone-shaped vessel, similar in shape to a lemonade shaker, about six inches in diameter at the top and one inch at the bottom and fourteen inches long, is a good size. Now get a piece of heavy screen wire and make a cone-shaped container, C, as shown, which goes around the top of the freezer can, B, and extending half way down the sides. Next make a light lid, D, and the freezer is finished. To use, fill the salt sieve, C, with crushed rock salt and slip on the container, B, as shown. Then place in the bucket, A, and pack all around with crushed ice to which has been added 25 per cent salt. Then put the ice cream mixture in the container, B. Put on the lid and allow it to set about an hour. The ice cream made is exactly similar to that frozen in any freezer. The cone shape prevents the ingredients from separating and the heavier parts from settling to the bottom.



The Latest Thing in Ice Cream Freezers—the Kind You Do Not Have to Turn for Half an Hour or So. In the Accompanying Article the Author Describes How to Build One. It Comprises Three Simple Parts Which Anyone with a Little Ingenuity Can Readily Construct or Else Have Made at Small Expense by Their Local Tinsmith. Cracked Ice, to Which Has Been Added a Considerable Quantity of Salt, Serves to Freeze the Liquid Placed in the Container B, in About One Hour.

Contributed by A. H. WAYCHOFF.

A LEAD TREE.

Put an ounce of sugar-of-lead in a quart of water; shake it well, let it remain for three or four days. Pour off slowly the clear solution only, into a bottle and suspend a piece of zinc in it. Do not disturb this and in a few days the resemblance of a tree in crystalline form will be seen in the bottle.

Crystallized Tin: Mix half an ounce of nitric acid, two of water, and six drachms of muriatic acid. Pour this over a hot tin plate, and feathery crystals are thus produced on the surface.

Contributed by EXWYZED.

MAKING METAL PATTERN LETTERS.

To make metal pattern letters, the letters are first cut out of heavy cardboard and glued on a strip of wood, as shown in Fig. 1. A thin strip of the board runs from one letter to the other as shown, with a gate and riser print at each end. These letters are now oiled and a plaster of Paris cast taken of them. After the plaster has set they are lifted off. Now get a soft pine board and drive the points of fine tacks in it, taking care that the heads of the tacks come down where the mould for the letters are. Lay this board on the

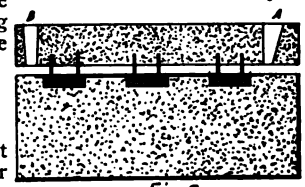


Fig. 2

Fig. 1

To Cast Metal Letters, the Latter Are First Cut Out Heavy Cardboard and Glued on a Strip of Wood as Fig. 1. A Channel as Well as a Gate and Riser Are Made at Each End of the Mould. The Tacks Shown Are Moulded Into the Lead Letters and Serve to Anchor Them in Place Wherever They May Be Used.

plaster as shown in Fig. 2, and cut a gate A and riser in it. Pour melted lead in the gate A.

The lead runs the letters, and around the head of the tacks. The board is then removed which leaves the letters with the points, ready to push into the pattern, doing away with trying to fasten them with brads. This is a foundry kink I used for years.

Contributed by A. H. WAYCHOFF

How to Use a Chemical Balance

By THOMAS W. BENSON

THERE are certain methods of using a chemical balance that add appreciably to the speed and accuracy of the weighing. Those taking up the study of chemistry or whose duties demand the use of a balance may find these paragraphs of assistance.

A sensitive balance should rest on as firm a foundation as posible. Excessive vibration renders difficult the accurate determination of the zero point and may injure the knife edges.

The balance should be protected from heat or cold. The arms should at all times have the same temperature so they will expand and contract equally. Unequal expansion will cause the zero point to change and the balance will not weigh correctly. If a lamp is used to light the balance it should be located above and back of the operator's head so that any heat rays falling on the balance will affect both arms equally.

When mounted in a case some basic substance such as lime or an alkaline carbonate should be kept in the case to neutralize acid vapors. Where the room in which the balance is used is excessively humid it is customary to place some drying agent such as calcium chlorid in the case. Sulfuric acid should never be used for this purpose.

PRECAUTIONS IN WEIGHING.

See that the balance is level.

Sit directly in front of the center of the balance to avoid parallax while observing movements of the pointer.

Release and arrest the movements of the beam and pans with a smooth steady movement. Jerky movements will in time injure the knife edges.

If practical, arrest the beam when in a horizontal position. The pads or supports placed under the pans while placing and removing the loads should be lowered before releasing and raised again after arresting beam and pans.

Avoid giving the pans a rotary motion in a horizontal direction. This will cause the knife edges to scrape.

Place the object to be weighed and the weights in the center of the pans. This will prevent the violent displacement of the pans when released with the weights to one side of the pans.

If the beam does not begin to swing as soon as it is released, set it in motion by wafting the air over one of the pans with the hand.

All objects to be weighed should be at the same temperature as the surrounding air to avoid upward air currents and moisture condensation when the object is warmer or colder than the operating room.

Hygroscopic, volatile, powdery and porous substances should be weighed in close vessels. This is to prevent absorption of moisture or loss in weight due to evaporation.

If the substance is hot when put in the closed vessel and then allowed to cool, remove the cover for an instant before weighing to bring the reduced pressure inside up to normal.

An object likely to become electrified by friction should not be brushed or wiped immediately before weighing.

Long objects such as tubes not easily centered in the pans should be suspended from a hook above the pans.

WEIGHING.

There are in use several methods of weighing but two most common are the usual balancing method and the method of Borda, also called the substitution method.

In the first method the zero point of the empty balance is first determined. If substance is to be weighed in containers is best to place similar vessels or in case of powder or crystals, a sheet of pa on each pan and then determine the z point.

Place the weight desired in the ri hand pan and then pour into the left h pan the material to be weighed. Slowly lease the balance, pans first then the be until the way the pointer turns is s and then as slowly arrest it again. Rem or add material as found necessary again release and arrest as bef Continue these trials until the pointer c cides with the zero point of the empty ance.

The substitution method has the adv tage of eliminating errors due to unec arm lengths and changing sensibility the balance.

The exact method differs slightly cording to whether it is desired to de mine the weight of an object or to w out a desired amount of material.

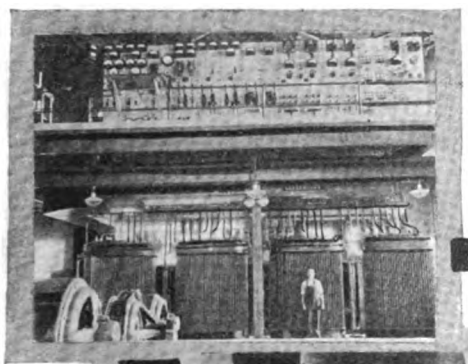
In the first case place a weight gre than that of the object in the left hand and the object in the right hand pan. weights to the latter until a balance is tained and the zero point determined. move the object and add additional wei till the pointer is again on the zero p The difference between the final wei and that of the weights with the objec the true weight of the substance.

In weighing out material a weight gr er than that of the substance desired is in the left hand pan, a balance obtained the zero point noted. Then remove wei from the right hand pan equal to tha the substance desired and replace with material till a balance is obtained on same zero point.

RADIO DEPARTMENT

300-K.V.A. Transmitter at Bolinas, California

By ALLAN C. FORBES, Assoc. I. R. E.



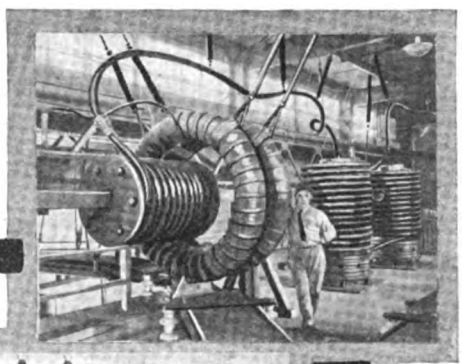
Left: General View of Switchboard Gallery and Bank of Four 11,000 to 440 Volt Step-Down Transformers. Note Comparative Size of Man.

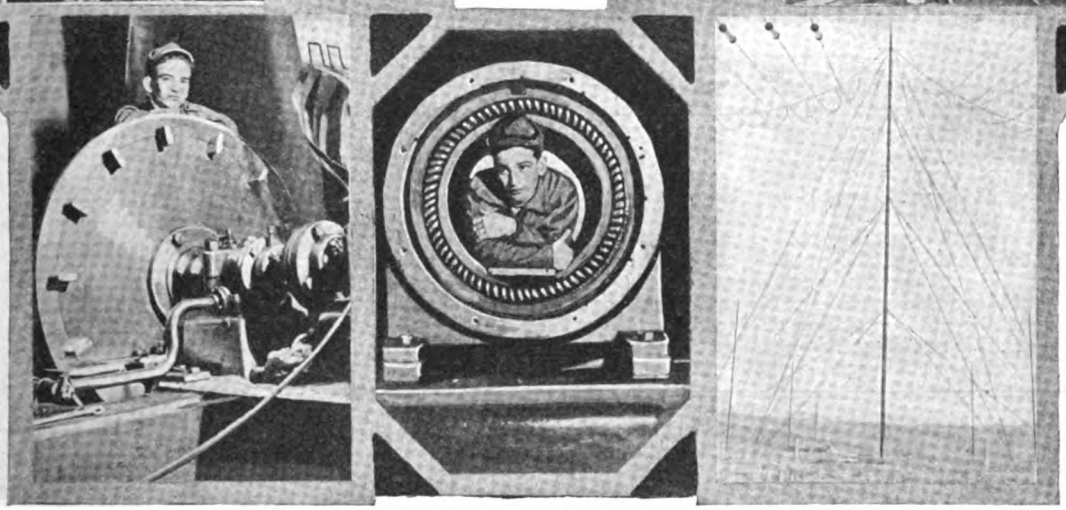
At Right: Jigger Gallery Showing a Gigantic Oscillation Transformer.

Lower Left: Close-Up View of Main Spark Discharger, Showing Relative Height.

Below: Side View of 500 H. P. Electric Motor Showing Relative Size.

Lower Right: Looking East from Power House Showing Full Length of Antenna.





THERE is no doubt many have heard of Bolinas, Cal. (K. E. T.), but it is very doubtful if any of them know just exactly where it is located, what the power is, whom they work with or what kind of apparatus is installed. I shall, therefore, try to convey to the reader a mental picture of the station, so that in the future when speaking of high-power radio stations, NAA will not always be referred to as the "largest spark station in the world." How many times have I heard amateurs, as well as professionals, radio engineers, speak of Arlington as the most powerful spark station in the world, and yet it is, as we all know, only a 100-K.W. Fessenden synchronous outfit. Bolinas has a 300-K.W., 2,000-volt, single-phase, 210-cycle generator, manufactured especially for this station. The generators have been overloaded 25 per cent successfully without any signs of heating, thus making the station transmitter input 350 K.W.

The station is rated at 300 K.V.A. input and can be operated on three wavelengths; namely, 5,000, 5,860 and 7,000 meters. The normal wave is 5,860 meters, and, altho it was thought that the two other waves would be used to transmit on when encountering heavy static, they are never used now, as it has been found by repeated trials that changing the wavelength this small amount, together with varying the input of power, did not help to any appreciable extent.

Power is obtained for the station from a specially constructed transmission line 27 miles long, carrying 3-phase current at 11,000 volts potential difference from the Pacific Gas and Electric Company's sub-station near Alto (Marin County), 5 miles from Sausalito, Cal.

Power is received at Alto 66,000 volts, 3 phase, 60 cycles, transformed down to 11,000 and supplied over the above line to Bolinas. At the power-house it is further stept down to 440 volts and led to the terminals of a 500-H.P. induction motor, which is direct connected to a 300-K.W., 2,000-volt, 150-ampere, 210-cycle, single-phase generator, having a rotary field of 14 poles.

The current is led from the generators thru a 7,500-volt, 300-ampere, double-pole General Electric A. C. oil switch to the buses, connecting with the low side of the 75-K.W., 2,000/13,000-volt, 210-cycle, single-phase transformers, which are connected in parallel. The current from these transformers is led thru specially made reactance coils to the high-tension air-brake switch keys, thence thru two specially made extra large choke coils, on to the high-frequency bus, which connects with the bank of high-voltage oil-plate condensers, consisting of sixty rows of six jars per row, or a total of 360 separate condenser units. These may be connected from two to six in series, or parallel, the best connection being four in series for 5,860 meters wavelength.

The secondary circuit is broken for sending purposes by specially designed high-tension air-break relay keys, which in turn are actuated by a small sending key thru a source of direct current, this current being furnished from a small motor generator set.

Arcing at the contacts of the main signal key is prevented by a heavy blast of air forced directly at the contact point by a specially designed electric blower motor.

The advantage derived in interrupting the secondary circuit lies in the fact that it permits 300 K.W. to be handled at various speeds of transmission, exceeding 100 words per minute, without error, by reason of the fact that it has been found much easier to break the high voltage of the secondary circuit in preference to the large current in the primary, to say nothing of the eliminating of surges due to breaking the primary and the inductive strain on the generator.

The transmitting aerial is of the inverted "L" type, consisting of thirty-two wires in four sections of eight wires each, with a flat top, approximately 2,500 feet in length. It is supported on three rows of steel tubular masts (three masts in each of the outside rows and two in the center row), which are approximately 325 feet high. The rows of masts are separated about 250 feet. An extra mast is placed on the end of the nearest row, so that an extension can be run out for a *receiving aerial*, should necessity arise, that would cause operation, *both sending and receiving* to take place from Bolinas. The natural wavelength of the antenna is 4,035 meters; when working on 5,860 meters (which has been found to be

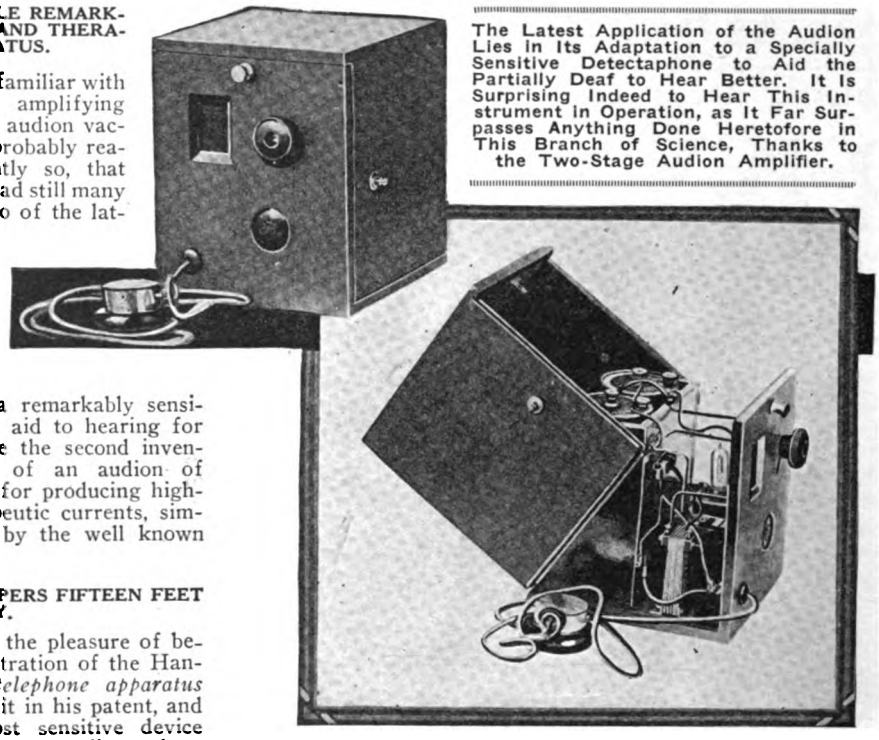
(*Continued on page* 780)

The Audion in a New Rôle

AUDION MAKES POSSIBLE REMARKABLE DETECTAPHONE AND THERAPEUTIC APPARATUS.

