November

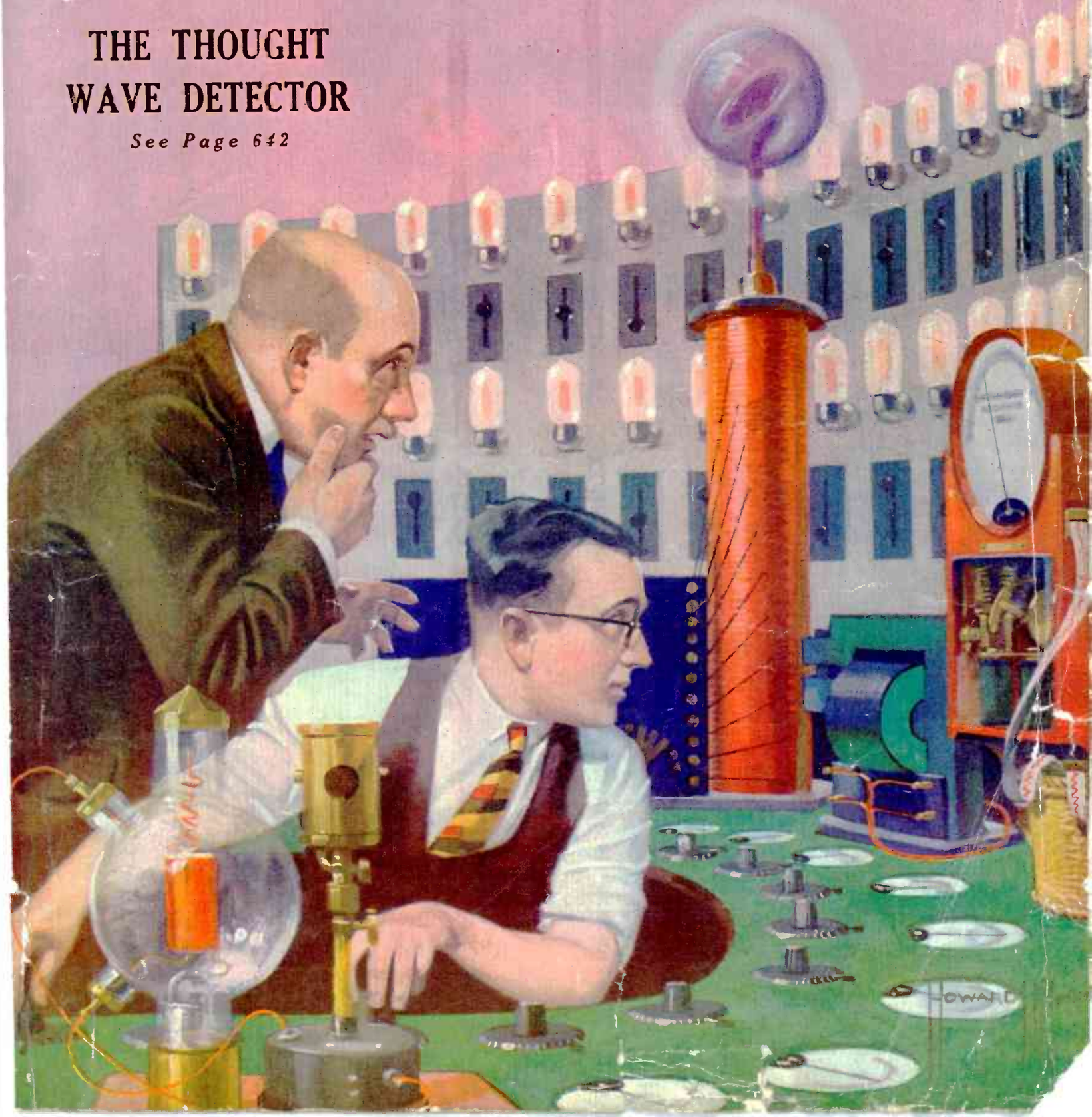
25 cents

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER

THE THOUGHT WAVE DETECTOR

See Page 642



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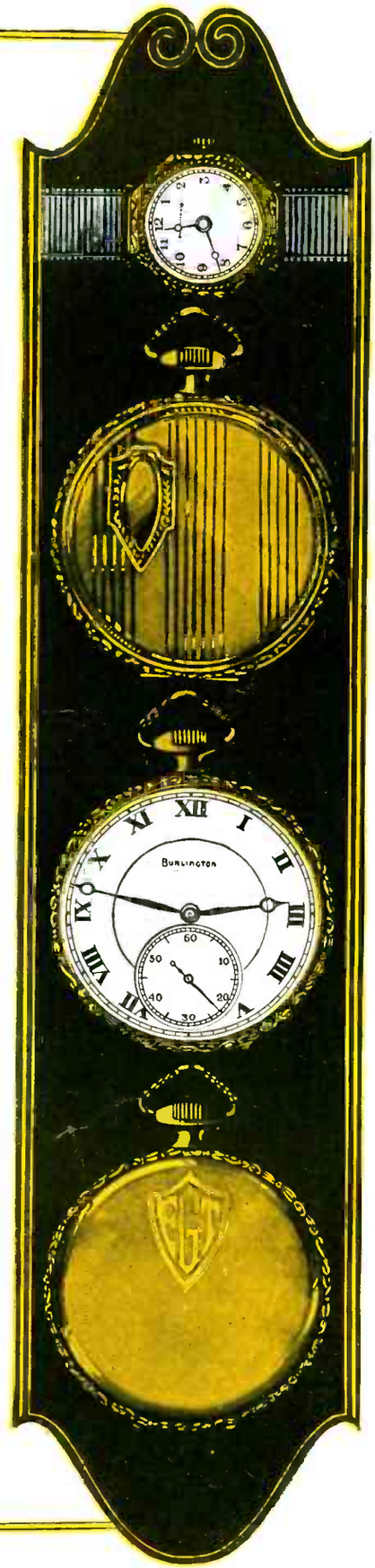

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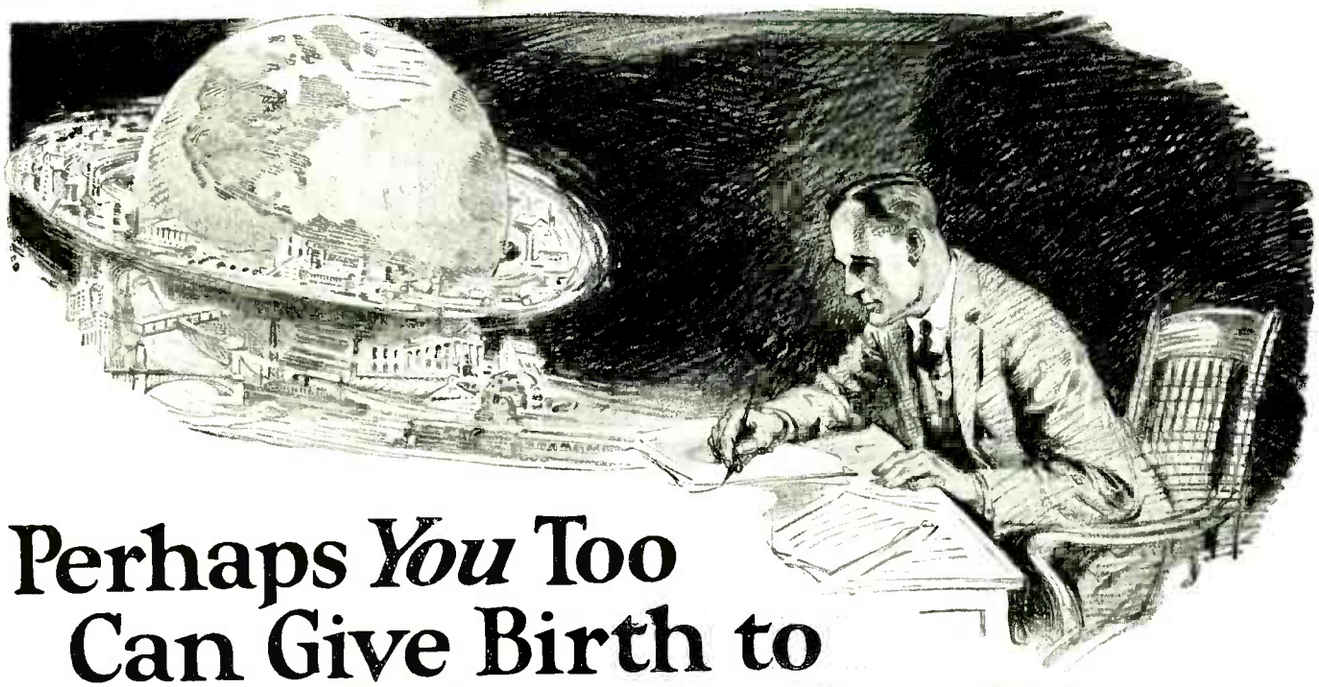