THOSE who are familiar with the wonderful amplifying properties of the audion vacuum tube have probably reasoned, and rightly so, that this clever little device had still many new rôles to essay. Two of the latest novelties in scientific apparatus due to Earl C. Hanson and Wendell L. Carlson, are shown in the accompanying photographs and diagrams.

The first of these instruments comprises a remarkably sensitive detectaphone as an aid to hearing for the partially deaf, while the second invention involves the use of an audion of medium or high power for producing high-frequency electro-therapeutic currents, similar to those produced by the well known Tesla and Oudin coils.



The Latest Application of the Audion Lies in Its Adaptation to a Specially Sensitive Detectaphone to Aid the Partially Deaf to Hear Better. It Is Surprising Indeed to Hear This Instrument in Operation, as It Far Surpasses Anything Done Heretofore in This Branch of Science, Thanks to the Two-Stage Audion Amplifier.

AUDION DETECTS WHISPERS FIFTEEN FEET AWAY.

The editors have had the pleasure of being present at a demonstration of the Hanson detectaphone, or *telephone apparatus for the deaf* as he calls it in his patent, and certainly it is the most sensitive device of its kind that they have ever listened to. When a person with normal hearing listens at the receiver attached by means of a flexible cord to the amplifying cabinet of the Hanson apparatus, he can readily interpret *whispers spoken fifteen to twenty feet away,* and ordinary strength of speech when the speaker is located seventy-five to one hundred feet away and more. When tests were made by covering up the transmitter in the front of the cabinet with the hand, it did not apparently lower the strength of the received speech.

In a few words, the Hanson audion detectaphone comprises a two-stage amplifier with two audion bulbs of miniature size (smaller than anything heretofore commercially employed except by the army and navy), together with two iron-core step-up transformers, as shown in the diagram below. A carbon ball microphone has been employed to modulate the primary current of the first transformer, but owing to the imperfect manner in which the best of carbon microphones transmit or interpret speech, Mr. Hanson is considering improving his apparatus by using either a new form of microphone, or its equivalent such as the Bell type receiver which as is well known, represents one of the most perfect forms of voice translator we have.

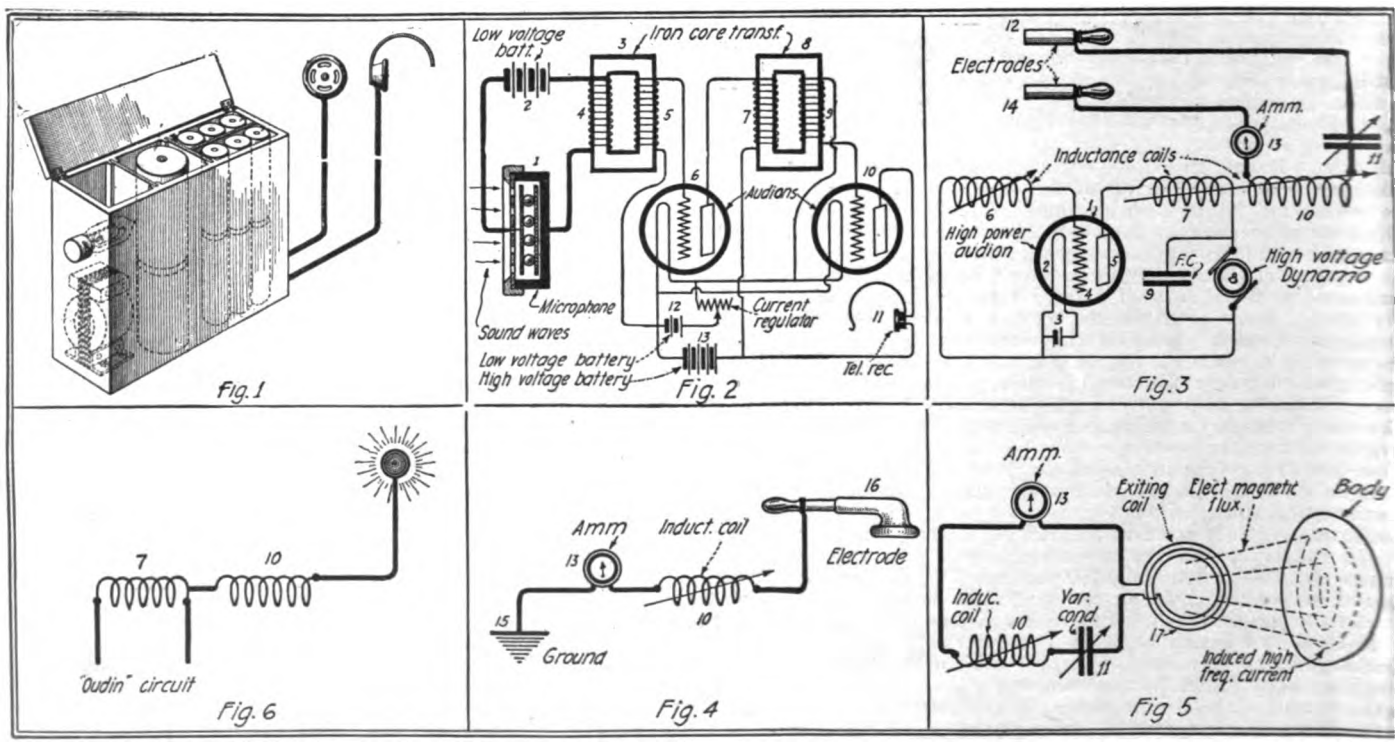
With this apparatus, it is remarkable to note that the audion filaments simply glow a dull red, the current passing thru the filaments—which are, by the way, connected in parallel to a common battery comprising two standard size dry cells—being regulated by a rheostat from a control handle mounted on the exterior of the cabinet. The high voltage battery is made up of a number of small flashlight cells. The "baby" audions used are of a new type and measure about 1¼" long by 7-16" in diameter.

THE AUDION ELECTRO-THERAPEUTIC GENERATOR.

In the patent issued to Messrs. Carlson and Hanson on an electro-therapeutic apparatus involving the use of an audion exciter, a clever circuit is shown for producing and utilizing steady and constant high frequency currents by use of a stabilizing capacity, which works similar to the manner in which radio circuits are attuned for similar effects—that is producing constant, high frequency oscillations.

As pointed out by the inventors, present day high frequency apparatus is quite likely to give severe shocks to patients, due to the currents being of varying frequency

(*Continued on page* 819)



Figures 1 and 2 Show the External Appearance of One Type of Audion Detectaphone, as Well as Hookup of Two-Stage Audion Amplifier With Transformers, Microphones, Common High Voltage Battery, Etc.

Fig. 3 Shows One Form of Audion Electro-Therapeutic Apparatus, the Vacuum Tube Acting as the Oscillation Generator in This Case. Fig. 4 Shows Hookup to Produce Uni-Polar Discharge.

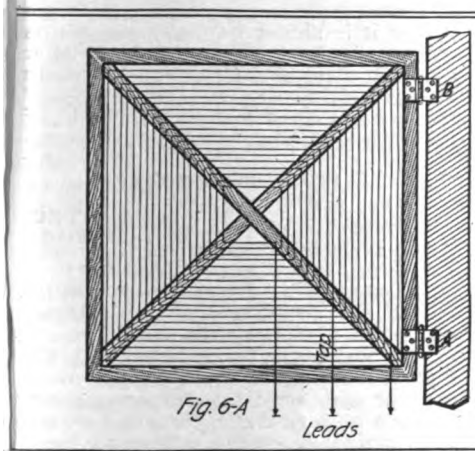
Fig. 5 Shows Method of Inducing High Frequency Currents in the Body of a Patient From a Coil Thru Which High Frequency Oscillations Are Passing. Fig. 6 Shows Oudin Circuit Arrangement.

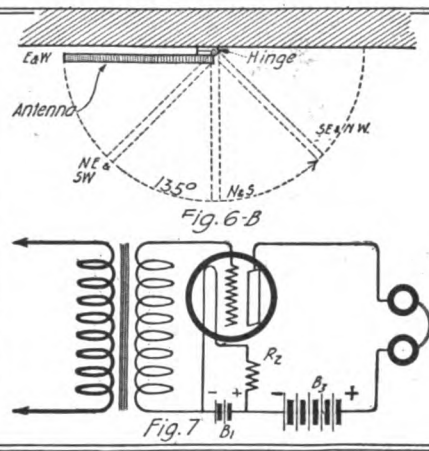
Simplest Long Wave Receiver

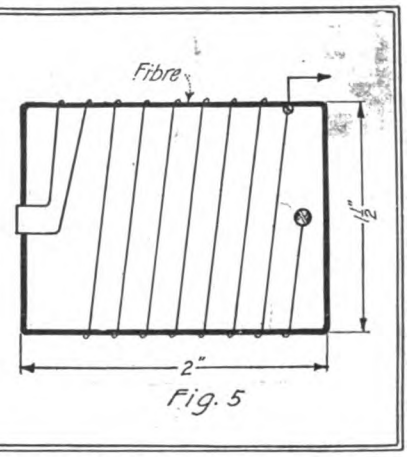
By ELLIOTT A. WHITE

PART II

THE value of the resistance "R" depends, as was previously remarked, on the kind of vacuum tube and the voltage of the filament battery used. The resistance is made of nickel ilver (German silver) or alloy resistance vire, wound on a fiber or bakelite card Fig. 5), and takes the place of the ordinary djustable filament rheostat. A size of wire rge enough to carry a little over an amere without scorching the card is needed, he length being determined by trial. In his set R is 40" of No. 19 nickel silver. long piece of wire should be connect-







g. 6-A—Loop Antenna for Use With Aun Receiving Set Here Described. It Is ilt Of Light Wood, Hinged At the Back d Wound Spirally With No. 28 D. C. C. Wire.

Fig. 7—The Usual Audion Amplifier With the Grid Connected Thru the Secondary of the Transformer to the Negative Side of the Filament.

Fig. 5—Neat Way Of Making Resistance Coil By Winding Resistance Wire Around a Bakelite or Mica Strip. The Coil Is Wound Non-inductively.

between the filament battery A1 and the ment of the tube, as shown in Fig. 1, gradually shortened by looping back the l and short-circuiting a portion until filament is brought up to normal brightss. The wire can then be cut off to leave correct length as thus determined, nbled, and wound non-inductively (that double) on the card, which has notches , filed, or sawed in the edge 1/10 inch art, as shown in Fig. 5. One end is dered to a terminal screw of the tube cket, which also holds the card in place. e other end is bent thru a small hole lled near the edge, and soldered to the ttery lead past thru the same hole. e looped end is made fast by pinching around the end of the card in two notches. is arrangement leaves the resistance proting out from the side of the socket. A newhat neater way is to put a small brass gle or foot on the bottom, which is mped under the terminal screw of the cket and makes the resistance stand up ngside the tube.

For the high vacuum tubes used during war a 4-volt storage battery requires a istance of about 1.1 ohms for the tube wn as the VT-1, no resistance being used the VT-11; with a 6-volt battery the mer requires about 2.5 and the latter ut 2 ohms. Other tubes require differ- values. The filament of the tubes now the market requires only 0.7 amp. ndard tables of nickel silver or alloy istance wire will indicate the size and gth if the resistance is known. If the -fashioned gas tube is used, the resistance y be determined by trial; or it is perhaps t to use an ordinary battery rheostat, the filament temperature adjustment is tical for best results.

The plate battery B2 is of 22½ volts (15 small cells, that is, 5 of the tubular flashlight batteries, which contain 3 cells each) for the high vacuum tubes mentioned above, and is not variable. The gas tubes sometimes require as much as 35 or 40 volts, and in this case the voltage should be made variable for critical adjustment, by means of a multipoint switch with taps to the end cells. The advantage of the high vacuum tubes is that no adjustments of filament current or plate voltage are necessary. The phones are of any kind with a resistance of 2,000 ohms and up. More than one pair may be connected in series.

For high vacuum tubes a leak resistance M may be necessary, depending on the insulation of the socket and grid condenser. If the insulation is good a resistance of 2 or 2.5 megohms (1 megohm equals 1,000,000 ohms) should be used, but if the insulation is poorer, less or none will be required. A leak resistance may be made in the usual way with a line of pencil or India ink on a strip of card, paper, fiber, or hard rubber, between two small binding posts. The end of this away from the grid may be connected either directly to the *positive* side of the filament, as shown in Fig. 1, or bridged across the grid condenser C2, so long as the ground is connected to the positive side of the filament battery.

Instructions for mounting this small set seem superfluous, as the builder can mount it to please his taste, on a small panel, in a small box (cabinet type), or in any way desired. The set described is contained wholly (with the exception of the storage battery) in a neat leather covered carrying case 10" by 12" by 6". The inductance coil L and the condenser C1 are mounted in the cover, which hinges back and gives a panel effect. The plate battery, grid condenser and leak, rheostat, tube, socket, bridging condenser, phone terminal blocks, and phones are contained in the main part of the case, with plenty of space left for a one-stage amplifier consisting of transformer, plate battery, tube, socket, and filament resistance. A battery switch to turn the filament on and off, and binding posts for antenna, ground, and storage battery connection are also added; so that it will be seen that a much smaller case than this might be used. Owing to the small size of the inductance coil, tickler, and condenser, a very small space is sufficient, and the builder's ingenuity will suggest compact ways of mounting. The writer's experience with this set in the vicinities of both Chicago and Detroit is that no amplifier is necessary for long wave stations in the United States, Mexico, and Canada. But an amplifier is a good thing to have and is required for easy reading of the European stations.

The usual amplifier is illustrated in Fig. 7, where B1 is the same battery as B1 in Fig. 1, but in this case the grid is connected thru the secondary of the transformer to the *negative* side of the filament; R2 is the filament resistance (fixt), and B3 is a separate plate battery of 22½ volts or more. It is possible to use the same plate battery for both detector and amplifier tubes, but for simplicity this connection is not shown. To use the amplifier, the primary terminals of the transformer at the left (Fig. 7) are connected in place of the phones P in Fig. 1.

DETAILS OF LOOP ANTENNA.

A loop antenna for use with this set for wavelengths of 2,500 to 20,000 meters is shown in Fig. 6-A. It is constructed of a frame of light wood (1" by 1") 4 feet on a side, and the wire is wound spirally around tacks or notches ⅛" apart on the diagonals. Two pounds of No. 28 D.C.C. wire are required, or about 3 pounds of No. 24, to give from 50 to 90 turns. Only the outside 30 turns are needed for 2,500 meters, so that a tap should be taken at this place. This spiral loop antenna is directional, and should be hinged to the wall or door frame, as shown in Figs. 6-A and 6-B. In Fig. 6-B the points of the compass are indicated on the assumption that the wall runs east and west, but the points can be easily supplied for any other case. It will be observed that the coil must be swung thru 135 degrees, so that either edge of it points towards the station being received. No signals are audible when the coil is at right angles to the direction of the station. If the antenna is made in the form of a helix instead of a spiral, it will be less directional, and fewer turns will be needed, as the average area of the turns will be greater; but this kind is bulkier, owing to its thickness, as the turns should, in both types, be spaced about ⅛ inch apart. Metallic bodies in the vicinity of a loop antenna tend to destroy the directional effect.

(*Continued on page* 810).

How to Become a Professional Radio Man

Part III—Conclusion

By PIERRE H. BOUCHERON

If You Would Become an All-around Radio Operator Capable of Holding Down a Land Station Berth, it is Necessary to Learn Land-line or Morse Code Telegraphy as Well as the Continental Code Employed in Radio Work. This Illustration Shows a Section of a Radio Institute Devoted to the Study of Sounder-work. Each Sounder is Enclosed in a "Resonator" Which Will Lie Close to the Student's Ear Not to Confuse Him by Hearing the Sounds from Other Nearby Instruments. The Student is Taught to Copy the Message Directly Upon the Typewriter.

NECESSARY REQUIREMENTS PREPARATORY TO SECURING A LICENSE AND HOW TO GO ABOUT IT.

NOW that we have covered some of the things met with in professional radio operating concerning just what is to be expected, some of you have probably reached the stage where you have decided in favor of taking some preliminary steps toward securing the much coveted "ticket."

RESIDENT SCHOOL INSTRUCTION.

There are two possible methods of procedure which have worked out quite well in practise. The first, and probably the best, is for you to personally attend a resident school and there submit to a course of training consisting of several months tuition, where you will be given an opportunity to learn practical operating in all its phases under actual conditions. That is to say, learning to receive and send the Continental Morse Code at the required speed of twenty words per minute or better; the handling of commercial traffic; maintenance and care of the mechanical and electrical apparatus as installed on shipboard and land stations, and in general learning the daily routine of a regular operator. This is no mean task and altho some may tell you that radio can be learned in two weeks or so, it is indeed a wise bird who will get thru in such a ridiculously small amount of time.

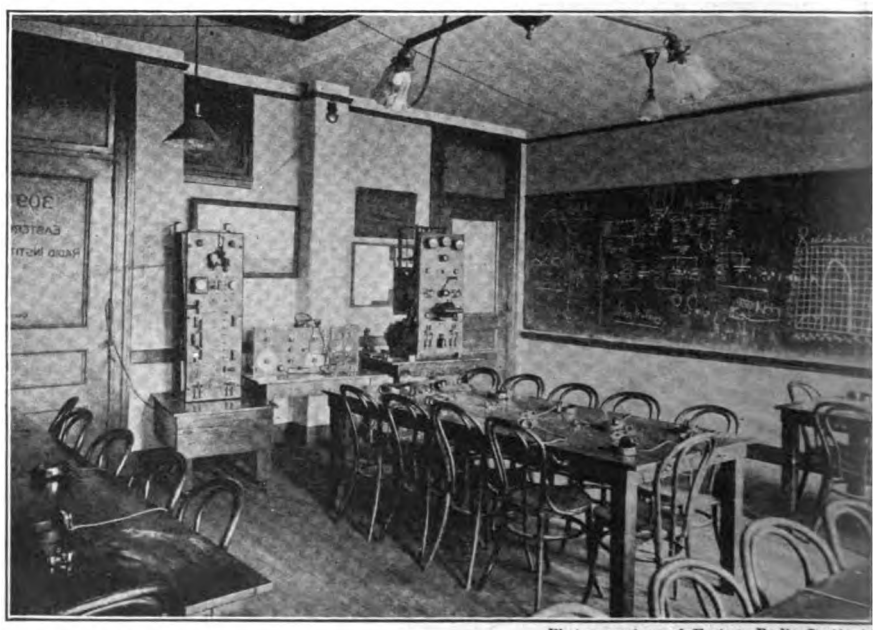
Radio has been given so much publicity and the game offers so many inducements that it is a small city which does not boast of at least one radio school. In fact some of the larger cities such as New York, Boston, Philadelphia, Chicago, San Francisco, Washington and New Orleans possess several excellent institutions for the training of radio men.

Attending a school has many advantages which are not secured in any other way. For instance, you associate with many other students having the same aim you have. This results in mutual exchange of ideas and assistance during the process of learning. Then again, resident schools are equipt with all manner of modern radio apparatus and since there is no longer any guess work in the matter of technical knowledge, experienced instructors will coach and guide the student in a manner otherwise impossible.

Most of the schools have classes not only during the day, but also hold night classes as well, so that if you are obliged to earn your living during the day you may take a night course, altho it must be understood, of course, that this will take longer than if you are devoting your entire time to instruction. If you are an absolute beginner it is almost necessary that you attend a school. On the other hand, if you are an amateur or a former telegraph operator and fairly well versed in the fundamentals of radio, home study offers the second best method.

STUDYING AT HOME.

Do not fool yourself; as we have previously said, it is more satisfactory to go to school in order to learn radio properly. However, if you are situated quite far from one of the large seaport cities, or if you are an ex-service man and have secured preliminary radio training at one of the Army or Navy technical schools during the war, or again, if you are a amateur with some amateur operating experience to your credit, there is no reason why you cannot secure a few good text books and acquire the necessary information in order to pass the government examination for a commercial license, *first class*. In this event it is assumed, of course, that you are capable of copying the Continental Code at a speed of ten or fifteen words per minute and that you are capable of sending code in a firm, well spaced manner. As a matter of fact mastery of the code is the most difficult task of the beginner. Incidentally it is a most important factor as it is really the stock-in-trade of the professional operator. If you are weak in this respect you must devote as much time as possible to the practise of sending



Photos courtesy of Eastern Radio Institute

A Corner of Typical Well-Equipt Instruction Room of a Radio Institute. Students Sit at the Tables and Practice Both Sending and Receiving Under Actual Operating Conditions. In the Background of the Picture Are Shown Practical and Up-to-date Receiving and Transmitting Instruments, the Theory and Operation of Which is Explained by Instructors With the Aid of Blackboard Diagrams.

and receiving. Whether you are attending a school or learning at home, your progress and the length of time before you will be able to secure a license depends materially upon your operating speed.

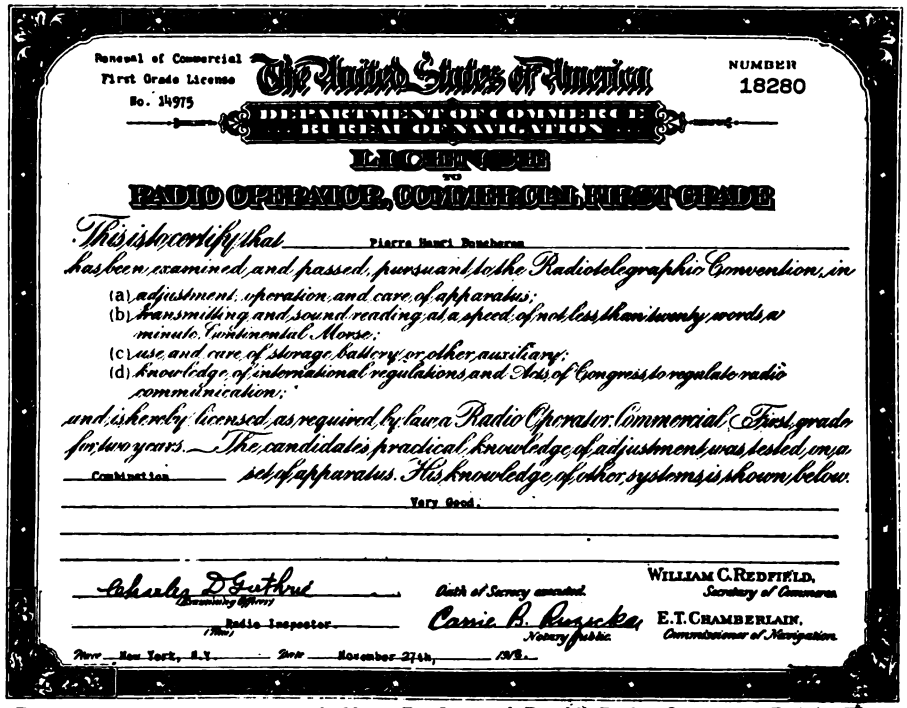
The home student who has erected an amateur receiving station has an excellent advantage in the fact that he is able to "listen-in" upon actual operating and thus he can learn to copy the many styles of sending as well as intercept the several classes of radio traffic which are:

1. The commercial paid and service messages.
2. Daily weather reports transmitted by naval coastal stations and others.
3. Press news items also sent out by coast stations.
4. All manner of code messages transmitted by war ships, merchant vessels and others.
5. The copying of foreign language messages such as French, Spanish, Italian, German, etc.
6. Hydrographic and obstruction reports as well as occasional S. O. S. messages where you have an opportunity to listen-in and learn exactly how the procedure of these important messages takes place.
7. Learning to copy thru static and interference—a most desirable accomplishment.

THE ART OF SENDING.

The home student must take great care in code practise, as it is very easy to acquire undesirable mannerisms and poor style of sending. You should constantly be on guard and if possible check yourself up by an occasional visit to a professional, where you can have him listen to your sending and judge as to its accuracy. Many beginners make the mistake of trying to send as fast as they can. That is not the right idea. Start by sending slow and clear. Let speed come with practise and under no circumstance try to send faster than you are able to receive at any time.

Concerning the matter of sending speed, a little personal incident is perhaps not out of place here. When I started out as a telegraph operator I developed an unconquerable mania for "fast" sending which I practised, however, only when conversing with a distant operator. When the operator at the other end would "come back" at me in lightning speed using a Vibroplex (often called a "bug"), I was able to even read two words in succession. Nevertheless, I would O. K. and go right along on some new topic. In other words, I "bluffed" it out.



Renewal of Commercial First Grade License No. 14975

The United States of America

NUMBER 18280

DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION

LICENSE
TO
RADIO OPERATOR, COMMERCIAL FIRST GRADE

This is to certify that Pierre Henri Boucheron has been examined and passed, pursuant to the Radiotelegraphic Convention, in

(a) adjustment, operation and care of apparatus;
(b) transmitting and sound reading at a speed of not less than twenty words a minute, Continental Morse;
(c) use and care of storage battery or other auxiliary;
(d) knowledge of international regulations and Acts of Congress to regulate radio communication;

and is hereby licensed as required by law a Radio Operator, Commercial First grade for two years. The candidate's practical knowledge of adjustment was tested on a Combination set of apparatus. His knowledge of other systems is shown below.

Very Good.

Oath of Secrecy executed.

Radio Inspector.

Carrie B. Ruzicka, Notary Public.

WILLIAM C. REDFIELD, Secretary of Commerce.

E. T. CHAMBERLAIN, Commissioner of Navigation.

Place New York, N.Y. Date November 27th, 1918.

Present Style of License Which Must Be Secured By All Radio Operators Before They Are Permitted to Board a Seagoing Vessel. A Brief Outline of the Examination Requirements is Printed upon the Face of the Document. On the Reverse Side Appears the Secrecy Oath and Pledge of Faithful Service, and Beneath This Is Written the Operator's Service Record, Which Must Be Signed By the Captain of Each Ship He Is Assigned to.

Articles to Appear In November Issue of "Radio News"

Comparison of Modulation Methods in Radio Telephony
By A. S. Blatterman

The Radio Compass on Board Merchant Vessels
By Arthur H. Lynch

New Amplifying Apparatus

Registering Radio Messages on Tape

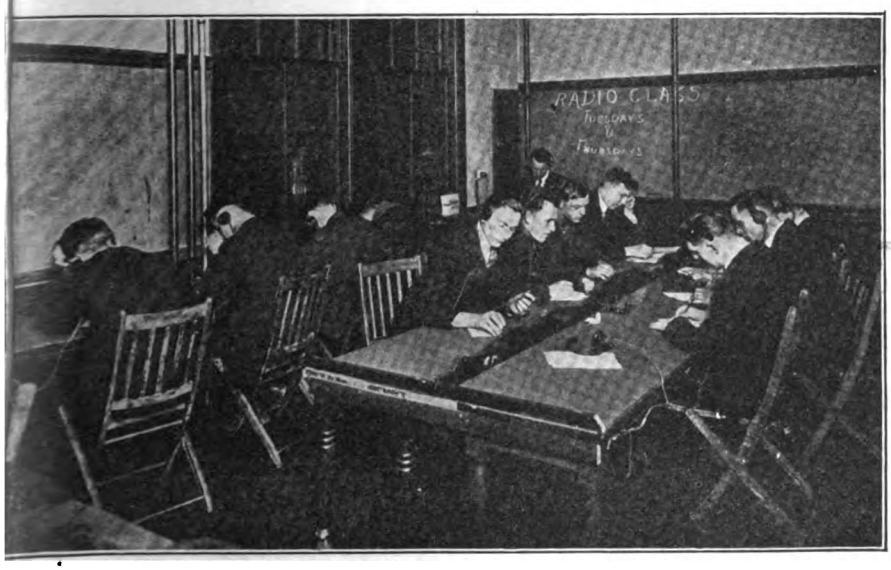
A New Continuous Wave Type Transmitter

New Radio Amateur Calls

The Mystery of the Dampt-Undampt Messages By H. L. Moulton

Building a Honeycomb Winding Machine
By Raymond Roof

Several Other Features—Look for Them



Ex-service Men Learning to Read and Copy Radio Signals at One of the Knights of Columbus Radio Schools. A Regular Mode of Procedure Is to Have Each Student Do a Certain Amount of Sending, Which Is In Turn Read and Copied By the Others.

One day while engaged in this pleasant pastime of bluffing the distant operator, a gentleman who had been standing at the counter apparently preparing a message for transmission, called me over to where he stood and handing me a telegraph blank said in a very ominous voice, "take care of this message immediately, young man"; he then turned and walked away rapidly.

This was an unusual request so I quickly glanced at the message, where I found the following lines:

"The young man should govern his sending speed according to his receiving ability. We must all creep before we can walk."

It was signed by the vice-president of one of the largest telegraph companies in the U. S., which incidentally controlled the system employing me. He was himself an expert operator and had been quietly listening to my little comedy. No, I was not fired, but I never forgot the advice.

The recognized method of holding and manipulating the sending key is known as the *Catlin Grip*. Use the first three fingers of your right hand, grasping the forward part of the key knob with the end of your thumb, while the other two fingers reach out to the backward part of the knob—thereby insuring a firm and yet pliable grip of the key. Then, too, the up and down motion should be controlled from the wrist and not from the finger ends, as is done by beginners. The principle is the same as that employed in the *Palmer Handwriting Method*—it is a wrist motion and is meant to relieve the fingers from the strain of too concentrated muscle action, thereby preventing "writers' cramp" or "telegraphers' paralysis." Too much cannot be said concerning this important subject. Remember one thing, it is just as easy to form *right* habits of sending in the beginning as it is to acquire *wrong* ones.

THE ART OF RECEIVING

The most discouraging period for the beginner is from the time he first starts, up to the point where he can begin to copy a few consecutive words without error; when this point is reached he takes on new life, so to speak, and immediately begins to gain confidence in himself, which fact comes in good stead when he finally attempts to copy actual signals straight out of the air.

(*Continued on page* 816)

WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

This Month's $5.00 Prize Winner—Walter Holey

FIRST PRIZE

HERE are some pictures of myself and my "Labs,"—chemical, electrical, and radio. The first photo shows my "Chemical Lab." I have about one hundred and twenty-five chemicals not including solutions. I have apparatus for making chlorin, H_2S, SO_2, etc., and also chemicals and apparatus for qualitative analysis. I have some "patent" formulas for gun powder which I will send to the "SCIENCE AND INVENTION" magazine soon.

The second photo shows my radio station and "Electrical Lab." The radio station consists of: Receiving set,—three loose couplers, two short and one long wave; a variometer; a galena detector; and 3,000 ohm 'phones. The couplers are connected by a switch, so that they can be used alone or with the primary windings in series, one acting as a loading inductance for the other.

I also have extra detector condensers and inductances. With this set I have had very good results, having heard "N.A.A." fifteen feet from the 'phones. I have also heard "N.A.A." using a tin rod for an aerial. I have also in my possession an indoor aerial and loop, both of which work very well.

The antenna is enclosed in the left-hand corner of the box, as is the sending set, which consists of a two-inch coil, a secondary condenser, gap, key, etc. The antenna switch handle extends thru the slot in front of the box. All of the instruments, except coil, are of my own construction.

In the lower right corner can be seen my home-made vacuum bulb and panel. The bulb is a twelve volt auto headlight, with plate on the outside.