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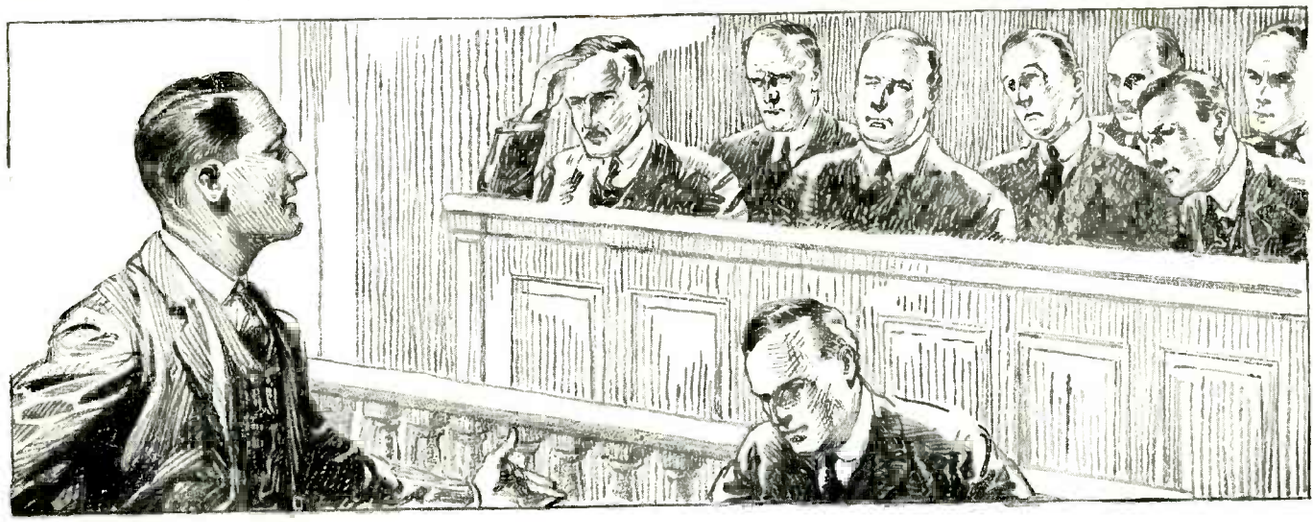

He Made a Jury Cry

How You Can Use In Business and Social Life The Magic Power of Making People Agree With You

SUPPOSE you were a lawyer for a client whose dog was killed by another man. Suppose your chances of winning the case were a thousand to one against you? Would you give up?

An inexperienced young lawyer out in Missouri actually had such a case to tackle. He knew it was almost hopeless and took no interest in the testimony and made no notes. But when his turn to speak came, he arose, and delivered the most beautiful tribute ever paid a dumb animal. When he finished, the jury was in tears and promptly returned a verdict for his client. Study his wonderful speech on this page and you will see why this young lawyer rose to be a United States Senator. He knew how to make people change their minds — how to make them agree with him — how to make them say "Yes."

Whatever you do, wherever you work—whether in an office or "out on the road"; from clerk to salesman, from bookkeeper or stenographer to shop worker, your ability to forge ahead in business or in social life depends on your power to make people say "Yes." No man ever made a big sale or wrote a winning letter or a famous editorial who didn't know how to use forceful, colorful, gripping language that commands attention and compels action! The man or woman who speaks or writes hazy, weak, negative words, cannot dominate — cannot influence — cannot win.

Dip into the pages of History and you will learn that the greatest statesmen, the most famous poets, authors and business men — the most winning, dominating personalities — were those who knew how to appeal to their audiences, how to use powerful, persuasive, positive words that struck home and compelled attention and made people act. They knew how to give instructions clearly and quickly, and how to clothe their thoughts in unmistakable, convincing language.

Can you imagine Lincoln at Gettysburg stammering and groping blindly for words — and then using vague, dull, lifeless language? Can you picture Charles M. Schwab making his famous Million Dollar Steel Sale to France — using weak, hazy, uncertain words? No man ever got very far in business or social or political life who didn't have the power to make people say "yes"! It makes no difference how brilliant your thoughts, or wonderful your ideas, if you don't know how to express them in forceful, powerful, persuasive words, you cannot hope to make people agree with you. No matter how much you know, you'll never win out unless you can express yourself easily, fluently, convincingly!

The ability to make people say "yes" is not a matter of education. Lincoln went to school only one year — yet because of his ability to use the English language, he became one of the world's most convincing speakers. Many men without any education whatever, mastered this power to make people agree with them and rose far above even their greatest expectations.

It isn't at all difficult to learn to speak and write with money-making power. It's as easy to master as learning to play an interesting game. — and just as fascinating.

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The Speech that Made a Jury Cry

"Gentlemen of the Jury — The best friend a man has in the world may turn against him, and become his enemy. His son or daughter that he has reared with loving care may prove ungrateful. Those who are nearest and dearest to us, those whom we trust with our happiness and our good name, may become traitors to their faith. The money that a man has, he may lose. It flies away from him, perhaps when he needs it most. A man's reputation may be sacrificed in a moment of ill-considered action. The people who are prone to fall on their knees to do us honor when success is with us, may be the first to throw the stone of malice when failure settles its cloud upon our heads.

"The one absolutely unselfish friend that man can have in this selfish world, the one that never deserts him, the one that never proves ungrateful or treacherous is his dog. A man's dog stands by him in prosperity and in poverty, in health and in sickness. He will sleep on the cold ground, where the wintry winds blow and the snow drives fiercely, if only he may be near his master's side. He will kiss the hand that has no food to offer; he will lick the wounds and sores that come in encounter with the roughness of the world. He guards the sleep of his pauper master as if he were a prince. When all other friends desert, he remains. When riches take wings, and reputation falls to pieces, he is as constant in his love as the sun in its journey through the heavens.

"If fortune drives the master forth an outcast in the world, friendless and homeless, the faithful dog asks no higher privilege than that of accompanying him, to guard him against danger, to fight against his enemies. And when the last scene of all comes, and death takes his master in its embrace and his body is laid away in the cold ground, no matter if all other friends pursue their way; there by the graveside will the noble dog be found, his head between his paws, his eyes sad, but open in alert watchfulness, faithful and true even in death."

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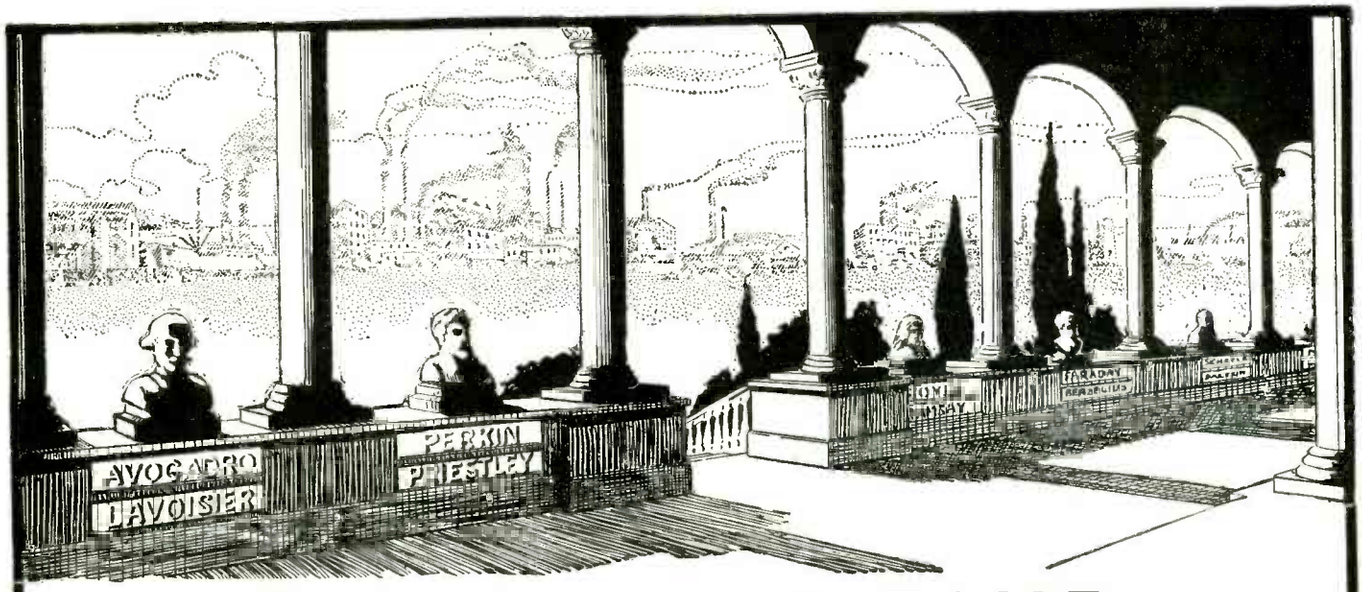

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"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact"—HUXLEY

New Forces

ELECTRICITY, as used for practical purposes, was not known prior to the nineteenth century. It is true that static electricity was known many years before that date, but it was never used in practical work. It never was called upon to do such actual work as the electric current performs for mankind today, and it was little understood before the year 1700. Although the ancient Greeks knew amber and knew that it would become electrified, it was simply used as a curiosity, the same as a lodestone, which was known to attract iron particles, just as the amber was known to attract light particles when rubbed. The ancients knew that there was a force, but it was locked up as far as they were concerned, for they could not exploit it. It was the same with lightning, which many years before Franklin's time was known to be of electrical origin, although it had never been proved, until Franklin made his historic experiment by actually drawing electricity down through a wet kite-string from the sky.

But knowing the existence of a force and using it practically are two different things. Even such a master of knowledge as Napoleon scoffed at the first galvanic battery when it was shown to him, and his powerful mind could not forsee the tremendous consequences that that battery would have in the years to come.

All about us in Nature there are dormant forces which as yet have been only dimly perceived. We stand in the same relation to these dormant forces as the ancients stood in relation to electricity, to steam, and other powers that modern man uses today to lighten his tasks.

Perhaps electricity embodies the greatest single force that has been discovered since mankind's earliest dawn, but why stop at electricity? It seems unreasonable to believe that electricity gives us the last of the forces and that we must stop here. This is not in the light of general progress. There, are other forces in Nature that we only dimly recognize now and of which we know practically nothing. For thousands of years people looked in awe at lightning, but it did not mean anything to them, except that it caused them to become superstitious and aroused their fears. Although we think ourselves more enlightened, we look at the same kind of phenomena without realizing their new and tremendous import.

Take, for instance, gravitation. We know that gravitation is a titanic force; that if it could be utilized by mankind it would eclipse all the work that electricity, steam, and gasoline are doing for us now. We know it as a force, but we know nothing whatsoever about it. We say that gravitation keeps the planets in their paths and makes the earth, as well as all the planets, revolve around their axes. Moreover, this work is performed with an invisible power, and is certainly a less wasteful force than electricity because it needs no wires for the transmission of the energy. Billions of tons of water are lifted every day by our tides, all of this work being performed by the gravitation of the moon and of the sun at inconceivably great distances from us. Just the same, this work goes on, but we only marvel at it, the same as the ancients and the cave-men marveled at lightning, uncomprehending.

Some inconceivable power is keeping the planets, tremendously large bodies, rotating, on their axes, in space, without any visible physical connection, nor does the force ever seem to abate. The scientist who will harness gravitation to do man's work will indeed be one of the greatest benefactors of mankind.

There is still another force far greater than gravitation. It is the force that holds all bodies together. We can take a thousand bricks and stack them on top of each other to form a wall. It does not take a very great effort to upset such a wall, the bricks all falling apart as they tumble earthward. But the atoms, molecules, and electrons that constitute the brick itself cannot be disrupted in any such manner. We can take a brick, chip off a fragment, and pulverize the particles as small as we desire, but they will always remain brick, or, rather, brick particles. But the force that is holding these particles together is unknown to us. It is far more tremendous than anything we can conceive. What is the force that holds all bodies together with such a tremendous force? We do not know. We call it atomic, or interatomic force and let it go at that, but with that we have not solved the problem. So far, no human being has succeeded in any practical sense in pulling apart the uttermost particles, let us say the molecules or atoms, which constitute all matter.

We know, and we can even calculate, the amount of energy contained in a copper one-cent piece. If we could release all this atomic energy at one time, or gradually, it would be sufficient to haul a long freight train further than from New York to Chicago. There is no explosive and no other means known whereby such a small amount of matter can perform, or deliver, such a prodigious amount of power.

Perhaps it is as well that we have as yet not solved the problem of atomic power. The chances are that the man who invents it will come pretty near to destroying our entire globe. The amount of energy contained in all particles in this globe is so titanic that the human mind can not conceive it. We are sitting on a ball far more explosive than nitroglycerine and it would not take much to set off this ball and turn it into a nebula. Once atomic energy is set free it would be impossible to stop its destructive effects, which necessarily would be felt from one end of the globe to the other. The scientist who first discovers atomic energy, let it be hoped, will have enough insight in the matter to know what he is doing, so that the powder barrel will not be set off prematurely.

H. GERNSBACK.

How Three-Hour Glides Are Made

By PROF. EDWARD P. WARNER

DEPARTMENT OF AERONAUTICAL ENGINEERING, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE amazing feats recently recorded in the German soaring flight competition have focussed the attention of the world on the glider, or *sailplane,* and there is particular interest in the methods by which such flights are made. Ordinary gliding or volplaning, the process by which an airplane makes a safe landing with its engine disabled, is familiar to everyone, but when a machine heavier than air and without power remains aloft for 3 hours and 10 minutes continuously on one occasion and for over 2 hours on another, when another pilot soars for 1¾ hours, when still a third carries a passenger in a glider for 13 minutes, when a flight lasting over an hour terminates at a point higher than that from which it started, it is evident that something more than ordinary gliding is involved.

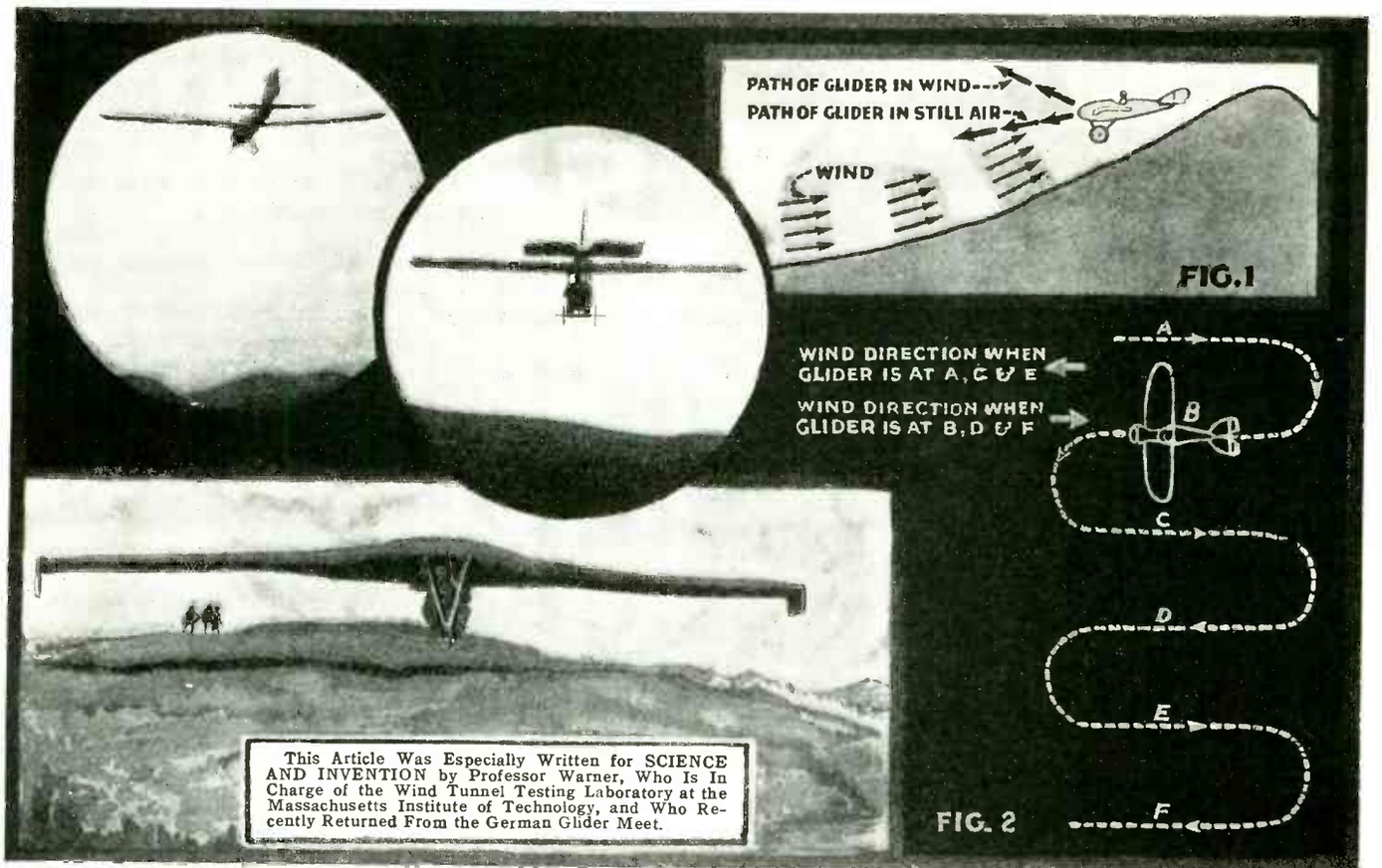
Straight gliding through still air or air moving steadily and horizontally cannot last more than a few minutes at most. The best and most efficient types of glider that can be built at the present time, with the present knowledge of airplane design, have to descend at the rate of 2 vertical feet a second in a straight glide. In the course of a 10-minute flight they would therefore lose 1,200 feet of altitude, and that is more height than was available at the sites of either the French or German competitions. Furthermore, ordinary gliding does not permit of rising above the point where the flight began, and the official records show that Hentzen, the most successful of the German pilots, actually rose on one occasion to a height of nearly twelve hundred feet above the hill-top whence he had started.