Near the center of the picture is a battery switchboard, with polarity reverser and rheostat. I also have a ¼" coil, a galvanometer, a Leyden jar, a helix, a goniometer, coherer, etc. In the upper left corner is a microphone with which I can hear a fly walk! I possess an ultra-violet light generator which operates on a 2-inch spark coil.

I am a subscriber to both the "SCIENCE AND INVENTION" and *Radio Amateur News*.—Walter Holey, Norwich, R. F. D. No. 3, New York.

Honorable Mention—Horace Fletcher, Jr., $2.00 Prize

HONORABLE MENTION

I AM sending some prints of my "Chemical Laboratory." The pictures were taken with a Premo film pack camera. I use my own flash powder, consisting of K Cl O_3, C, S, Mg, and Al. This is by far, more of a chemical "Lab," than an electric "Lab."

In photos number one and two is shown the alcohol making apparatus, from which I made three ounces of alcohol from one gallon of the ferment as previously described in Prof. Darrow's series on "Practical Chemical Experiments." I have a small box holding eight batteries, from which I get a current strong enough to decompose water, and you also need a little current for certain experiments. The bottles are kept in good order and are all properly labeled as can be seen.—Horace Fletcher, Jr., 3430 Crawford St., Falls of Schuylkill, Phila., Pa.

What to Invent

By JAY G. HOBSON

$1,000 PRIZE FOR A PRODUCT TO MANUFACTURE.

A LEADING manufacturer of intricate and accurate stampings, screw machine work and mechanisms made therefrom will pay $1,000 to the person submitting plans for a product to be manufactured if the product is adopted by the manufacturer. No product will be accepted for which the demand is less than $500,000 per year.

Here is an excellent chance for the reader to cash in on some practical idea, invention or device that will be in universal demand when made in quantities and advertised to the public.

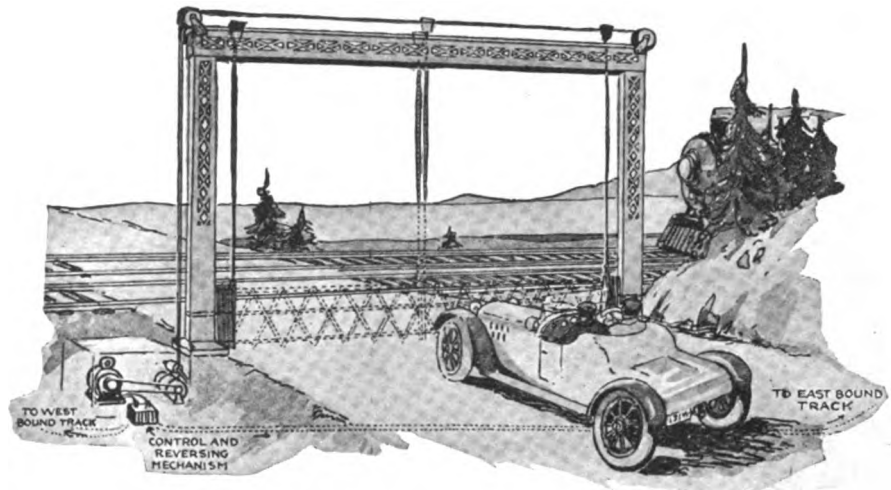
While the requirement that said product must have a demand of $500,000 yearly is indicative of great profits to the manufacturer of same, and on the surface it may appear the inventor should share more in such profits than to the extent of $1,000, yet in point of fact the risk the manufacturer must assume investing his capital, time and the like in advertising and marketing the article, is deserving of the lion's share because the inventor's only risk is his idea or invention which has no commercial or tangible value until it has been placed on the market thru the expensive financial efforts of men involving expenditure of their money.

Therefore, the dictates of reason convince us that receiving $1,000 cash for an idea, as stated above, with an initial investment of $100 or less for a patent and the time necessary for perfecting it, should please the most particular, considering the fact that the $1,000 prize offered above is about 900 per cent profit on the investment involved. Do not waste your time submitting plans for products which cannot be manufactured as required by the manufacturer in question.

RAILROAD CROSSING SIGNAL.

"The automobile drove across the tracks back of one freight train and directly in front of another. The crossing signal and train could not be heard by the driver. The automobile was struck squarely." Only forty-four simple words in this grim newspaper notice but volumes could be no more effective in recording the fatal result. How unnecessary this useless destruction of life and property when a simple device like that illustrated would prevent 100 per cent of it. The bell signals now employed can be heard no more by the traveler than can the train whistle miles away. Road gates are effective, but a watchman to operate them cannot be stationed at every country crossing. Therefore an automatic watchman mechanically operated by the approaching train is greatly needed to prevent the growing number of gruesome accidents in daily evidence.

An electrical guard placed in the center of the road leading across the tracks, about fifteen feet from the crossing; a warning made similar to the folding telephone



Every Year Many People Lose Their Lives at Railroad Crossings, Due to Improper Signalling Devices, or, as Often Happens, Autoists and Others Drive Across Railroad Crossings When There Are No Gates to Stop Them, Especially If a Train Seems to Be at Quite a Distance. A Suggestion for a Simple, Automatic, Self-closing and Opening Crossing Gate Is Here Given, Which Could Be Connected Up So as to Be Operated Electrically Whenever a Train Approached from Either Direction. There Is No Reason Why, with Our Present Engineering Skill, That Such a Gate Could Not Be Perfected and Successfully Operated.

holder, red lights secured upon same, and electrically operated by a motor connected to the control arm that folds and unfolds the collapsible guard upon the approach and passing of the train are suggestions.

The commercial and life-saving value of this improvement cannot be overlooked. Every railroad would gladly adopt it upon demonstration of its perfection.

WOOD BORING BEETLE DESTROYER.

Out in California the telephone companies have considerable wire trouble caused by beetles eating the insulation which exposes the wire to the elements resulting in short circuits and the like. The following notice explains the difficulty:

When telephone girls in California find their wires are "shorted" a bug may be on or in the wire, for California has a wood-boring beetle that goes thru wood and also thru similar substances considerably harder than lead. The beetle has put hundreds of telephones out of commission by boring holes in the cables that carry the wires. Water enters the cables, making wire connections useless until the bored places are found and repaired. The problem of control of this active boring beetle is still unsolved, according to the bureau of entomology of the United States Department of Agriculture, and it will be difficult to find a practicable way.

Some chemical preparation mixed with the insulation or painted on it to poison these destructive pests appears to be the means desired to eradicate them. Undoubtedly telephone companies would pay a substantial price for a successful formula.

DOCTOR'S PATIENT RECORDER.

How many times have you waited hours to see your doctor and lost out by having some inconsiderate nabob rush in ahead of you, possibly thinking he was next, but more probably not caring a hang about you or your valuable time? This is a daily annoyance in nine-tenths of such places, and the inefficiency causing this condition suggests a much needed improvement of this system.

A practical electric recorder could easily be invented to keep proper tab on the patients to be treated, a small device in the form of a register that both designates the visible number in order and issues a duplicate number to the patient incoming. These numbered checks could be made of metal to be used over again, and the operation of the recorder would be practical in every way.

The patient pushes the button on the recorder *when he first calls*, thereby causing the machine to place a consecutive number in the glass indicator. At the same time a small metal check bearing a duplicate number comes out into the operator's hand. This check is retained by the patient and referred to as the doctor looks at the number in the recorder and calls out the next number in order. The patient holding the number announced then steps forward placing his check in the receiver provided in the doctor's office.

Using this device each person would be sure of keeping his place as originally received, and the efficiency obtained by the doctor in seeing his callers properly would more than warrant the cost necessary to install a system of this kind in his office, and of the 200,000 doctors in America, 100,000 would gladly buy an improvement like the one described.

The same scheme would find a use in our crowded barber shops.

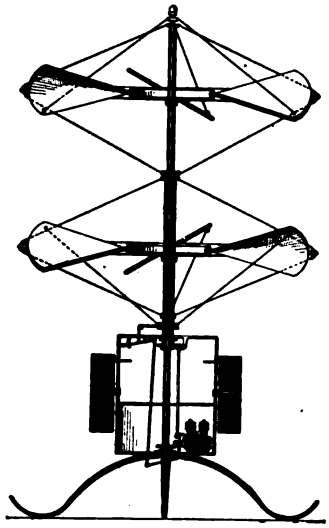
Have You Waited Hours to See Your Doctor, and Finally Lost Out by Having Some Inconsiderate Nabob Rush In Ahead of You, Possibly Thinking He Was Next, But More Probably Not Caring a Hang About You or Your Valuable Time? Why Not Perfect an Electric Recorder to Keep the Doctor Posted as to Just Who Is Next? The Device Could Be Made to Indicate the Patients' Numbers In Order, Besides Issuing a Tally Check to Each Patient.

LATEST PATENTS

Flying Machine.

(1,345,159. Issued to James H. (Freeman.)

Here we have another of the now common helicopter types of flying machines which, however, has the added improvement in that it will act as a parachute in case of stoppage of the engine, thus enabling the occupant to make a safe landing. In order to prevent undue gyratory action on the part of the propellers they are so coupled that one will rotate in one direction and the other in the opposite direction. Four vertical vanes keep it end up and act as rudders to incline the machine from the vertical. The propellers are rather flexible and



are arranged in such a manner that their pitch can be adjusted so as to increase or decrease the lifting effect, or they may be thrown entirely out of operation in which case the lifting propellers are used as a parachute for effecting a safe landing.

Submarine Destroying Apparatus.

(1,344,074. Issued to William E. Williams.)

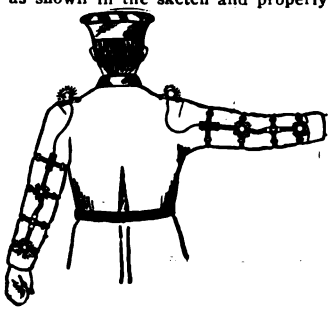
We have here another device for the detection and destruction of submarines. It consists of a large number of submergible floats which are dragged by a steam trawler, each of which can be controlled individually by the operator on the parent ship and the submerged ves-

sels to which mines are attached may be separated from each other or directed closer to each other at the will of the operator. Each of these floats has within it a motor for actuating the rudder and carries microphonic telephonic transmitting diaframs adapted to receive sound waves from different directions. When a receiving device on the vessel announces that a stimulus has been received in one of the floats, the direction from whence it comes is readily determined, and the trawler is sent in quest of the enemy submarine. The mines can be exploded by contact, or simply by closing an electrical circuit when it is believed that the vicinity of the submarine has been reached.

Portable Signal System.

(1,346,531. Issued to Benjamin W. Davis.)

Several months ago we described in this journal and showed a photograph of a traffic policeman illuminated which forms the gist of this patent. Lamps are secured to straps as shown in the sketch and properly

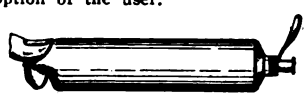


connected to batteries suspended from the waist of the user. A novel feature is an automatic switch which controls the lights. It consists of a small tube having metal ends half filled with mercury. When the arm is raised to a horizontal position, mercury flows across the two metal contacts, thus closing the circuit and lighting the lamps.

Collapsible Tube.

(1,346,897. Issued to Clifford G. King.)

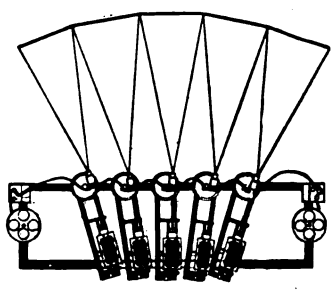
A new collapsible tube which promises to relegate all the present types to the scrap heap is here described and is used for dispensing shaving cream, tooth paste, etc. It has incorporated within it both forms of nozzles so that either a flat ribbon or a cylindrical shaped mass may be expelled. A cap on the end closes both openings. When the cap is removed, the cylindrical form of paste will be expelled upon pressure on the tube. When the cap is screwed into place again and a small slidable sleeve moved upward slightly, it opens a slit-shaped nozzle and a ribbon mass is expelled at right angles to the tube. Either style may be delivered at the option of the user.



Panoramic Apparatus.

(1,347,103. Issued to Thomas A. Killman.)

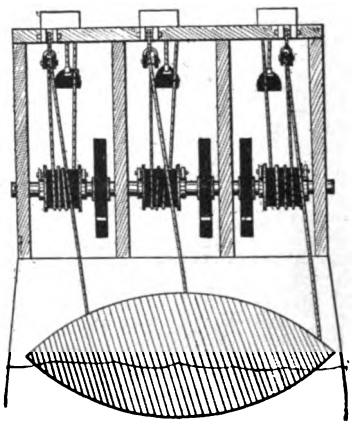
Rather a remarkable piece of apparatus is exemplified in this method of taking and projecting panoramic pictures, but its use seems quite limited as far as the ordinary playhouses are concerned. It consists of a series of projectors or cameras, all coupled to the same shaft, so that their shutters and speeds are in synchronism. Each of the cameras or projectors uses only a small part of the picture from the regular movie strip, so that if there are five projectors there will be five distinct sets of pictures on the same film, which will make the film look as if the five motion picture films were joined in parallel. Each of the five lenses take care of one of the five strips of pictures and upon projection a continuous panorama is viewed by the audience.



Wave Motor.

(1,346,399. Issued to William A. Crawford-Frost.)

Varied and numerous are the ideas on wave motors and the idea similar to the one here described was the subject of an article publisht some three years ago in this magazine. The inventor aims to construct two towers with truss work connecting them. From this truss work he suspends by means of ropes a large float about 100 feet long. These ropes encircle a drum where the action of the water upon the float causes it to rise and fall with each wave and consequently the ropes will cause the drum to revolve. A ratchet on the drum rotates a wheel and shaft, thus giving movement in one direction only. The shaft in turn is coupled

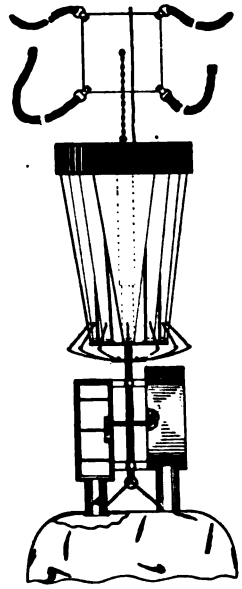


at the far end to a generator thru a system of gears, the function of which is to increase speed of rotation.

Parachute.

(No. 1,344,044. Issued to Andrew Kaminski.)

This invention relates to a form of parachute. It consists of three telescopic tubes, the lowermost section is fastened to the back of the

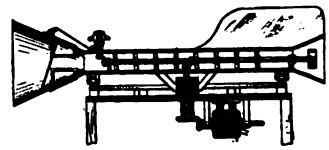


aviator with straps. The parachute proper is folded up. When the telescopic tube is extended, it releases a series of fan blades which immediately spread out like a spring umbrella and serve to stay the fall of the aviator. These blades are so arranged that they may be rotated by means of two powerful motors which are actuated by air or other gas under compression in an envelope above the motors. This also serves to stop the fall of the aviator because of the helicopter action of the fan blades.

Air Motor.

(No. 1,345,022. Issued to Dew R. Oliver.)

This is a rather novel invention for the utilization of wind to pro-

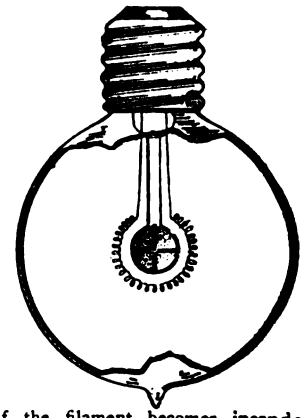


duce power and then to employ the power so produced to generate electric current or to utilize it in any other way desirable. It consists of a long tubular body which can swing in a horizontal plane so that it will always be nose-on into the wind. This tubular structure has a large funnel at both ends in order to allow for the concentration of the force of energy upon a plurality of propellers fixt upon a single shaft, and rotating as shown.