There are several possible explanations of soaring, whether it be practised by men or by birds, but the simplest, and one which covers most cases satisfactorily, is based on the existence of rising currents of air. The existence of such currents can be observed in almost any city street, where one sees papers picked up by the wind and carried high in the air. A piece of paper allowed to fall from a window will settle to earth, if the air be perfectly calm, at a rate depending on the weight and size of the paper, but if the air is rising more rapidly than the paper would ordinarily fall, the paper does not fall at all, but is carried upwards by the air. Since the rate of fall of the paper, after it has traveled far enough to be moving steadily, depends on the resistance to its motion which is offered by the air, it can be considered as moving in the air and controlled by the air, quite independently of its distance above the ground. Its behavior is the same as that of a boat in moving water. If a motor-boat were driven through the water at 8 miles an hour, being kept headed up a stream running 10 miles an hour, the net result would of course be that the boat would move past the banks backwards, or downstream, at 2 miles an hour. Similarly, if a sheet of paper which would fall 2 feet a second in still air were set free in a current of air moving upwards at 3 feet a second the result would be that the paper would move up away from the ground one foot every second. If the speed of the wind were 2 feet a second instead of 3, the paper, as long as it stayed in the current, would just hover, neither rising nor falling.

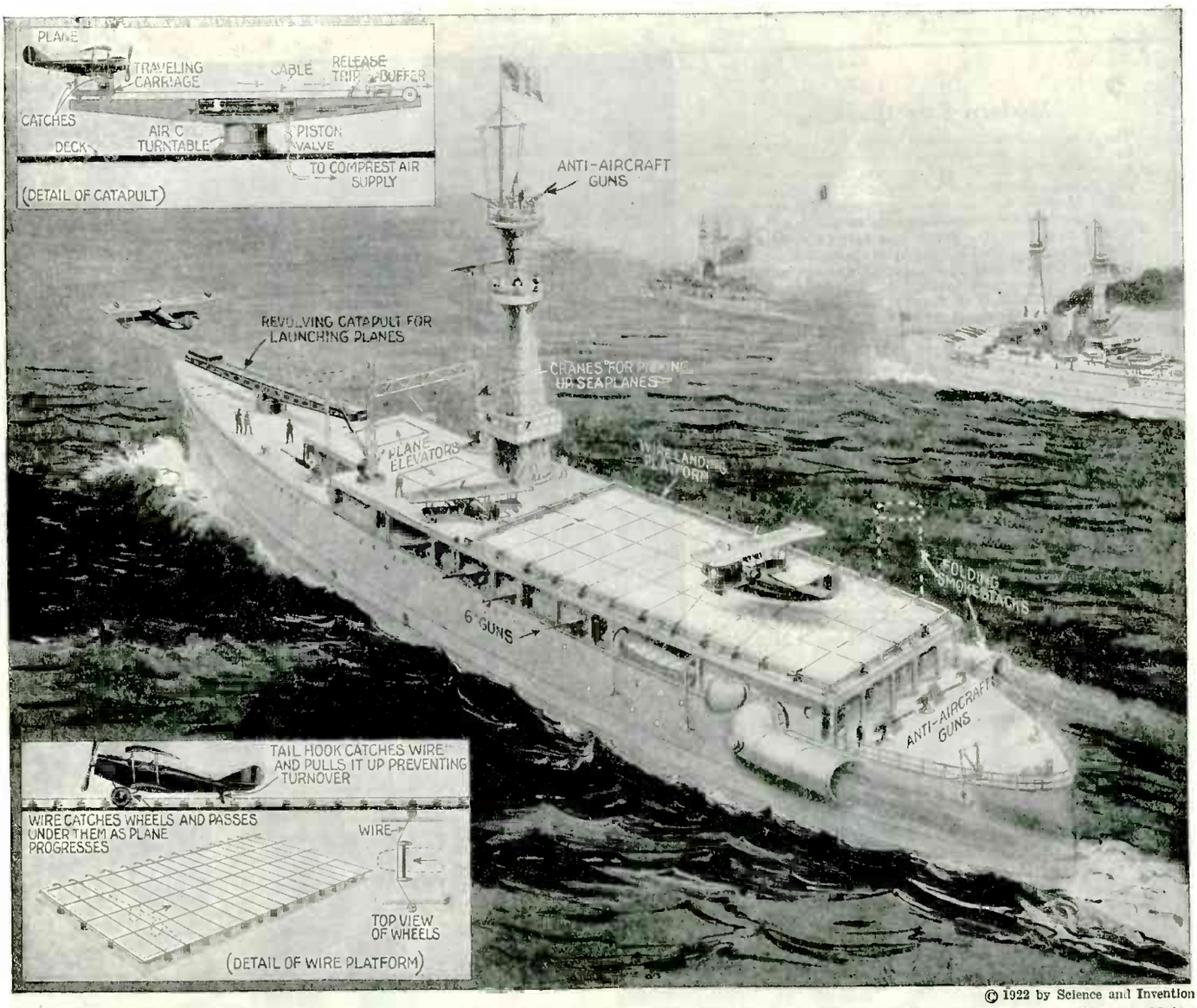
The glider is capable of behaving exactly like the sheet of paper. If it gets into a rising current of sufficient strength, into air which is ascending more rapidly than the glider would settle in still air, it can stay up as long as it remains in those favorable conditions. The first problem of the soaring pilot is then to locate a good rising current, and then, having found it, to get into it and stay there. The rising current of course need not be traveling vertically, like the little eddies which pick up the papers and dust in the city streets. It is quite sufficient that there should be a slightly inclined wind. The best place to look for an inclined wind is evidently where the wind is forced to rise by the ground, where it is blowing up the slope of a hill, and it is on the windward slopes of hills that all the long flights have been made.

The first actual use of rising currents for making a glide of great length was made by Mr. Orville Wright, who remained in the air in a glider for 10 minutes in November, 1911, establishing a record which stood for nearly ten years. Mr. Wright's flight was made in the North Carolina sand dunes, when a strong wind was blowing in from the sea and up the face of the dunes. The speed of the wind was as great as the normal speed of the glider through the air, and it was therefore possible to hover over one spot, headed

(*Continued on page* 680)



The Two Circular Insert Cuts Show, At Right—the American Glider Entered in the French Meet in Actual Flight, Piloted by Edmond T. Allen; Left—Successful German Glider in Flight. A Large German Glider of the Espenlaub Type, Piloted by Wasseraape, is Shown in the Lower Left Hand Corner of the Picture Above Starting Off on a Flight. At the Right of the Picture, Two Diagrams Especially Prepared by Professor Warner Show in a Simple Manner How It Is That a Glider Manages to Rise and Sustain Itself on Rising Air Currents, the Upper Diagram Showing the Air Currents Rushing Up the Side of a Hill and the Direction Taken by the Glider in Consequence. The Lower Diagram Shows One Possible Method of Taking Advantage of Variations in the Wind Direction or Speed, Such as When Making Two- or Three-Hour Glider Flights. The Secret of Long Glider Flights Lies in the Pilot Taking Advantage of Successive Puffs or Gusts of Wind.



The Navy's Newest Airplane Landing Device Involves the Use of Steel Wires, Held Taut by Means of Springs on the Four Sides of a Frame, as the Diagram Makes Clear, so That a Regular Land Type Plane Equipped With Wheels Can Descend Onto This Platform and Be Stopped in a Short Distance. It Was First Tried Out on a British Naval Ship. The Wires Catch the Wheels as Well as the Tail Skid and Slide Over the Wheels After a Certain Tension Has Been Exerted Against the Wires. The Longitudinal Wires Tend to Keep the Plane From Turning and Skidding Off the Platform at the Sides. The Action of the New Navy Catapult for Accelerating Planes to a Speed of Sixty Miles an Hour in a Distance of Sixty Feet, Is Also Shown Both on the Ship and in the Upper Insert Diagram.

Landing Airplanes on Ships

By GRASER SCHORNSTHEIMER

NAVAL EXPERT

PROBABLY the most serious problem facing naval aviation today is the landing of airplanes on small areas, such as the flying deck of an aircraft carrier. Its solution will mean that land planes may be carried to sea with the fleet instead of the heavy seaplanes, which are slower and more awkward than the land type. Almost since the birth of this branch of flying various schemes have been tested and put aside as useless.

Finally, in 1917, the British hit upon a sort of trap to catch the plane as it touches the landing and to slow it down rapidly until it comes to rest. It is a wire field arrangement and the most successful of all the landing platforms yet proposed. Very successful landings have been made on the British aircraft carrier *Furious*, despite that vessel's funnel and superstructure which divide the landing platform in two parts. Another landing stage has been installed on the aircraft carrier *Argus*. This one is even more successful, because of the great field provided by the vessel's deck. However, there are beautiful "spills" occasionally.

America was not slow in following up this British achievement. The Naval Aviation service began to experiment with a similar device at the flying station at Hampton Roads, Va., near the naval operating base. Not only was the wire stage studied but various other proposed methods of landing planes were tried. At present the stage is reaching a high state of perfection and may be installed aboard the aircraft depot ship *Langley* almost any day. This vessel will then go to the Pacific fleet as aircraft tender.

Imagine a frame about 105 feet long by about 30 feet wide covered by crossed wires forming open squares about two feet across. This net sits one foot to one and one-half feet above the landing platform. Its wires are held outside the frame by unstretched springs, which keep the strands of the net quite tight.

A plane swings low and lands fairly upon the first strands of the net at a speed of 35 or 40 miles an hour. As the wheels of the plane press against the wires of the net the wires give, the springs yielding and allowing the wire to be drawn out. As the plane progresses one set of wires passes under the wheels and other wires engage them, retarding the advance of the plane across the net until motion ceases. Usually the plane is brought to a stop before it has covered more than three-quarters of the length of the net.

When these landings were first tried there were some bad spills. The planes turned over because of the impact on the front wheels and the lack of a holding down device on the tail. The speed of the plane caused it. In order to mitigate or in some way remedy this evil a pair of up-turned hooks were fitted to the tails of the planes. These hooks catch in the cross strands of the net, drawing the wires up and these wires hold the tail of the plane down and as the plane progresses one strand passes out of the hooks and others engage them. In this way it has been possible to keep planes on almost an even keel.

Two of the six battle cruisers which are on the stocks, but which we must not complete because of the terms of the Naval Treaty, may be converted to aircraft carriers. Congress has sanctioned the plan. It is proposed to mount these landing traps on them. Then we will have two 32,500-ton, 33-knot aircraft carriers of the first line. They will be capable of taking both land and seaplanes out to sea and both kinds of planes will be able to land on their decks.

Modern Safe Breaking

The Accompanying Illustration Shows the Leading Methods Followed by Modern Safe Breakers in Opening Strong Boxes Either by the Aid of Explosives, Jimmying or Burning With an Electric Arc or Oxy-acetylene Flame. The Latter Method, as Was Recently Pointed Out by One of the Experts at the International Police Conference, Held in New York City, Has Not Proven Very Successful, Even in the Hands of Crack Yeggmen, as the Paraphernalia Includes Considerable Heavy Apparatus Such as Oxygen Tanks, etc.

The Simplest and Most Deadly Method of Fooling the Safe Makers, or at Least Where the Safes Are Not Made of Specially Treated and Hardened Steel is Probably the Electric Arc Trick. This Method of Burning Out the Combination Lock is Shown in One of the Accompanying Pictures. A Carbon Rod, Such as Those Used in Arc Lamps, Is fitted With an Insulating Handle and Shield, and the Necessary Current Taken from a Convenient Lamp Socket. One Side of the Circuit Is Grounded to the Safe Frame, While the Other Wire from the Circuit Connects to the Carbon. The Electric Arc Gives a Terrific Heat, Equivalent to That of the Oxy-acetylene Flame, and Melts Ordinary Steel Like Butter.

Some of the Other Yeggmen Tricks Illustrated Are an Alarm Bell to Be Operated from the Street, So As to Warn the Men on an Upper Floor of the Approach of the Police; a Combination Brass Knuckle, Dagger and Pistol; Powerful Clamps for Forcing the Combination Lock or Plates on Safe Doors; Large Jimmy Bars for Forcing the Plates and Doors on Safes, and Also the "Can-opener," Shown in Use, Which Cuts Open Thin Steel Plates as Easily as You Would a Can of Condensed Milk.

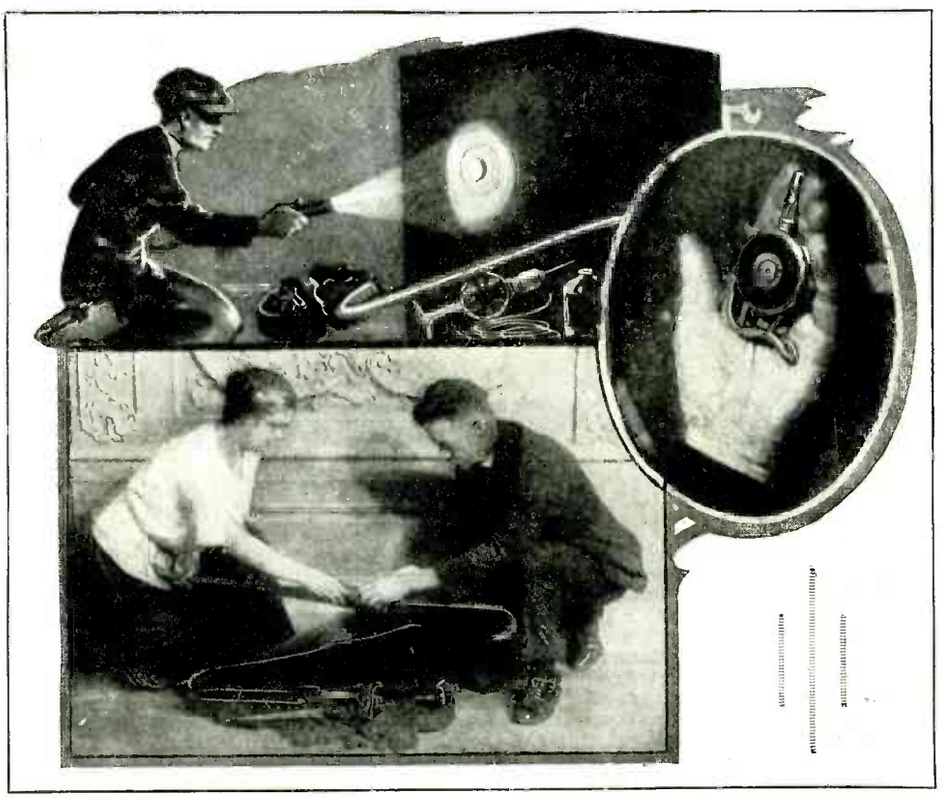
How Safe-Breakers Work

By A. P. PECK

IT would seem to the average person from reading the newspapers, that practically all criminals go undetected. The newspapers emphasize all the crimes which are enacted in which the offender is not brought to justice, but when the police make a capture they frequently pass it over with nothing more than a mention of the fact.

However, at the recent International Police Conference, at the Waldorf-Astoria in New York City, there was an exhibition of many tools of crime that have been taken from captured law-breakers, some of whom were nationally, and even internationally, famous, which show that the police are by no means lax.

At this conference a system for the prevention of crime, which has been developed by the Police Department of New York City, was described. It is known as the *modus operandi* system, and has in many instances led to the detection of a criminal. It works as follows: When a crime is committed, it is analyzed and classified at Police Headquarters. For instance, if a certain broker's office is burglarized by persons entering from the roof, the police are reasonably certain that the crime was committed by one of, perhaps, a score of characters who are known to work in this manner. Hence, their field of operations is considerably narrowed, and a general alarm is sent out for the suspects. Dozens of crimes are detected in New York City alone each month, merely because the crook has in some manner or other, left the key to his personality on the scene of the crime.



Police Officials From All Over the World Recently Met at a Convention Held at the Waldorf Astoria Hotel in New York City, to Discuss the Ways of Crooks. The Photo at Left Shows Burglar's Tool Kit in the Form of a Violin Case, and a Long Two-Piece Safe-Opening Jimmy Being Put Together. Photo at Right Shows Deadly Pistol, With Which Twelve Shots Can Be Fired Rapidly, Simply by Squeezing the Hand, the Barrel Lying Between Two Fingers.

Of course, the *modus operandi* system is not infallible, inasmuch as there are always new entrants into the field of crime, as well as older criminals who have not been detected, and whose methods are not accurately known. If this system fails, there are many other methods left to the police, and the greater percentage of the game is on the side of the law, rather than on that of the crook.

It is a well-known fact among detectives and other law enforcers, that very few criminals commit a crime unless under the influence of drugs. The majority use cocaine to keep up their nerve, and if they are unable to obtain this, their nerves become so weakened, that they are either caught during the job or else give up the idea entirely.

Many forms of tools used by burglars were on exhibition at the rooms in which the conference was held, and they presented an interesting study. Bolt cutters were very prominent, inasmuch as they were used in innumerable ways. Padlocks were cut with them as easily as one cuts wire with a pair of pliers.

A dozen or more types of jimmies were shown, ranging from small pocket ones about eight inches long, up to enormous jointed bars, which when screwed together would give a tremendous leverage. Some of these larger ones were six feet long when joined together.

When one of the more up-to-date office workers plans a job, he generally decides to crack more than one safe in a night. Therefore, he finds it well worth his while to utilize an up-to-date electric drill. Carrying this, together with a complete set of drills and several jimmies, he is ready for almost any average office safe.

The tool container of some of the more aristocratic safe-breakers is sometimes unique; one man carried his tools in a violin case, while still another used a banjo case.

The *modus operandi* of the crook who uses the electric drill method, is somewhat as follows: After gaining access to the building and finding his way to the safe, he sets his flashlight on the floor with the beam directed against the face of the safe. The wire connecting the electric drill is now plugged into an ordinary lamp socket, and the real business of the evening begins. Note that the victim pays for the current!

On the opposite side of the safe door from the hinges a small hole is drilled at the crack between the door and the safe body. After this hole is drilled to the desired depth, a larger drill is used, and so on until the hole is of sufficient size for the safe-cracker to insert the pointed end of his jimmy. He now puts together his jointed jimmy, several feet long, inserts the end, and with several strong heaves, the bolts give, and the door swings open.

If this method fails he may resort to drilling a circle of small holes around the combination dial, after which the holes are enlarged by means of a larger drill. The entire combination lock may then be removed from the door, the bolts worked loose, and the door opened.

Still another variation of this method is to cut out around the combination dial with an oxyacetylene torch or an electric arc.