Illumination.

(1,346,172. Issued to Lucian W. Bugbee and Edgar D. Tillyer.)

The electric light bulb featured in this patent is radically different from those which we generally see in that it provides for a small body at the central position of the bulb. This body is not of itself conducting or coupled with any source of electrical energy, but by the heat

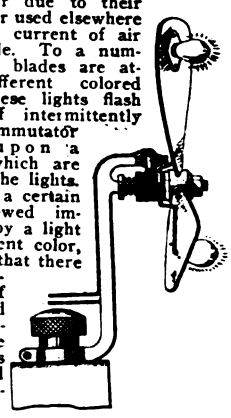


of the filament becomes incandescent and gives off a secondary light without directly using up current.

Display Device.

(1,344,084. Issued to James K. Hackett.)

A very novel feature is here described and relates to display devices adopted to be mounted upon moving vehicles and operated by a rush of air due to their movement or used elsewhere where such current of air is obtainable. To a number of fan blades are attached different colored lights. These lights flash on and off intermittently due to a commutator mounted upon a shaft to which are connected the lights. By having a certain light followed immediately by a light of a different color, it appears that there is a progression of lights and the appearance of the device is rendered very attractive.



Scientific Humor

"Pre-Matrimonial" Astronomy.—It was beautiful moonlight night and they were king a stroll down the beach.
SHE: "Does the moon affect the tide?"
HE: "No, dearest, only the un-tied."—*oger E. Davis.*

So the Boss "Fired" Him.—"My tools nt mad today."
"How come?"
"I left them near a fire and they lost ir temper."—*Arthur Levy.*

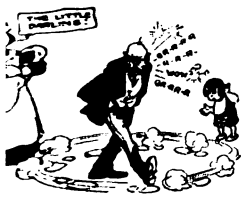
U. S. A.—C. O. D.—When John left me for Europe, his father told him to d a short wireless message if ever he s in trouble. One day the message duly ne "collect" and this is what it read:
Dad:
S.O.S. $ P.D.Q. R.S.V.P.
Son.
—*Kenneth Courtright.*

A High Flyer.—"If you are skilled in some particular pursuit, we shall be glad to let you follow it," said the deputy warden to a newly arrived prisoner.
"Thanks," said the prisoner, "I'm an aviator."—*Ellis King.*

esides, Pneumonia Costs Less.—hat's the difference between ammonia pneumonia?"
ne comes in bottles, the other in s."—*D. H. Bigelow.*

e'd Be "Fired" Too!—CHIEF ELECAL ENGINEER, questioning Applicant: at would you do if lightning struck exploded our apparatus?"
PLICANT: "Go up with the report, sir."—*eph Baenoff.*

oes He "Collect" Privately Too?—father," said the little boy, "is a smatician."
Why, Johnny," exclaimed the teacher, mismatician is a coin collector."
es'm, that's what my father is; he's a uctor on an electric car."—*Samuel ino.*



A Regular Cloudburst.—"So you have twins at your house, Johnnie?"
"Yes'm, two of 'em."
"What have you named them?"
"Thunder and Lightning. That's what pa said when they came to the house."—*A. Jones.*

e's Busy!—In one of the little towns ine there is a single-track trolley line, runs two cars in summer and one in . A passenger last summer, noticing he car ran very slowly except at rare als, when it would spurt ahead for a e or two, was greatly puzzled.
hat makes these sudden bursts of ?" he asked the motorman.
," grinned the motorman, "that comes the car at the other end of the line for passengers."—*J. Kent Smith.*

FIRST PRIZE $3.00

A Scientific Tell-Tail-Tale.—The farmers killed their cows and sent the tails to town for ox-tail soup. They found this quite expensive, so they just cut off the tails, letting the cows live. But they soon realized their mistake when the next year they wanted to sell the cattle; they had to sell them wholesale, because they couldn't *retail* them.—*Ruth Bonebrake.*

In "Polly"-Syllables?—Great Britain may be behind in aerial navigation, but in other respects she seems to be in the lead if we are to judge by the extract from a London paper reporting the experiments being made of crossing carrier pigeons with parrots in the hope of getting verbal messages thru the enemy's lines in time of war.—*J. Kent Smith.*

Too Much Music.—1ST MEDICAL STUDENT: "Are you going to that appendicitis lecture this afternoon?"
2ND STUDENT: "No; I'm tired of those *organ* recitals."—*Raymond Jones.*

ALL jokes accepted and publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

That Pinned Her Down.—"Mother, I just took a splinter out of my hand with a pin!"
"A pin! Don't you know that's dangerous?"
"Oh, no, Mother, I used a safety pin."—*Mrs. E. J. McEntee.*

Tried and Not Found Wanting.—(Sam, who covets the boss' white pants.) "Boss, ah jes' can't clean dem pants of your'n."
BOSS: "Have you tried gasolene?"
SAM: Yas, sah, it don't do no good!"
BOSS: "Well, try ammonia."
SAM: "I'se done tried 'em on, boss, and day fits me fine."—*J. Cecil Hulto.*

Why He Raised the Price of Milk.—"One of my cows swallowed my pocketbook," announced the chatty milkman.
"Any money in it?"
"Forty dollars."
"Well, I hope your milk will be a little richer," said the grouchy customer.—*E. Minch.*

This Joke Is On Us!—MRS. GLADSTON: "What is your idea of a practical scientific joke?"
MRS. SADSTONE: "The one which brings a dollar to my pocket."—*Mary Mattern.*

Same Here—Minus the Talk.—In China when the subscriber rings up exchange the operator may be expected to ask:
"What number does the honorable son of the moon and stars desire?"
"Hohi, two-four."
Silence. Then the exchange resumes.
"Will the honorable person graciously forgive the inadequacy of the insignificant service and permit this humbled slave of the wire to inform him that the never-to-be-sufficiently censured line is busy?"—*Edward Grimm, Jr.*

A Sad "Tale" of a "Swallow."—"I heard your dog committed suicide today."
"Yes, he put his tail in his mouth and that was the end of him."—*Cornelius Hogan.*

Perhaps the Sergeant Too.—It was Sunday, and Sergeant Jones was driving a bucking, one-cylinder Ford down the streets of the old home town.
"Ought to put Lizzie's name on the casualty list," called a fresh gob who witnesst the struggle.
"Whaddye mean?" hist the sergeant between bucks.
"Missing in action!"—*Elmo Hegman.*

Why Professors Go "Bugs."—A student in Zoölogy pinned together a grasshopper's head, a cricket's body and a butterfly's tail. To fool his professor, he asked: "What kind of a bug is this?"
PROF.: "Did it make a humming sound when you picked it up?"
STUDENT: "Yes."
PROF.: "Then it must be a humbug!"—*Walter H. Schulte.*

A Licensed "Driver."—BIGGS: "Our carpenter can drive nails like lightning."
JIGGS: "How's that?"
BIGGS: "Well, you know, lightning seldom strikes twice in one place."—*Joseph Baenoff.*

Perhaps He Was Cremated.—FIRST CROOK: "I hear Jerry got the electric chair."
SECOND CROOK: "Yeah, must have been a *grave* offense."—*D. H. Bigelow.*

"Science and Invention."—Byron Irwin was stopping overnight in a southern hotel and he asked the darky attendant to wake him up at 7 A.M.
"Say, boss," replied the darky, "I reckon you ain't familiar with these heah modern inventions. When you wants to be called all you have to do is to push the button at the end of de bed, then I comes up and calls you."—*Lawrence Degraff.*

THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will answered here for the benefit of all, but only matter of sufficient interest will be publis Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else writt in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to t department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considera research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questi are answered.

REMOVING TATTOO MARKS.

(1065) R. Garnes, San Francisco, Calif., asks:

Q. 1. What will remove or obliterate tattoo marks from the arms, and give directions for use?

A. 1. Tattooing is the mechanical introduction of pigments under the skin, and a very well-known process. The pigments employed are carbon, cinnabar, carmine and indigo.

Most methods employed to remove these marks are by a reactive and a destructive inflammation which will result in the formation of a crust later cast off together with the tattooed markings. One method is to retattoo the marks with a solution of 30 parts of zinc chlorid and 40 parts of water. A mild inflammation will result; a crust forms and about a week later falls off, leaving a scar which gradually heals. Later, a repetition of this may be necessary. This may be done by the professional tattooer.

The second method is to tattoo again, making the punctures close together after the design has been drawn over with a concentrated solution of tannin. A stick of silver nitrate is then firmly drawn over the surface and after a period of several minutes, it is then wiped off. This is far more effective than the first and less scar forms. Two other substances, perhaps more efficient than either of the above, and applied in the same manner as the first, are caroid and glycerole of papoid.

COMMENT ON "ODDITIES OF SOUND" ARTICLE.

(1066) P. W. Calhoun, Madison, Fla., writes:

Q. 1. I notice in the article, "Oddities of Sound," publisht in your May issue, that the author states that the Woolworth Building could, theoretically, be shaken to pieces by a few violins. This is not the first time I have seen similar illustrations of the powers of vibration, but I believe the authors in each case overlook one very important item in their calculations, viz., *friction.*

To illustrate what I mean, let us take two violins, both tuned to a certain note of an organ. Let one violin be equipt with the best grade steel strings and the other with *copper* strings. Place them side by side and sound the organ, and what happens? The steel string begins to vibrate, reaches a certain intensity and remains there. No sound is heard from the copper strings unless it is very close to the organ. Is it vibrating? Examination with a magnifying glass would reveal that it is.

Where does the difference lie? Simply in that it takes a certain amount of power to vibrate each one, but much more power is required to vibrate the copper string on account of the friction of the softer metal; therefore the steel string vibrates much stronger, since each string receives the same energy from the organ pipe. But in each case you will notice that each string will not vibrate above a certain intensity, this intensity being the range at which the internal friction and air friction of the vibrating body exactly counterbalances the power available to vibrate it.

What has this to do with the destruction of the Woolworth Building with musical instruments?

Just this: The maximum amount of energy which could be produced by violins stacked all over the Woolworth edifice would be only a few paltry horsepower at best, and the amount of energy it would take to overcome the friction generated by such a building vibrating an almost inestimable amount would be quite a figure. Of course, the building would vibrate some, but, as in the case of the copper string, not enough to tell it.

The matter of soldiers marching across a bridge is a different matter, for two reasons. First, because it doesn't take anything like the energy to vibrate a bridge that it does to vibrate a building, because there isn't much friction in the vibration of a bridge, all motions being possible by simply springing the metal parts instead of having to drag bricks and timbers together. Second, the amount of power developed by several hundred men bobbing up and down together would be sufficient to vibrate almost anything. It is interesting to note, tho, that there is no military rule against marching in and out of buildings in cadence, which in itself proves that a building is much harder to vibrate than a bridge. However, if it were not for the friction of a bridge, it would be possible to adjust an alarm clock to the right speed, set it on the bridge, and down she would tumble in due time.

[EDITOR'S NOTE:—We referred the interesting query from Mr. Calhoun to Prof. Dayton C. Miller, the well-known expert on the physics of sound and vibration, and author of the work, "The Science of Musical Sound." Professor Miller says:]

A. 1. Mr. Calhoun's comments are not altogether well taken, neither are his criticisms all wrong. Of course, the main supposition of the original article is based on assumed conditions, which are never actually present. It is easy to deny your conclusions by refusing to accept your premises.

A performer on the violin, or a thousand, are not going to cause the Woolworth Building to collapse. To argue this regarding the original article is useless. The author was illustrating a perfectly sound principle of resonance and of accumulated vibratory energy. The author's point in the article referred to was that if the energy were not absorbed or dissipated then, according to well-established principle, the body in resonance with a feeble source of energy might in time acquire a very large store of energy, even enough to be compared with that which would bend structural steel frame work; and under certain assumed conditions this might be dangerous to the stability of large structures.

As to the conditions by which the act vibrations produced by a violin are dispersed in the Woolworth Building, the author presumably employed the violin in a rather figurative sense; meaning that some independent source of suitable vibrations were in operation the result might be important. Such a source might be an earthquake, for instance. Then accumulative vibratory energy would surely be dangerous.

Mr. Calhoun is not quite correct in his interpretation of the difference between copper and steel strings. If he were to take strings of these materials of the same diameter, same length, and tune them to the same pitch exactly (the tensions would be nearly alike, since the densities of copper and steel differ but little) then, when they are placed near the organ-pipe in unison, both strings will be made to vibrate in practically the same amplitude. If he has tried the experiment, I am inclined to think that the copper string has been under less tension than the steel. The elastic property of a string is mostly due to its tension. Mr. Calhoun's idea of "friction" is not quite correct in its application to vibratory motion. Of course elasticity is everything, and internal friction or viscosity is important in the transmission of certain kinds of vibrations thru bodies, but it does not apply, as he suggests, to the transverse vibrations of a string.

The differences between a bridge and the Woolworth Building is due to the differences in the ability to absorb and transform simple vibrations. It is much easier to set the bridge in vibration because it is acoustically a much simpler type. Of course, if by "friction," due to "friction," he means absorption or dissipation, but it is not the internal friction of the material, *viscosity*.

SPECIAL TIME SWITCH.

(1067) Earl Cochran, Poplar Bluff writes the Oracle:

Q. 1. Asking how he can construct a switch for opening or closing a circuit a certain number of coulombs have pa

A. 1. There are several ways of opening or closing a circuit when the current from a four-volt battery has delivered a certain quantity. The simplest is by means of a watt-hour meter which will automatically make contact with one of the hands or metal piece opening or closing a relay. Another way is to have a long tube or trough balanced with plates at both ends and filled with silver salt. The current passes between these plates. If a sensitive balance is established and sufficiently weighted at the other end, it will be found that in a solution .001118 gram of silver will be deposited upon one plate for each coulomb. When the plate therefore becomes heavier on one side it will automatically unbalance the balance and open or close the circuit. These plates could also be immersed in a solution suspended from a delicate balance and sufficient weight added to one scale pan to overcome any slight additional weight until the desired weight is reached.

What Makes A Magazine Cover

By CHARLES A. GROTZ

(*Continued from page 731*)

printing frame and electric lamp in operation making a print.

Figure 5 is a view of the operator in the act of laying the sensitive copper plate on the negative. You will notice that this printing frame is of a different construction than that used in printing on paper from a negative, but we have to contend with two non-flexible substances, namely a sheet of copper and a glass negative. Neither of them is optically flat, and it is necessary for us to get optical contact. We then must resort to some extreme pressure. The basis of this frame is heavy plate glass. After the negative and copper plate are in the frame a heavy rubber blanket is clampt down over them. This blanket has a rubber hose attach to the center which in turn is connected to a vacuum pump. This removes all of the air from between the negative and copper plate, giving a vacuum and an extreme suction, so much so, that a curve or wave in either the glass negative or the copper, is brought into optical contact with the neighboring surface.

ETCHING AND FINISHING THE PLATE.

The next step is in etching and finishing the plate, and here considerable skill is required. The printed copper plate is placed in an acid bath. This etches or dissolves the unprotected copper between the dots. After the plate is removed from the acid bath, the parts which have been protected by the enamel are in relief, and the plate could now be printed from, on a regular printing press, but the plates in this condition are far from perfect and require skillful re-etching in order to bring out the colors and detail perfectly.

Figure 6 shows a Finisher at work. He must now refine the etching by staging or painting in with a *resist* preparation, certain portions of the picture which he considers have had enough etching, and then giving to the unpainted portion a still further etch. He may find it necessary to fine etch the plate in several steps, holding back first the shadows, then the middle tints, etc. After he is satisfied with the etching, he cleans off all of the staging and rubs in a white powder. This sticks *between* the dots, or rather in the sunken parts and enables him to see the plate just as it will print. He then looks for needed toolwork, such as cutting in delicate high-lights, or taking out blemishes.

ROUTING OFF SURPLUS METAL ON CUTS.

The plates now pass to the routing room. Here the surplus metal is routed away by a machine which is practically a high speed cutter mounted on a universal jointed arm which can be guided by the operator to any position desired. This cuts or routs away the large open portions which would take too long to etch deep enough so that the ink rollers of the printing press and the paper on which same is to be printed will not come in contact with the bottom of the plate thereby causing a dirty impression.

Figure 7 shows the plates being routed. After the plates are routed the burrs left by the routing tool must be carefully trimmed by an engraver, after which the plates

(*Continued on page 770*)

What Makes a Magazine Cover

(*Continued from page 768*)

are ready for the *proving*. This is done on a regular power printing press much the same as the presses upon which the cover is finally to be printed, only of a smaller type.

Figure 8 shows a view of the proving department. Here the plates are printed in the rotation for which they have been made—usually yellow first, red second, and blue third. If a fourth impression is used, it is printed in black and is the last printing on the sheet. However this is not a set rule. The colors can be printed in any rotation and we will get practically the same result. But one thing is important, and that is the *register*. The respective colors must print each one *exactly* in its proper place.

Figure 9 shows an enlarged side view of a halftone printing plate. It will be noticed that the actual printing surface is all on a plane and the tones are produced by large and small dots.

This in a general way explains the process. Space does not permit us to go into the many little phases and detail.

The cover of this issue is a most interesting example of three color work. The large butterfly on a slightly dotted ground is an exact reproduction of the small one, but enlarged some 16 diameters. It has been made to show the action of the screen and how the colors are produced by superimposition. If examined at close range it looks like a crazy-patch quilt, but from a distance of fifteen or twenty feet, its colors blend and give a perfect picture of a butterfly with variegated wings. It is the best illustration of this type of color work that has yet been produced.

If the small butterfly is examined with a microscope, it will be found to be the same in all respects as the large one. Even the pale blue background is made up of the same proportion of little blue dots, widely spaced in the relative sense and regularly distributed.

Figures 10, 11 and 12 are "progressive" prints of the small insert, but printed in black only. They show the color formation and if these same plates were printed in yellow, red and blue, exactly in register, you would see the same little butterfly as is reproduced on this cover.

The picture was made direct from a *real* butterfly, no painting having been made. The name of this butterfly or rather moth—a valuable specimen—is *Urania Croesus*. It was kindly loaned to us thru the courtesy of Asst. Curator Dr. Frank E. Lutz, Entomological Dept. of the American Museum of Natural History of New York.

It was necessary for the Editor to spend two days at the museum where he inspected *over* 100,000 *butterflies and moths*, before the right one was found. There is practically no butterfly that has all the three colors yellow, red and blue, which we desired in order to illustrate the three color process. So we finally had to take *Urania Croesus*, not a butterfly at all, but a moth.

The Editor here wishes to express his appreciation to Dr. Lutz and his associates for their very kind assistance in locating the desired specimen.

ORANGE, N. J., PLANT DELIVERS PART OF RADIUM ORDER.

A radio-chemical company announced recently that one gram of radium valued at $120,000 had been brought from the radium-extracting plant at Orange, N. J., to New York. This is the first part of New York State's purchase of two and a quarter grams. It is to be used for research purposes.

Phonograph Prize Contest

(*Continued from page* 740)

By placing a fan on the shaft in place of the buffing wheel those who have electric Victrolas might have a suitable fan for the warm nights when they wish to play their phonograph.

LESTER BENOIT.

HONORABLE MENTION.

Wire Winder.

The following kink of using an idle phonograph has saved me many toilsome hours of winding wire on spools after some experiment.

I constructed the following winder:

I first procured a steel plate 6" in dia., ½" thick, and drilled a hole in the center thru which the pin in the phonograph passes.

Then, taking another plate 1½" in. dia. and ¼" thick and drilling a 3-16" hole and slightly counterboring one side and riveting this to a 6" x 3-16" drill rod which had been previously threaded for 2 inches of its length, I procured a wing nut and washer to fit same. Then drilling and tapping the plates, I assembled the pieces into this winder, the weight of which is sufficient to keep it in place while revolving.

By placing a spool on the stand and putting washer and nut into place a first-rate winder is the result.

WALTER C. PATZOLD.

HONORABLE MENTION.

Flying Toy Airplane.

A light paper toy airplane is mounted at the outer end of a wire arm offset about 18 inches from the vertical center line of phonograph disc. The lower end of this wire is clampt onto the center pin of the phonograph disc by a spring clamp similar to a spring clothespin.

As the disc rotates the little airplane will fly or whirl around in a three-foot circle and a light paper propeller mounted on the front of the airplane will be caused to spin rapidly by its passage thru the air. A small cloth flag mounted on top of the airplane will heighten the speed effect.

CARL S. BATES.

HONORABLE MENTION.

Metronome.

The following useful metronome has been constructed and used by me and my younger brothers for over a year and it has proved very successful.

A narrow, half-round strip of wood was glued across an old record of the "ten-cent" kind. A tube in the form of a right angle was soldered to the cover of a shoe paste box after the latter had a hole cut in it.

A hammer was made by gluing a hardwood stick into a hole in a hardwood ball.

The other end of this hammer was rounded so it would slide over the strip glued to the record. A light spring keeps the ball in contact with the back of the can and is fastened to the hammer arm just below the point where it is pivoted to the front of the can. If the cover does not fit tight enough it will have to be soldered in place.

If the attachment is to be placed on a Victrola, then the goose neck must be revolved back to the rest position.

If necessary, a rest of wood with felt on the bottom can be used to hold the wood "needle" off the record, but not off the wood

(*Continued on page* 809)

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(Continued from page 739)

be lost in the glare of the sun, tho possibly at the time of the vernal and autumnal equinoxes when the sun is crossing the equator individual particles would be projected against the sun's disk.

Diagram 1. Earth's Shadow Inclined 23½° to the Equatorial Plane. E, Earth; R, Hypothetical Ring of Meteorites in Plane of Equator 4,000 Miles From Surface; C, Critical Distance, Between 2.44 and 2.86 Radii (9,700 and 11,400 Miles), Within Which Range a Meteorite a Mile or More in Diameter Would Be Ruptured by Tidal Strains; S, Distance 8,000 Miles at Which a Satellite, 1 Mile in Diameter Would Be About as Visible as Mercury; P, Distance, 120,000 Miles, at Which a Ten-Mile Diameter Satellite Would Be Almost as Visible as Mars. If S¹ is a Meteorite, It Will Only Be Visible at Sunrise or Sunset and More Clearly by an Observer Near the Equator.

just after sunset or just before sunrise hin the tropics would be the only favor- e time and place to look for a ring of teoric particles encircling the earth in equatorial plane. Were there such a consisting of many particles it would visible only in the twilight hours extend- along the celestial equator as an arch faint light passing close to the zenith the tropics and fading away toward the tern and western horizons. In mid- tudes it would never attain a sufficiently h altitude above the horizon after sun- to be visible in the glow of twilight.

The zodiacal light, which is so conspicu- in a clear sky at night in the tropics a faint haze of light extending along the ptic entirely across the heavens with a re luminous patch exactly opposite the called the "gegenschein," owes its gin to an extensive ring of meteoric ticles revolving about the sun in the ne of the earth's orbit and extending beyond the orbit of the earth. The t hazy light is due to sunlight reflected n these countless minute particles of ter. The cause of the "gegenschein" "counter-glow" is not so clear, but it t come from particles lying beyond the e of the earth's shadow which falls veen 844,000 and 873,000 miles from the h's center. It may be due to a dense lensation of these particles about 930,- miles beyond the earth where the field he earth's attraction begins and where result these particles are whirled about er the rival attractive forces of the h and sun.

our latitudes the zodiacal light is h less conspicuous than it is in the

tropics where the ecliptic arches high across the heavens and it can rarely be traced in mid-latitudes more than 90° from the sun, its light fading away as the distance from the sun increases.

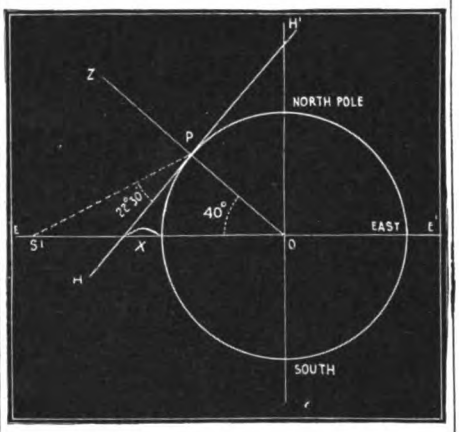


Diagram 2. Invisibility of an Object in Plane of the Equator to an Observer at High Latitudes. O—Center of the Earth. HH¹—The Plane of the Horizon for a Point P in 40° North Latitude. Z—The Zenith of the Point P. EE¹—The Plane of the Earth's Equator. S¹—An Object in the Plane of the Earth's Equator 4000 Miles from Its Surface. HPS¹—The Elevation or Altitude of the Object S¹ Above the Horizon (22½° for 40° N. Latitude). X=1222 Miles for 40° N. Latitude. An Object in the Plane of the Earth's Equator Within This Distance of the Surface Would Lie Below the Horizon HH¹ and Be Invisible.

A dense ring of meteoric particles surrounding the earth within four thousand miles of its surface would have the same hazy appearance as the zodiacal light, tho instead of lying along the ecliptic it would lie along the celestial equator. In mid-latitudes, just after sunset or just before sunrise, it would rise less than twenty degrees above the horizon and would be lost in the glow of twilight. In the tropics as we have said it might possibly be faintly visible at twilight as an arch of dim, hazy light across the zenith from east to west fading away toward the horizon. That the observation of no such phenomenon has ever been recorded in the tropics we may take as an indication that no dense ring of meteoric matter does exist within the critical limit for the earth. This does not preclude the possibility that many isolated meteoric fragments averaging one hundred feet in diameter or less may be revolving about the earth within four or five thousand miles of its surface or in fact anywhere within the field of its gravitational influence. The stony and iron meteorites that frequently fall to the earth's surface may be stray members of an extensive group encircling the earth, remnants possibly of a meteoric ring that has gradually been absorbed by the earth during the aeons that have elapsed since its birth.

We may feel certain, however, that no extensive ring of meteoric particles could exist undetected within the critical limit for the earth and no minute satellite *without* this limit as great as a single mile in diameter.

Fig. 1—1. Mars Viewed Thru Telescope. 2. An Object One Mile in Diameter and 400 Miles Distant, and 3. An Object 10 Miles in Diameter at 120,000 Miles Distance, All Viewed Thru Same Telescope.

AMERICAN TYPEWRITERS AND SEWING MACHINES IN THE DESERT.

Wander where you will among the oases of the Sahara desert, the click of American typewriters and the whir of American sewing machines are always with you.

The typewriters have followed the French railway that is creeping farther south into the heart of the desert every year, linking up the oases. Every station, no matter how lonely, has its machine—which, very likely, saw service with the American S. O. S.

As for sewing machines, every oasis town has its "sewing machine row," where the Arab operators sit elbow to elbow, cross-legged in the sand with their machines in front of them, gossiping and sewing all day long. Every Arab who can scrape together enough francs to buy a machine joins the local sewing circle.

Views of these oasis sewing machine rows are included in the film, "The Children of the Sahara," which the American Red Cross has taken in Algeria and Tunisia.

300 K.V.A. Transmitter at Bolinas, California

By ALLAN C. FORBES

(*Continued from page 757*)

the best working wave), the minimum input is 50 K.W., using main generating set, radiating 115 amperes; the maximum rated input 300 K.W., radiation 265 amperes. The radiation will vary, depending upon whether both the counterpoise and salt water "grounds" are used, whether the phase angle adjustment on the generators is in correct relation with the studs of the spark gap on discharge, etc. The effective height of the antenna is approximately 275 feet.

The station is provided with two "grounds." No. 1 is a salt-water ground, consisting of forty lengths of aerial wire buried in the ground and extending over the embankment into the ocean, and there fastened to zinc plates buried in the water. No. 2 ground consists of thirty-two lengths of aerial wire ploughed directly under, and extending the full length of the antenna.

The power-house consists of essentially two main rooms with two small storerooms and offices. The building is about 100x200 feet, and comprises the generator, condenser, storage battery and storeroom on the main floor, while upstairs are situated the switchboard gallery, jigger gallery and offices of the engineer in charge. In the generator room are located all the apparatus, with the exception of the switch keys, which are located in the jigger gallery. All apparatus is in duplicate, consisting of the two 300-K.W. motor generators, 2.75-K.W. direct-current generators (exciters), two air-compressors (to furnish air to the discharger), two exhauster motors that supply fresh air to the discharger rooms, two key-blowers supplying a blast of air to the switch keys located in the jigger gallery, two small signal motor generators for operating the switch keys, four 11,000/440-volt service transformers, five 2,000/13,000-volt radio transformers.

The condenser room is used exclusively for the condensers, which are enclosed in an iron railing for protection to the engineers. The storage-battery room contains a bank of 55 storage-battery cells; the total battery is rated at 125 volts, 20 amperes, normal discharge rate. This storage battery is used for furnishing an emergency lighting system for the power-house and to control the oil switches in case of failure of the electric company's power. The jigger gallery contains the oscillation transformer, high-frequency bus bars, choke coils, switch keys, reactance coils and loading inductance. The switchboard gallery contains a 17-panel switchboard with suitable instruments.

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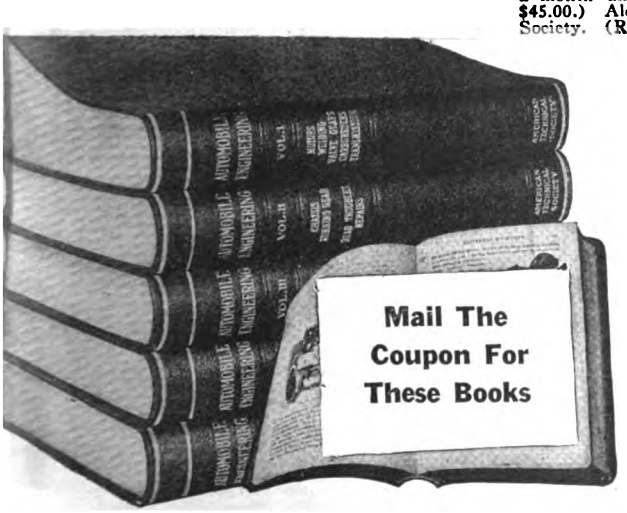

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Blind Now Read by Musical Sound

(*Continued from page* 744)

this means the light that falls on the printed matter forms five bright spots in line, forming what is called the "scala." Each spot is pulsating at a rate corresponding to the number of holes in the circle of perforations to which it belongs multiplied by the number of revolutions per second of the disc. There are 18 holes in the innermost circle, 24, 27, 30 and 36 in the other circles respectively, and if the disc makes 21⅓ revolutions per second, the second circle of holes will produce 512 pulsations of light per second—corresponding to the vibrations in the musical note C^1. The numbers of holes given above are in proportion to the vibrations in the notes G, C^1, D^1, E^1, G^1, (sol, do, re, mi, sol). A change in the speed of rotation of the disc of course alters the pitch of the notes, that is, the key in which the motifs are sounded, but the intervals remain unaltered.