To foil the burglar using tools which require the use of the electric lighting circuit, is exceedingly simple. One very good way to do this would be to have the current or light cut off after business hours, with the exception of one which contains the night light. This night light could be placed in a recess in the wall, the face of which is covered with non-breakable glass, set securely into the cement. The socket containing the lamp may be of a special design, and unless the yegg has complete inside information, it would do him no good whatsoever to break the glass, inasmuch as he would not be able to plug in on the special socket. As a further precaution this socket could be set into the masonry. This would also prevent the use of an electric arc. Another good idea would be to have the regular night light right in front of the safe as usual but with a fuse in series with this light which will blow out when more current is drawn from the socket, than is ordinarily required by the light itself. Of course, in this case also, the other lights in the building must be cut off by a switch. Now, when the burglar plugs in his electric arc or drill which will naturally draw more current than a 16 or 32-candle power light, the fuse will blow immediately, thereby incapacitating him.

Besides those safe-breaking methods mentioned above, there are, of course, those in which the crook blasts his way into the safe with nitro-glycerine, or *soup*. The latter is generally of their own manufacture and does not always work as it was calculated to. It very often fires prematurely, and sometimes not at all. Occasionally, the explosion is much more powerful than was counted upon, and in other cases it is not even powerful enough to make a dent in the safe door. In the latter instance, it is a case of "love's labor lost," inasmuch as the noise of explosion invariably attracts policemen, watchmen and others to the scene.

One of the methods of using *soup*, which, by the way, is a mixture of dynamite, wood alcohol, and other chemicals, is to drill a hole at the crack between the edge of the safe door and the safe proper, about one inch in

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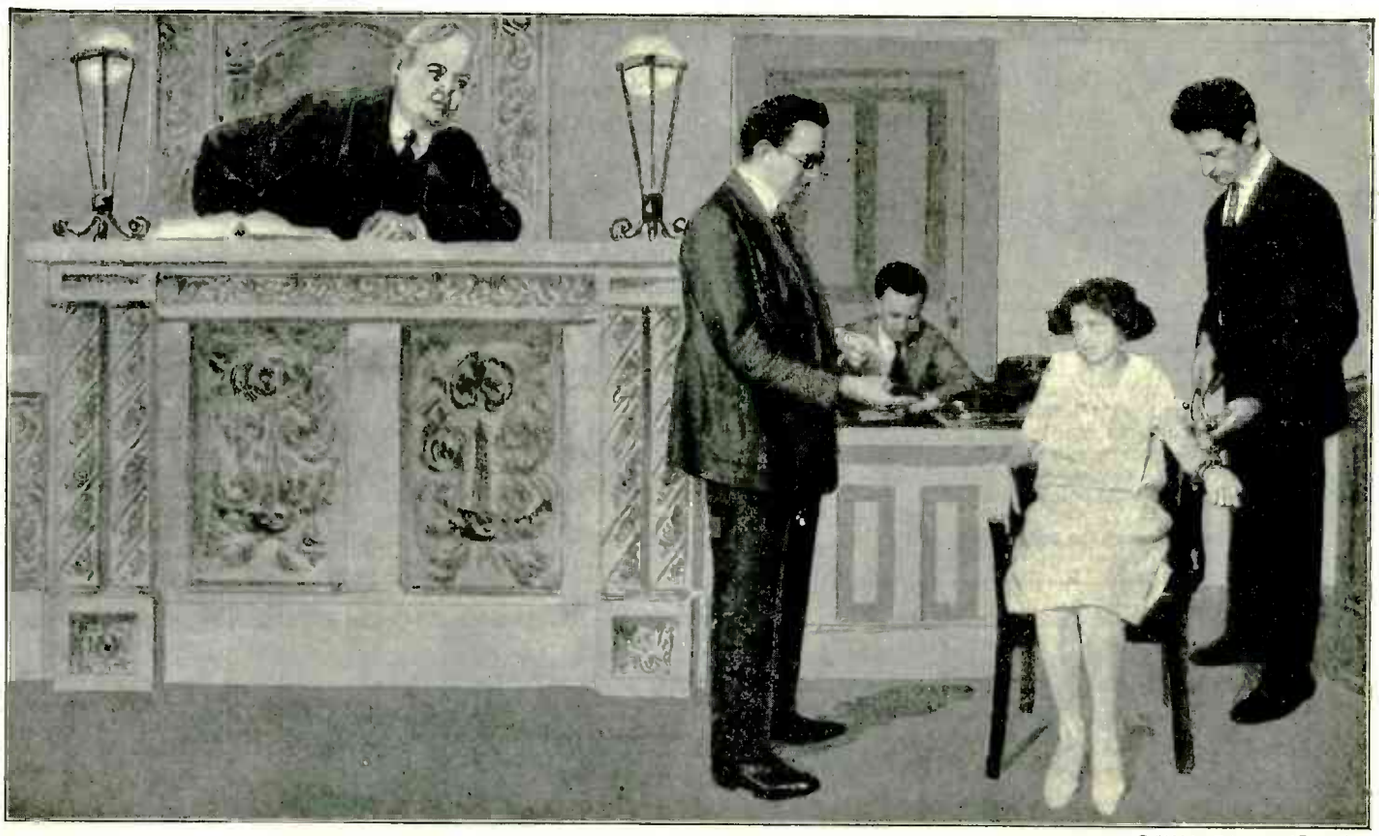


The District Attorney Had Grilled the Suspect for Three Hours. Suddenly the Revolver With Which the Crime Was Committed Was Produced. "Did You Not Fire the Fatal Shot?" The Suspect's Reply Was Calm and Reserved, "I Did Not," But the Doctor, With His Instruments Strapped to the Witness's Wrist, Knew That She Was Lying. The Lie Detector, Working Hand in Hand With Justice, Cannot Be Fooled.

The Lie Detector

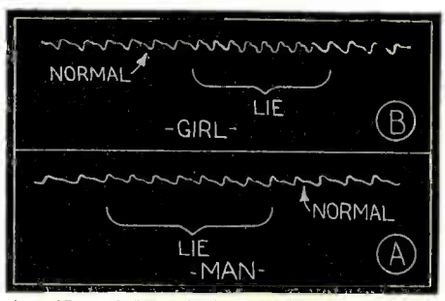
By JOSEPH H. KRAUS

STAFF MEDICAL EXPERT

A LARGE courtroom meets our view. The Chief Justice is sitting on the bench. The district attorney, for that later he proves to be when we inquire, is in a hot debate. As we enter we see him furiously waving his hands. Every few moments, counsel for the defense interrupts. We approach closer, and take a seat. James Alphonso Frye is on trial for the murder of Dr. Robert W. Brown, a negro physician. The debate this time is not over his innocence or guilt, it is whether or not the testimony of Dr. William H. Marston, professor of psychology at the American University, at Boston, Mass., shall appear in the minutes of the court proceedings. Dr. Marston has a set of instruments in his hand which he desires to strap to the arm of the alleged slayer. He claims that the sphygmomanometer, for that is the name of the complete device, will infallibly detect whether the prisoner is lying or telling the truth. He desires to make the test in the presence of the jurymen. The furious battle of words is finally stopped when Chief Justice McCoy of the court firmly and definitely refuses to permit Dr. Marston to take the stand. The learned Justice intimates that the twelve men tried and true who sit in the jury box are human "sphygmomanometers," and can just as easily detect a lie as the instrument itself. In the opinion of the Chief Justice the machine has not proven itself to be a recognized infallible lie detector.

Has the sphygmomanometer actually rendered lying instantly detectable? In the opinion of the writer, it has done so. Actual tests in the editorial offices of this magazine with this instrument have indicated that the action of telling a lie is very marked and positive on both the blood pressure and pulse beat. The sphygmomanometer is an instrument which has been used by the medical profession throughout the world for many years to indicate blood pressure. By the term blood pressure is meant the pressure exerted by the blood on the arterial vessels through which it is flowing. This pressure originating in the heart beats is maintained by the elasticity of the vessel walls, and the resistance to the flow offered by the restricted area of the capillaries. When the left ventricle of the heart contracts, it drives the blood through the arteries. The instant that the pressure wave passes through a portion of the artery, the elastic walls stretch and then recoil. This recoil produces the pulse beat, and helps to assist the blood in its passage through the smaller blood vessels. The sphygmomanometer, the instrument used for detecting lies, is not designed as a lie detector, but as a measurer of blood-pressure.

In order to obtain accurate readings of blood pressures, we must take into consideration what is medically called systolic pressure. This represents a factor of the total heart-energy, and is the force which sends the blood coursing through the arteries. We must also watch the diastolic pressure. This is the pressure found in the period of rest during the normal heart-beat, and is the absolute minimum pressure in the blood stream. At the time of its occurrence, the blood has a tendency to flow backward along the arteries. The pulse pressure is the third reading. This indicates practically the efficiency of the heart, in that it establishes a sort of mean between systolic and diastolic pressures. In other words, this pulse pressure represents the efficient work the heart does in maintaining the circulation.