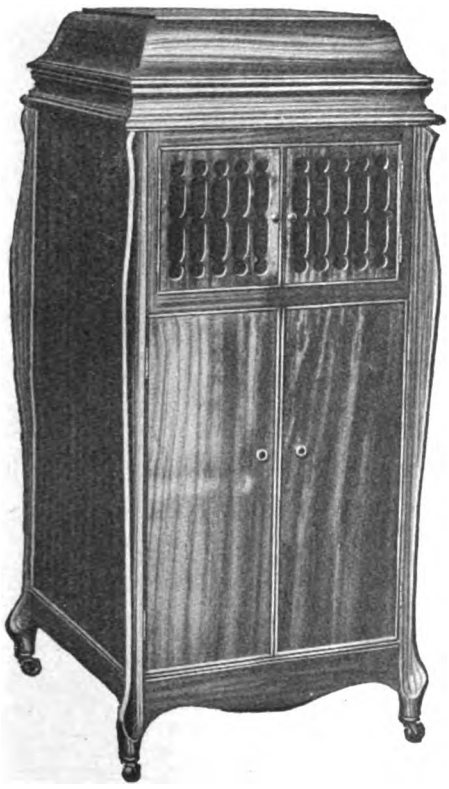
The optical system used to produce the image of the holes has a variable minification, so that the length occupied by the scala of five spots may be adjusted to equal the height of the letters to be read, the range of adjustment covering the various sizes of type employed in ordinary printing. The optical system is so designed that the sharpness with which the five spots are focust upon the surface of the paper is little altered by a change in the minification, but more accurate focussing can be effected by movement of a small lens situated immediately below the selenium bridge. The spot of light corresponding to low G is caused to fall on the lowest points of such letters as j, p, y, etc., the high G^1 falling on the tops of capitals and of the high letters. The three intermediate spots cover the height of the short letters. This will be readily seen by reference to Fig. 5, which is an enlarged diagram showing the scala passing over the word "Type."

With an Optophone constructed in accordance with the above description, if all the spots of light fall on white paper—the space between two words, for example—all the notes will be sounded together in the telephone, producing a discord. If the scala passes over the letter V, the top note G^1 (high sol) will first be silenced, then E^1, D^1, C^1, D^1, E^1, G^1. Each letter will alter the succession of sounds in a different manner. This arrangement constitutes what is called the "white sounding" Optophone.

The present improved type of Optophone is modified so as to make it "black sounding." In this form white paper is represented by silence, and notes are sounded as the scala passes over the black letters. With this Optophone the letter V is represented by the motif G^1, E^1, D^1, C^1, D^1, E^1, G^1 (s m r d r m s).

The "black sounding" is obtained by providing a second selenium bridge which is called the "balancer"—illuminated by a small part of the intermitted light reflected aside before it reaches the paper—and connecting this bridge to the telephone and the battery in the manner shown in Fig. 6, so that the current traversing the balancer bridge (Se. No. 2) acts in the reverse direction in the telephone to that of the current thru the main selenium bridge (Se. No. 1). One battery is used and the two selenium bridges are connected one to each end of the battery, and both thru the telephone to a selected intermediate junction of the battery in the manner shown. The balancer thus tends to cause the telephone to sound all the notes continuously, and the main selenium bridge, that receives the light re-

(*Continued on page* 784)



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"I have the model No. 1 set up and in fine running condition and would not sell it unless I could get another one like it. It is equal to any I ever saw. I have finished it in natural wood and all that have seen it say that there is not a finer machine in any store in town."—Corbin, Vancouver, Wash.
"Have just finished the cabinet and believe me she sure does look swell. I can guarantee you several more orders very soon."—Armhein, Milwaukee, Wis.
"I am well pleased with the MAKAFONE I ordered from you some time ago and am now placing another order for a No. 4 machine."—Hysong, Covington, Ky.
"I received my MAKAFONE and have built it and find it a dandy. I will send an order for a No. 3 machine in the very near future."—Bank, Sanatobia, Miss.

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Blind Now Read by Musical Sound

(Continued from page 782)

flected from the paper, annuls the effect of the telephone in respect to any note when the spot of light corresponding to that note falls on white paper. The division of the total voltage of the battery can be varied so that when the whole scala falls on white paper the telephone is silent, and notes are sounded only as the scala moves over the black letters, as previously described.

MECHANICAL CONSTRUCTION OF THE OPTOPHONE.

The book-rest consists of a metal frame standing on four feet and supporting the curved glass plate on which the page to be read is placed face downward. Means are provided for clamping down the page so that it lies in close contact with the upper surface of the glass.

The shaft carries an aluminum casting called the "tracer," on which are mounted the electric lamp, the revolving disc and its motor, the optical system and the selenium bridges. The tracer can swing from one side of the book-rest to the other.

The lamp holder is carried at the lower end of the tracer. Above it there is a rotating disc, thru the perforations of which the light passes to the objective and thru a small lens near the top of the tracer, above which again there is placed the main selenium bridge (Se. No. 2). Under the objective there is a concave-convex lens, placed at an angle, which reflects a portion of the intermittent light back to the secondary selenium bridge (Se. No. 2), called the "balancer," situated in the tracer a little above the disc and to the right of its axis. (See Fig. 3.)

When the tracer is swung over to the right hand side (by means of a handle projecting out in front of the book-rest in Fig. 1) a spring situated on the shaft behind the book-rest is bent down and tends to throw the tracer over to the left. A governor is provided which controls the swinging of the tracer to the left. On the top of the governor box (which is situated behind the left back corner of the lamp holder) there is a screw with a milled head for controlling the speed of swing of the tracer—*i. e.*, the speed of passage along the line of printing.

An adjustable friction gear is provided for moving the tracer down the page a line space at a time, or up the page one line space at a time if desired for re-reading a line.

READING SPEED 25 WORDS PER MINUTE AND HIGHER.

In the case of the letter V already referred to, the connection of the characteristic tune or motif with the actual form of the letter is readily recognized from the succession of notes. It must not be supposed, however, that Optophone reading consists in analyzing the sound motif so as to identify the forms of the letters indicated. When the alphabet has been learned, the motif for each letter is recognized as a whole, and later in the reading practice, the more extended motifs for syllables and even words will become familiar to his ear. A practiced Optophone reader will recognize words as readily as a telegraph operator interprets a succession of clicks on the Morse code. The great rapidity that has been attained by hundreds of readers of Morse sounds encourages the hope that equal or greater speed in Optophone reading will be attained with practice. Already it has been found that one of the latest type of Optophone a blind reader after some practice has attained a speed of reading of 25 words per minute.

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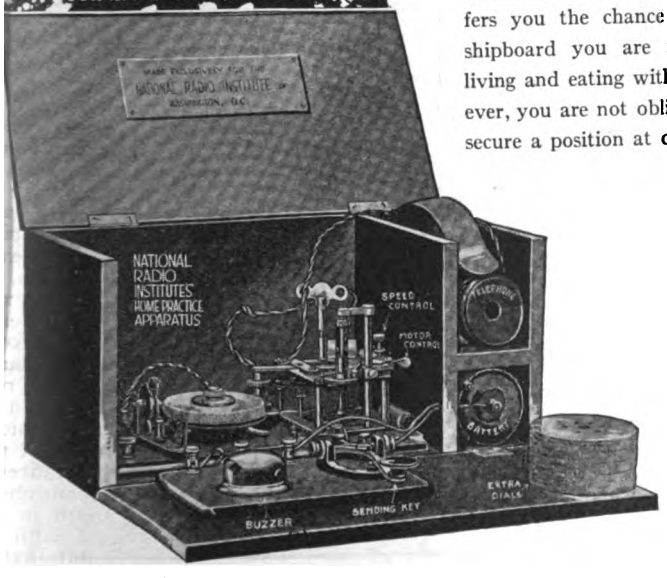

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When the "Sub S-5" Sank

(*Continued from page 729*)

hours thru Thursday evening and Friday morning, when a hole large enough to pass us thru was finally finished at 3 o'clock Friday morning. The most exhausted men were past thru first to the floating staging, and from there taken aboard the *Alanthus*.

"Next to my inexpressible admiration and praise for every officer and man in my crew and my pride in their courage and fortitude, my deepest feelings are of gratitude for the officers and crews of the *Alanthus* and the *General George Goethals*, who so heroically and tirelessly labored. Our rescue was an accomplisht fact. The rest of the story, I believe, has been told," he said in an interview with the New York *Times*.

SIGNAL BUOYS FOR SUBMARINES.

All of which makes fine reading indeed, but many of us were waiting to hear the details of the highly praised "signal buoy" so strongly featured in the first newspaper accounts of the disaster. But final accounts of the rescue of the crew failed to mention anything about the automatic signal buoy.

It is understood, however, on good authority, that the modern American subsea craft are fitted with such detachable signal buoys, which can be released from inside the craft in distress, the buoy floating to the surface of the water and being held directly over the sunken vessel by means of a self-retrieving cable, as clearly illustrated in the accompanying figures.

The signal buoy carries a telephone fitted in a water-tight box, the door of which can be readily opened by anyone coming to the rescue. The buoy also carries a tolling bell which can be heard for a distance of a mile, besides electric and acetylene lamp signals, and a rocket projector.

The signal buoy is designed to fit snugly into a recess in the hull of the submarine, so as not to spoil the smooth contour of the hull in cutting thru the water. When an electric release button is prest, the buoy is supposed to rise to the surface.

Why the "S-5" did not use or have such a signal buoy is not publicly known. If it had no such safeguard, it would seem about time that the Navy Department experts looked into the matter.

Super-Silkworms and Super-Silkworm Food

By RICHARD HOADLEY TINGLEY

(*Continued from page 719.*)

supply of raw materials. Our imports of raw silk in 1919 amounted to $329,338,872.

It is generally held that the United States can raise just as good mulberry and other trees upon which the silkworm feeds as any other country. Also, that we can raise the silkworm and the cocoon in competition with any nation. It has long been held as a demonstrated fact, however, that we fall down when it comes to reeling the silk in competition with Japan and China because of their cheap labor—and labor is a big element in reeling while in the other processes nature does most of the work.

It is the claim of Dr. Osigian that, with the application of his discoveries and inventions, the handicap of cheap Oriental labor competition will be more than overcome. It is his special mission in life to teach the American people how this can be done—how much of the 300 odd million dollars can be kept at home—and he has already made a good start at it.

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Why We Remember Things

By WILLIAM M. BUTTERFIELD

(*Continued from page* 734)

a foundation for and influence all of the ideas that may come to us later as a result of memory. Every moment of wakeful consciousness increases this spontaneous supply. Every voluntary movement of the body is prompted and controlled by this store of knowledge, which is provided primarily for such purpose.

No one without sensation, we see, can have a knowledge of things, and without memory knowledge would be useless; hence we know how to feed ourselves with what is wholesome, agreeable food, solely by initial sense impressions that have been indelibly registered in our mind, and which memory recalls, as a guide or incentive. We protect and care for our bodies in the way common to us simply on account of memory. It is quite different with animals who have an instinct, a sort of mechanical mind—similar to that of man, provided unquestionably for purpose of protecting their bodies and securing food necessary to their existence.

The operations of memory, complicated as they are, and recalled by trivial, seemingly unconnected things such as an odor, sound or sight of an object, are all of them definable. For, the process of recalling an event or fact is a voluntary brain response. This response is created by one or more sense impressions, received in the normal way, forming a new product by combining the recent and the stored-away impressions. This produces a vision, or something akin to it, in the mind. Such sensations we call mental pictures. The mind, thus stored with mental impressions, varies greatly in different individuals, not so much on account of the difference in physical attributes, but because some people are more interested in or give more attention to certain affairs, and in this way acquire special impressions. Hence we have the musical mind, philosophical mind, mechanical mind, and so on.

It is said that as the body decays the mind decays also; this may or may not be true, according to the nature of the wasting process. Certainly there is second childhood when the minds of the old are keen in recalling anew events that had been crowded out and forgotten during the period of their declining years. This faculty, many believe, is due to the fact that the power of the brain to receive and store impressions is never destroyed.

To aid the mind in its conception of common events, one must have a lively, keen interest in common events, else the mind will have little or no understanding of them. This, of course, is true of every variety of mental impression. When a person says "I have no knowledge" of a thing, we may assume that they have never seen or given attention to this particular object. We may conclude, in a like way, if they have acquired a knowledge of the object, but never again see it, or any thing that reminds them of it, the knowledge they once had may become dead or forgotten. Thus one may have had, at some time, a very clear knowledge of an event, object or fact. Yet because one no longer takes an interest in its source, or in things that may recall it, one may loose, temporarily or forever, all of this knowledge. We can see, if we look at it in this way, that "loss of memory" is not necessarily an indication of physical or mental decay, but rather caused by a cessation of the interest necessary to recall or renew it.

use of this direct-connected set for long waves on a straight open antenna. During the past summer the author has had no trouble on the open antenna except during thunderstorms, altho in this part of the country the summer has proved rather favorable for radio. Again, when the amateurs start transmission, trouble may be experienced on the open antenna from QRM.

The following table gives some sample settings for tuning on one particular loop antenna; of course the settings will differ in other stations.

Station	Wave Length	Inductance Tap	Condenser Setting
Annapolis	NSS 17,000	1" (175 mhy)	74 degrees
		⅞"	96
		¾"	140
		⅝"	165
		½"	
New Brunswick	NFF 13,600	1"	42 and 53
		⅞"	46 70
		¾"	82 103
		⅝"	117 144
		½"	149 168
Arlington	NAA 6,000 (arc)	½"	0 (antenna only)
		⅜"	60
		1/16"	159 (calling)
	NAA 2,500 (spark)	5/16"	8
		¼"	10
		3/16"	12
		⅛"	13
		1/16"	20
		0 (antenna)	22

From this table it will be seen that any tap up to 5/16" brought in 2,500 meters, so that the first tap might be placed at ¼", for the minimum wave length of 2,500 meters. For the maximum wave length, it may be seen that for the longest wave station, NSS, on 17,000 meters, any tap from ⅝" to the end of the coil (1") was suitable; and for NFF on 13,600 meters, any tap from ½" to the end of the coil. Moreover, any tap from ⅝" to 1" gave both NSS and NFF by merely turning the condenser. This shows that for this particular antenna only ¾ of the coil needed to be used, or even less, and that one tap at ¾" covered the upper range of wave lengths. If then one tap were put in at ½" or half the coil, for intermediate wave lengths, all wave lengths from 2,500 to 20,000 meters would be covered by the three taps of ¼", ½" and ¾" respectively. This would mean that the inductance switch would need only three or four points, to cover the whole range specified, and that this switch would hardly, if ever, have to be toucht, the tuning being all done by the single 43-plate condenser, and the loudness of signals brought out by pulling out the tickler to the critical point. It is surprising how simple such a set can be made. Settings for the open antenna are not given here, for the readings are similar and the conclusions the same.

(*Conclusion.*)

NEW RADIO LICENSE RULES AT NEW YORK.

Applicants examined in the New York office for commercial radio operator's licenses will be tested in their transmitting ability in sending Continental Code.

Applicants for commercial first grade operator's licenses will be required to send 100 satisfactory code characters in succession in a five-minute test at a 20-word-per-minute speed.

Applicants for Commercial Second Grade Operator's license will be required to send 60 satisfactory code characters in succession in a five minute test at 12 words per minute speed.

The transmissions by the applicant will be received by the examiner and will also be graphically recorded on a tape recorder as a check against transmissions in case of doubt.

Radio schools training men who expect to take these examinations are requested to prepare their students for this transmitting test and include a test therein before they give the student the usual letter certifying that they have satisfactorily past the course, and for which the applicant is allowed a 10% experience mark in this office. The transmitting test given the applicants will include characters, numbers and signals of all kinds used in the usual transmission.

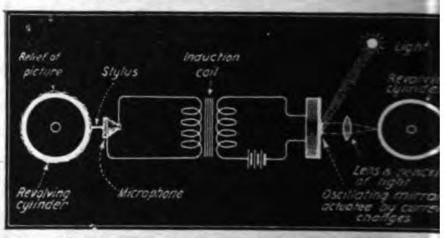
The Belin System of Telephotography

(*Continued from page* 805)

duction of a varying or irregular undula tory current. These are the first two step —the first mechanical, the second electrica Then the current, as the third step, also a electrical one, causes the mirror to oscillat The fourth step may be taken as optical this step is the focussing of light reflecte from the mirror upon the sensitized pape It is at this stage that one of the most cha acteristic features of the process appear The work is being done with very feebl currents, of what may be crudely terme microphonic intensities. So all the wor that is given them to do is to cause a sma and exceedingly light mirror to oscillat and it is its imponderable beam of ligh which, acting on the sensitized paper, brin us to the last step—the final photograph one. The final step is the one of greate delicacy, for it is fair to say that the sens tiveness of the photographic surface is a example of one of the highest degre of that quality attained by man outside vacuum tube reactions and the like, whe the investigation or processes approac pretty close to the molecule or even to t electron.

Thus there is a regular succession processes of gradually increasing delicac beginning with mechanical action and en ing with the photographic effect. The la is the most delicate of the progressive ope ations, the first is the least sensitive.

We give in addition to the illustratio of the apparatus, both sending and recei ing, some interesting examples of the wo of the system. The photographs (unr touched) of the representatives of t French and American armies, Genera Mangin and Pershing, were transmitted a few minutes, perhaps the principal del being the time required for the developme of the photographic image.



Method by Which Pictures Are Transmitt and Received by the Belin System.

Autographic writing is transmitted wi still greater ease, as there are no gradu tions to be taken care of, and the sudd change from black to white represent t simplest phases of the subject. Yet o illustrations show that the infinitesim gradations of the photographic liken are given with great clearness in the production.

The applications of the invention a evident. There are many occasions wh the transmission of an autograph messa would be most desirable, if only for soc or similar motives. It would not constit as things are now, a legal signature.

The general disposition of parts is giv in the diagram, which, taken with the te above, makes the principle clear. T cylinder with its picture or writing in r lief, is shown with the microphone on whi the arm acts mechanically. The line wi induction coil and battery and other quirements, transmits the vibration fr the microphone to the distant receiver-li device, whose diafram carries a mirr This reflects the light thru a system lenses to the sensitized paper on the r ceiving cylinder.

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On its remarkable trans-Atlantic flight the U. S. Navy flying boat NC-4 used A-P VT Amplifier-Oscillators. So efficiently did these A-P tubes serve on this flight, and so much did they contribute to the success of this great achievement, that voluntarily the Bureau of Engineering of the U. S. Navy wrote our Laboratories a letter of appreciation.

THIS is the LETTER

THIS is the TUBE

A-P tubes manufactured under the De Forest Audion and Fleming patents. Other patents applied for and pending.

N. S. F. 5a
ADDRESS BUREAU OF STEAM ENGINEERING, NAVY DEPARTMENT,
AND REFER TO NO.

ENCLOSURES.

NAVY DEPARTMENT.
BUREAU OF STEAM ENGINEERING
WASHINGTON. D. C.

July 5, 1919.

Moorehead Laboratories,
San Francisco, Cal.

Gentlemen:

While on the Trans-Atlantic Flight the Moorehead tubes gave such excellent service, that I feel it my duty to personally tell you of their performance and send you one of the tubes used and a portion of the lead fish that held down the antenna to which the receiving equipment was connected.

During the trip your tubes made it possible to receive signals from the Norfolk Radio station while the N C 3 was on the water near the Azores, a distance of 2300 miles. But the longest record of reception of radio signals in any type of plane while in flight was far surpassed when signals were received from a ship 1800 miles away. This enviable record is even more distinguished from an aviation point of view in that your tubes required but half the power used by other types of tubes, thus saving many valuable pounds in weight of storage batteries.

Thanking you for the valuable part that you have taken in the first Trans-Atlantic Flight and with best wishes for your continued success, I am,

Very respectfully,

Robert A Lawrence

Radio Officer N C Seaplane Division 1.
Trans-Atlantic Flight.

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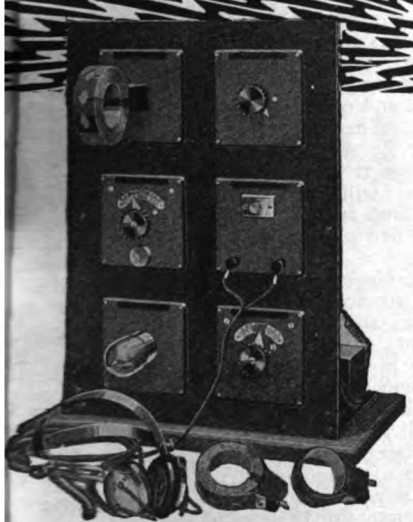

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Both Sets are part of the famous DeForest Unit-System and additional panels to increase the range and selectivity of the sets may be added at any time. For the beginner, or even the experienced Amateur, these sets are the most logical system: They do away with costly cabinets and more costly factory assembly, thus saving money for the purchaser. They are also more instructive as by wiring the panels the Amateur secures practical information.

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DE FOREST

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page 750*)

To make hydrogen connect the furnac with a copper boiler as shown in figure (and the accompanying cut. In the silic combustion tube place a layer of iron fil ings. Turn on the current and bring th tube to a good red heat, at the same tim heating the water to the boiling tempera ture. As the steam passes over the red ho iron it will be decomposed forming iro oxid in the tube and liberating large volume of hydrogen, which may be collected ove water in the usual way.

Making Water Gas: If pieces of charco are substituted for the iron filings, wate gas consisting of a mixture of hydroge and carbon monoxid may be obtained an collected in the same way.

An Astonishing Demonstration: Usin the furnace and tube alone bring the silic combustion tube to a good red heat an then seizing it with the tongs quickly plung it into a tall jar of ice water. There wi be a great seething and bubbling but th tube will not break. The co-efficient c expansion for silica is so small that th tube is subjected to very slight strain an no fracturing results.

The Crucible Electric Furnace: For host of laboratory purposes, a crucible fu nace is an ideal luxury. These furnac are made to run continuously on 110-vo circuits, either direct or alternating, an will generate temperatures of 1,200 degre Centigrade. In such a furnace you c make fusions, alloys, quicklime, coke a charcoal, glass, reductions of metallic oxi and bring about many other chemical rea tions.

Making Brass: Into a fire-clay crucib of suitable size to fit the receptacle of yo furnace, weigh 70 grams of copper and ha at hand 30 grams of zinc. Place t crucible in the furnace and connecting t latter to a 110-volt circuit obtain the hig est temperature possible. When the co per has melted into a clear lake of liqu metal, which it will do at 1,084 degre Centigrade, add the zinc. The zinc w melt and quickly dissolve in the molten co per. When the zinc and copper have mix thoroly, seize the crucible with tongs a plunge it into a pail of cold water. T brass will quickly solidify and may knocked from the crucible.

Other alloys may be made in a simil way.

Making Quicklime: In the crucible the furnace place lumps of marble, or lim stone, and heat to white heat for abo twenty or thirty minutes. Allow the qui lime to cool in the furnace and then pla a lump of it on a watch glass or in a p celain dish. From a wash bottle play small jet of cold water over the lime. I mediately steam will appear and the h lump of lime swelling in size will crum to a powder. Enough heat will be genera to ignite the head of a match.

This process is called *slaking* and is same action that takes place in the prepa tion of mortar.

The Oxy-acetylene Torch: While use of the oxy-acetylene torch is outs the province of amateur work, it is of v great commercial importance and gives te peratures very close to those of the elect arc. With it iron may be cut and welc with the greatest facility. In San Fra cisco is a skating rink containing 10 mi of brine pipes and 10,000 welds, all of wh were made by the oxy-acetylene proce In cutting steel girders and old armor pl the oxy-acetylene torch has reduced time and cost to a small fraction of wh they were in the days of more primit methods.

VER HALF A MILLION TONS BY MOTOR.

The American Red Cross has about 900 otor vehicles of all kinds operating in ance, Rumania, Poland, Western and uthern Russia, Constantinople, Vienna d other places doing relief work.

Within six months the Red Cross has oved over half a million tons of supplies motor to and from trains and steamships. A train of thirteen cars—ten of which re trucks, recently left with 134 cases of are parts, 75 barrels of oil and 10 barrels grease for the Polish Commission.

How to Become a Professional Radio Man

By PIERRE H. BOUCHERON

(*Continued from page 761*)

If the home student is not very speedy in receiving and yet is unable to attend a school or have a friend send to him at regular intervals so that he can gradually acquire speed, he may resort to the use of a mechanical sending machine, several practical models of which are on the market today.* One of these instruments employs a disk having its edges slotted out with dots and dashes and spaces so that when the disk is made to revolve by clockwork the slotted edges cause a contact maker to reproduce actual messages by means of a local buzzer and telephone circuit. In the other case, specially prepared phonograph disks when placed in a regular talking machine reproduce actual messages. These last have been so perfected that even static and interference are inserted here and there in various parts of the records in order to duplicate, as near as possible, actual operating conditions.

These mechanical sending devices are mentioned here for your information, but it must not be inferred that they will teach you radio receiving with the same effectiveness that a personal instructor would. As mentioned before, they are only to be resorted to when other methods are impossible.

If you are a fairly good receiver and can copy a message on paper without too many breaks, it is suggested that you learn the art of copying directly upon the "mill," which is telegraphers' slang for a typewriter. This is a very effective and business-like way of receiving messages and is one which will come in good stead when you become a practical operator.

HOW LONG WILL IT TAKE?

The time necessary to prepare yourself to the point where you are ready to take the government examination for a license depends entirely on the following conditions:

1. Your previous knowledge of either radio or wire telegraphy.
2. The degree of enthusiasm, the adaptability and the consistency you display in your studies and code practise.
3. The extent of your education.
4. The amount of time you have to devote to study, which is to be based on whether you are taking a day or night course at a resident school or learning at home.
5. Your income while learning, whether you are receiving instruction at a school, or at home by means of text books.

LICENSE GRADES AND THEIR REQUIREMENTS.

The United States Government issues a number of licenses covering certain purposes for which they may be required. There are eight grades of these, as follows:

1. Commercial Extra First Grade.*
2. " First Grade.
3. " Second Grade.
4. " Cargo Grade.
5. " Temporary Permit.
6. Experiment and Instruction Grade.
7. Amateur First Grade.
8. " Second Grade.

*A regularly licensed operator must have 1 months' actual experience before eligible to take the examination for this rather rare document.

In the present instance we are concerned with but one grade, that of *Commercial First*. This is the one which is insisted upon by all radio companies and there are very few instances where a company will employ any other operator but one holding at least

*The Omnigraph. The Victor Radio Practise Records.

a Commercial First Grade License. It behooves you, therefore, to strive for this "ticket."

The necessity for an operator holding a license is required by international law which was decided upon several years ago, when certain regulations were drafted and from which we glean the important fact that "the service of the station on shipboard shall be carried on by a telegraph operator holding a certificate issued by the government to which the ship is subject."

Concerning the matter of licenses, there is at the present moment of writing a movement on foot to change the present system of grading operators, as it is felt that the method of today is not as effective as it might be. In this connection the United Radio Telegraphers' Association is co-operating with the United States Shipping Board, as well as with the Secretary of the Department of Commerce, to bring about a mutually agreeable system of issuing radio licenses based primarily upon ability and length of service, taking into consideration the grading of vessels ranging from large passenger to small cargo tramps, and the licenses which will be held valid on each type. These tentative changes, however, need not worry prospective operators; they need only concern themselves with the important task of training themselves as it is being recognized, more and more, that the important post of ship operator should be filled solely by competent men.

COMMERCIAL FIRST GRADE.

The general requirements for this license should be carefully noted and diligent study of them practised. Briefly these are:

(a) The adjustment, operation, and care of the apparatus, including correction of faults and change from one wavelength to another.

(b) Transmitting and receiving by ear at a speed of not less than twenty words a minute in Continental Morse (five letters to the word).

(c) Use and care of storage battery or other auxiliary power apparatus.

(d) Knowledge of the international regulations in force applying to radio communication.

(e) Knowledge of the requirements of the acts of Congress to regulate radio communication (secs. 3, 4, 5, 6 and 7 of the act of Aug. 13, 1912).

(f) The commercial extra first grade and the commercial first-grade licenses qualify holders for employment at any ship or land station of any class.

CITIES WHERE EXAMINATIONS ARE HELD.

Commercial radio operators' licenses, as well as amateur licenses, of all grades, may be secured upon due examination by applying to any of the following named cities, where are situated representatives of the Department of Commerce:

Radio Inspector, Customs House, Boston, Mass.
Radio Inspector, Customs House, New York City, N. Y.
Radio Inspector, Customs House, Baltimore, Md.
Radio Inspector, Department of Commerce Bldg., Washington, D. C.
Radio Inspector, Customs House, Savannah, Ga.
Radio Inspector, Customs House, Charleston, S. C.
Radio Inspector, Citizens Bank Bldg., Norfolk, Va.
Radio Inspector, Customs House, New Orleans, La.
Radio Inspector, Customs House, San Francisco, Cal.
Radio Inspector, Customs House, Seattle, Wash.
Radio Inspector, Customs House, Chicago, Ill.
Radio Inspector, Customs House, Cleveland, Ohio.

As may be seen, this covers all the radio inspectors in their offices, and elsewhere by special arrangement. Additional opportunities for taking the examination are also offered to applicants as may be deemed necessary. These special dates and places may be readily ascertained by writing to the Commissioner of Navigation, Washington, D. C., or to the nearest radio inspector. In this manner prospective applicants who are

situated in remote sections far from any of the above-named places are often given the opportunity to take the examination thru the courtesy of traveling radio inspectors.

WHAT TO STUDY.

To attempt to detail within this article the exact matter which you should study in order to pass the examination is, of course, impossible. You are supposed to be familiar with all-around radio conditions before you can qualify. Do not think that it is a case of "boning up" on a lot of stock questions so as to be able to answer them by rote or memory system. If you expect to pass the examination you must have a good knowledge of the technical side of radio, involving theory and practise. You will probably be asked to draw complete circuit diagrams of a ship's modern transmitter and receiver; in fact, be prepared for it. The questions will also cover the advantages and disadvantages of various radio appliances, the complete method of procedure in tuning a transmitter with a wave meter; faults and repairs of the power circuit. Receiving systems with their attendant practical operation are also covered in detail. The modern storage battery is given considerable attention. This involves the Edison as well as the lead cell. You will need be quite familiar with the manner of caring for these cells and the proper method of charging and discharging.

Motors, generators and motor-generators are very important items of the examination.

In addition to the above it is also necessary that you familiarize yourself with radio laws and regulations, which takes in not only those of the United States but also those which have been adopted by the International Radio Telegraphy Convention.

In order to secure a very good knowledge of all of the above-mentioned subjects, I can do no better than refer you to the following volumes which should be secured and carefully digested:

> The Radio Communication Laws of the United States and the International Radio Telegraphy Convention, Edition Aug. 15, 1919, and which can be secured by writing to the Government Printing Office, Washington, D. C., for the sum of 15 cents. This volume is almost indispensable to the would-be radio man.

In addition to the above book the prospect is referred to:

(a) Practical Wireless Telegraphy, Wireless Press, New York, N. Y.
(b) The How and Why of Radio Apparatus, Experimenter Publishing Co., New York, N. Y.
(c) The Principles Underlying Radio Communication, Government Printing Office, Washington, D. C.

Outside of the first mentioned government book it is not, of course, necessary for you to secure all of those mentioned in the second list, one of them will do. Incidentally you are cautioned against resorting to book knowledge alone. If you are one of the unfortunates who cannot attend a school, it would be well for you to secure a certain amount of practical instruction in the care and maintenance of a ship's radio station before attempting to take the examination. For even if you do manage to obtain a license solely on book knowledge, you may find yourself up against it when confronted with some real trouble or breakdown when on board ship at sea.

RADIO ENGINEERING.

Ship radio operators are often given the opportunity to become operators at land or coastal radio stations which are situated, as every one knows, at many important points along the Atlantic and Pacific coasts. If the operator has the necessary education, it is often from these posts that some are called