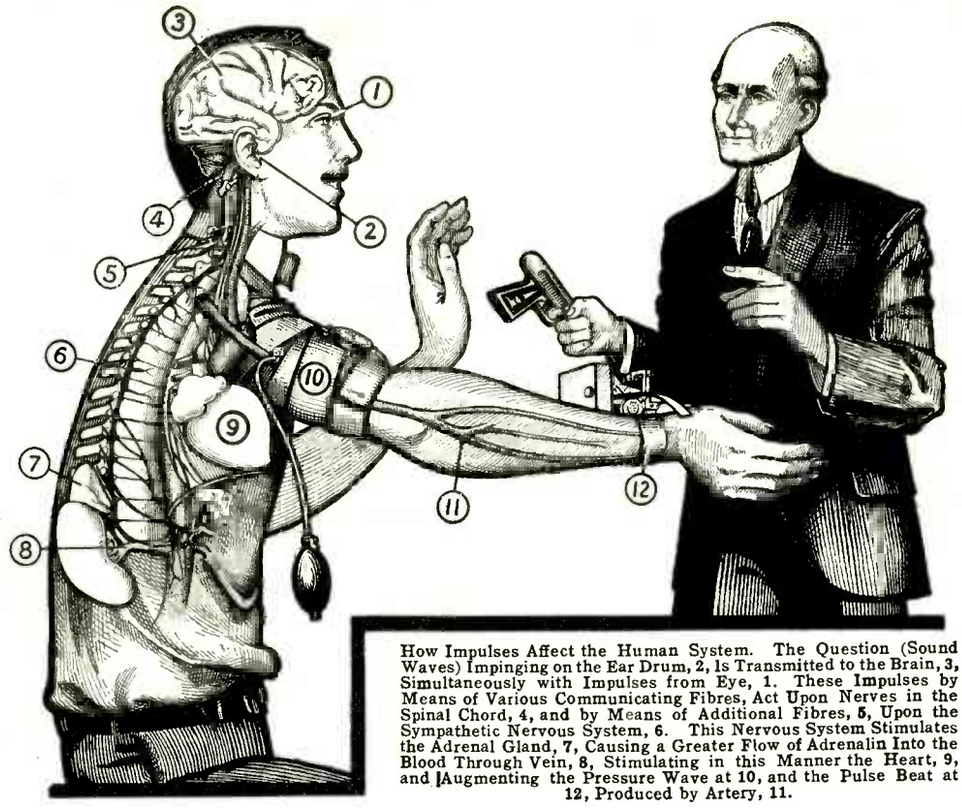


Actual Records Taken in the Editorial Offices to Determine the Possibilities of Detecting Lies by Means of a Sphygmomanometer and the Sphygmograph. A Rise in Blood Pressure of 6 to 8 Millimeters Was Quite Evident

The sphygmomanometer consists primarily of a compression sleeve, an indicating dial, and a small rubber air pump. This compression sleeve is a long band of cloth within one end of which a small rubber bag has been secured. The rubber bag is supplied with two flexible tubes. To one of these a pressure-gauge with dial reading pressures in millimeters of water column is attached. To the other, a rubber bulb fitted with a by-pass is secured. The band is placed around the arm of a patient, the fingers are placed on the pulse at the wrist, and air is pumped into the compression sleeve until the pulse beat is obliterated. By releasing the air slowly, the character of the pulse may be determined. The instant that the pulse returns, evidenced by the sensation of pulsating pressure felt by the fingers, as the air is being released, indicates the point of systolic or heart pressure, which is read directly in millimeters on this well-designed instrument.

On cross-examining a subject, the blood pressure increases quite sufficiently to

suggest to us other causes besides nervousness, whenever a lie is told. Some individuals having instruments of this nature strapped to their arms, as has been proven in tests in the editorial offices of this magazine, become quite nervous, but this nervousness can be disregarded, as whenever a falsified statement is made, there is a marked increase in the blood pressure over and above the nervous effect. Not being satisfied with merely the sphygmomanometer records, an instrument called a sphygmograph was also attached to the subject's wrist. This instrument records the pulse beat. It was found that whenever the truth was told, the pulse beat was quite regular. When, however, a falsified statement was made by the subject, the blood pressure increased quite considerably (sometimes as much as fifteen millimeters), while the pulse beat increased rapidly, and often became irregular.



How Impulses Affect the Human System. The Question (Sound Waves) Impinging on the Ear Drum, 2, Is Transmitted to the Brain, 3, Simultaneously with Impulses from Eye, 1. These Impulses by Means of Various Communicating Fibres, Act Upon Nerves in the Spinal Chord, 4, and by Means of Additional Fibres, 5, Upon the Sympathetic Nervous System, 6. This Nervous System Stimulates the Adrenal Gland, 7, Causing a Greater Flow of Adrenalin Into the Blood Through Vein, 8, Stimulating in this Manner the Heart, 9, and Augmenting the Pressure Wave at 10, and the Pulse Beat at 12, Produced by Artery, 11.

Subject No. 1 with both instruments secured in place is seated in the chair, and given rapid cross-examination. Personal questions are being asked, because answers to these are always likely to be concealed.

Q. Have you read the paper this morning?

A. No. (No change in pulse beat or blood pressure. See graph.)

Q. You have recently made quite a bit of money, have you not?

A. Yes; *again no change.*

Q. Is it true that you spent more than $200.00 last week. *There was a slight hesitation between the question and the answer and the reply made was "Yes." Note the increased rapidity of the pulse* (A). *The blood pressure in this individual, normally 120, rose to 126. and then dropped almost as suddenly.*

Q. Do you like motoring?

A. Yes.

Q. This instrument indicated that you told a lie in reference to the $200.00.

A. No, I did not. *Here again the blood pressure increased to 128, and the pulse beat much more rapidly than at first.*

Confronted with these facts and others, the subject later admitted that he still had the $200.00. (Only a portion of the record is shown here.)

Subject No. 2 was requested to take the stand. The instruments were secured to her, and the cross-examination started.

Q. Do you like your present situation?

A. Yes. *No change in blood pressure or pulse beat.*

Q. When do you intend to get married?

A. Next year. *Again no change.*

Q. Are you engaged to the gentleman you are going with?

A. Yes. *Here the pulse beat quickened perceptibly and an increase in blood pressure was evidenced.*

Q. What color stockings do you prefer?

A. Flesh color. *Here there was no change in either pulse or manometer readings.*

Q. How old are you?

A. Twenty. *Here the needle on the sphygmomanometer, as is evidenced by the record at B, did all sorts of tricks. The speed of the pulse beat was augmented considerably. The blood pressure increased fully six millimeters.*

Later, when the witness was confronted with these two misstatements in the testimony, beside several others occurring as the testimony continued, she admitted her deception.

It is evident from this and other tests made by the writer, that these truth machines, as they have been erroneously called, will eventually find their way into the courts. Chief Justice McCoy, although refusing to permit the test, declared that some day when the instrument attained the same degree of efficiency as the telegraph and telephone have today, it might be possible to make good use of it in trials.

The courts have decided that an individual could not testify while under a hypnotic spell, nor could he be made to testify while under the influence of a drug or liquor. He must be fully conscious and aware of what he is doing. Perhaps this instrument will meet with greater favor than drugs have met with, as the witness will at all times be conscious of what he or she is doing.

The device proved infallible in our tests.

HOW THE "LIE DETECTOR" WORKS

One may wonder how the physiological effect here shown is produced in the human body.

When a question is asked, the vibrations of the voice affect the ear in a manner which has been thoroughly described heretofore. Nerve impulses arise which are recorded in the brain. Similarly, nerve impulses from the eye are transmitted to the brain and, thence, by means of various communicating nerve fibres, stimulate certain portions of the spinal nerve tract. This stimulation acts upon what is known as the sympathetic nerve system, which nerves supply nearly all of the internal organs.

The particular organ which causes the increase in blood pressure and simultaneously the augmentation of the heart beats, is the *adrenal.* This is a small body situated immediately above the kidneys, and has been called, in the older terminology, the *superrenal,* because of its location. When stimulated, it gives off a peculiar, complex fluid, which is taken up by the bloodstreams, where its effect is very pronounced, even though rather temporary. This gland (for the adrenal is in reality a gland) secretes the complex fluid called *adrenalin.* When adrenalin is injected into the bloodstream it produces contraction of the muscular walls of the arteries. Consequently it causes a rise in the blood pressure. It also acts on the heart as a strong augmentative, and develops an accelerating influence, so that the heart beats much more effectively, even against the contracted peripheral arteries.

The vagus nerve must not be omitted from the action and reaction. Whenever the heart is stimulated to a great extent the vagus, which acts as its control, or as a sort of safety valve, immediately sends impulses into the tissue of the heart, which have a strong retarding action upon its beat. The exact function of the adrenals is not thoroughly understood. We know that if they are removed in animals under test the subject dies, perhaps within 24 hours. Our diagram shows the nerve impulses being propagated through the nervous system, and likewise affecting the sympathetic nerve ganglia, where, through many anastomoses and cross-fiberizations the stimulus is finally transmitted to the adrenals, the secretion passing into the blood, and developing an increased pulse throb, as well as an augmentation of the blood pressure.

Photos staff photographer, instruments courtesy George Tiemann & Son.

New York Stadium Concerts Sent by Wireless

By a special equipment installed at the stadium of the College of the City of New York, the Philharmonic concerts have been broadcasted over an area occupied by 75,000,000 people. Never before has a great New York symphony orchestra had its music broadcasted.

The music was recorded by a special type of microphone developed by the Westinghouse Electric and Manufacturing Company. This device, in appearance a small black cylinder four inches long and four inches in diameter, is suspended in view of the audience about twenty-five feet in front of the platform and about twenty-five feet high. It is supplemented by a second microphone located just above the orchestra leader's platform for the purpose of recording any soloist. These microphones convert the music (as well as the applause that follows) into an electric current of strength and character that varies in accordance with the character of the sound waves that impinge upon the diaphragm.

This current was then transmitted over a special leased wire. The wire extended through the various telephone exchanges to the famous Westinghouse broadcasting station WJZ at Newark, N. J., a distance of twenty-five miles from the stadium. At the broadcasting station the electric current is amplified by special vacuum tube circuits; the amplified current is then impressed upon the modulator tubes of the transmitting set. These modulator tubes in turn vary the output of the radio transmitter in accordance with the same sound waves that are impressed upon the microphones at the stadium.

"Movie" Scenes to Order

By H. WINFIELD SECOR

How Volcanoes in Eruption and Train Wrecks Are Staged in Miniature

NEW tricks in producing startling as well as novel motion picture scenes are constantly being worked out, and several of these masterpieces are shown in the accompanying illustrations. The first picture shows one of the latest manipulations being used in certain moving pictures, wherein the effect is given for example, of a bridge, such as the Brooklyn Bridge which spans the East River in greater New York City, standing serenely against a background entirely foreign to this famous structure; in one case a well-known bay along the coast of California. In the trial scene incorporating this effect, two boats were caused to pass along under the bridge-span, much to the amusement albeit and astonishment of one of the uninitiated private audience, who viewed the film in the special projection room of the company who made the film. "Yes, that is the Brooklyn Bridge all right, sure enough," quoth the uninitiated beholder, "but how in the name of reason did it get out here across that bay? I know that there is no such bridge across that bay."

The mystery of this scene showing the Brooklyn Bridge spanning a California body of water was explained by the director after the exhibition. This trick was executed by placing a piece of plate glass before the movie camera, on which sheet of glass an artist had previously painted in fine detail and in the proper colors, the Brooklyn Bridge. Of course this image of the bridge had to be changed several times until the color of the paint and the edges of the picture were properly located, so as to blend smoothly into the actual scene with regard to the near and distant shores. There are many other possibilities opened by this new idea in freak or mystic motion pictures—for example, one may behold one of these days the giant Woolworth Building, fifty stories in height, resting serenely on the surface of the Great Salt Lake. "Aha," will quoth the movie expert in the gallery, "I know how that was done. They photographed the Woolworth Building on one film and the Great Salt Lake on the other, and superimposed them in printing;" but as the hero always says to the villain finally, *Foiled again!*

A VOLCANO THAT NEVER EXISTED

Volcanoes that spout boiling lava are not always what they seem in the movies. True, real movies of volcanoes in action have been taken, but frequently it does not pay to dispatch a camera-man with his paraphernalia across the Pacific to the Hawaiian Islands or some other distant place to snap a few thousand feet of one of these volcanoes in eruption. So it has come to pass that the motion picture experts have found a way to overcome the difficulty by making a volcano to order. Some months ago, we described an elaborate "movie" volcano built nearly life size, but the present one, shown in the illustration, is a cute little one, about three feet high; and when the cinema photographers get through with it, they defy you to tell the finished picture from a photograph of the real thing.

A heap of sand several feet high usually forms the basis of the miniature volcano, and in the center of this is placed a series of explosives and slow burning powder charges, together with some other chemicals, such that they will, when once ignited, cause a very realistic imitation of a volcano in full eruption. A lurid flame shoots skyward, while a heavy pall of smoke floats ominously overhead. Molten lava trickles down the sides of the miniature volcano, and the effect of rocks and other material blown skyward and dropping into the adjacent harbor, is created by two or more sturdy assistants who stand out of range of the picture and throw handfuls of pebbles and sand, so that they will drop in the water within range. To smooth down the details and sharpness of the picture and also to provide the atmospheric haze which should naturally accompany such a scene, especially after the volcano has been erupting lava, rocks and gases for a while, several thicknesses of transparent gauze are interposed between the camera and the scene.

THE accompanying illustration and story explains some of the interesting tricks used in producing many of the most spectacular movie scenes of the present day. Of course, there are thousands of other devices and artifices resorted to, which no one but the movie producers themselves know anything about, as many of the ideas used are naturally kept secret. Theatre-goers have taken it for granted for many years that the various scenes presented to them in a show, were naturally all that they could expect—if a locomotive dashed across the stage, they knew full well that they could not expect to see a real locomotive used in the scene; and it must be said that the scene painters and stage carpenters have certainly given us some wonderful productions.

But when the motion picture people began to produce spectacular scenes, they started right in photographing the real thing, and while it is practically necessary, and in fact, more convenient in many cases, to photograph the actual objects, there are occasions when the cost of production would be prohibitive. One cannot for example, go out any day in the week and photograph a volcano in eruption and destroying towns and villages. How the motion picture studio experts get around this difficulty, and other such problems, is told in the accompanying story.

A number of miniature houses are cleverly arranged in the foreground at the base of the volcano, and at the proper moment several of these are set on fire. Another detail sometimes includes miniature automobiles dashing through the streets in the near foreground, while ships in the harbor (miniature ones) are wrecked or set on fire. By using a red stain on that part of the movie showing the volcano in eruption, a very vivid effect is produced, and this also helps to tone down the sharpness of details so as to present a still more exact duplicate of a real volcano.

RAILROAD WRECKS

If you have been going to the motion picture theatres for a few years, you have probably witnessed at least half a dozen railroad wrecks, including a few choice head-on collisions. Some years ago or in fact at the present time in some particular instances where occasion demands it, real locomotives and cars are used even at an expenditure of thousands of dollars, all for the sake of producing a startling scene, occupying perhaps but a few moments' time on the screen. However, in many film plays, a miniature reproduction of an actual railroad collision will suffice. The writer has seen several of these, and while other theatre-goers sitting beside him did not notice the deception, he was able to note that it was a miniature train and not a bona fide one which appeared on the screen.

The writer recollects one excellent scene which was that of a snow storm, and the train bearing the hero homeward bound for Christmas to visit his family, was seen dashing along in the night among the snow banks. A very pretty scene indeed, and one that had its full effect on the audience as was evidenced by the remarks overheard both during and after the show. Such scenes, particularly those representing night effects, are staged in one of several ways. The falling snow is usually imitated by dropping finely cut up pieces of white paper, while the snow covered fields may be nothing more or less than cotton batten. The train may be pulled with a string or it may be an electric one, and by the time one of the clever scenic artists gets through repainting and decorating the miniature train, and the electrician has placed a few lights in the cars, so as to shine through the windows indirectly, it will take a sharp eye indeed to detect the difference between the imitation and the real thing.

The writer remembers another scene where two trains met head-on in the center of a high trestle, the locomotives and cars finally falling over the side of the trestle into the river below. As this part of the picture occupied but a few moments on the screen, the expense necessitated by staging a real honest-to-goodness railroad wreck was not warranted, so the miniature scene filled the bill thoroughly well, and no chances were taken with the happiness and welfare of the motion picture actors or actresses, permitting them to save their energies for more valuable scenes, where perchance they might have to jump from one airplane to another, or be picked up by an airplane from a boat or moving train.

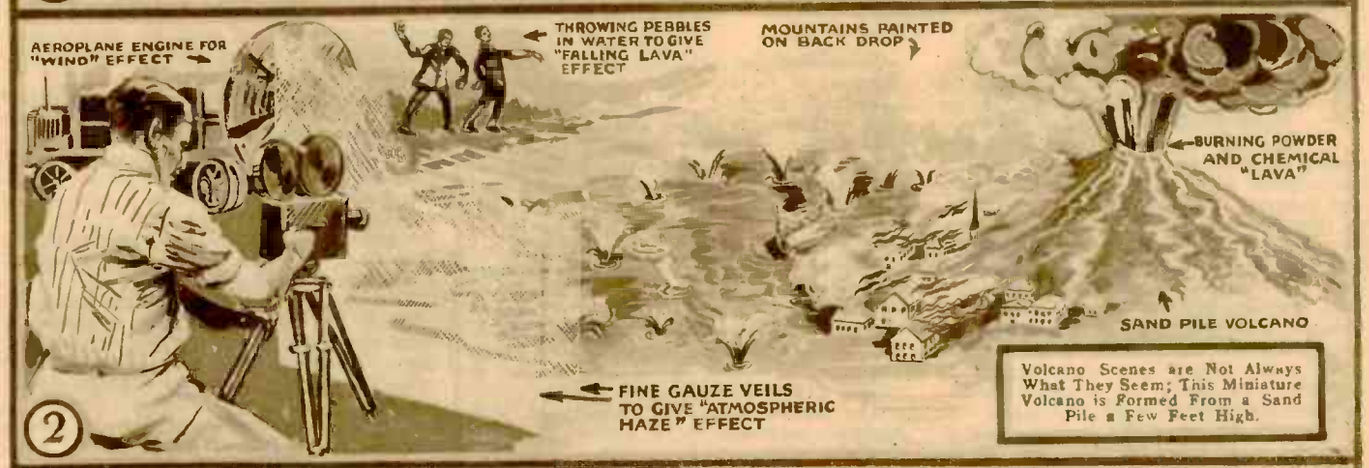
THE DELUGE

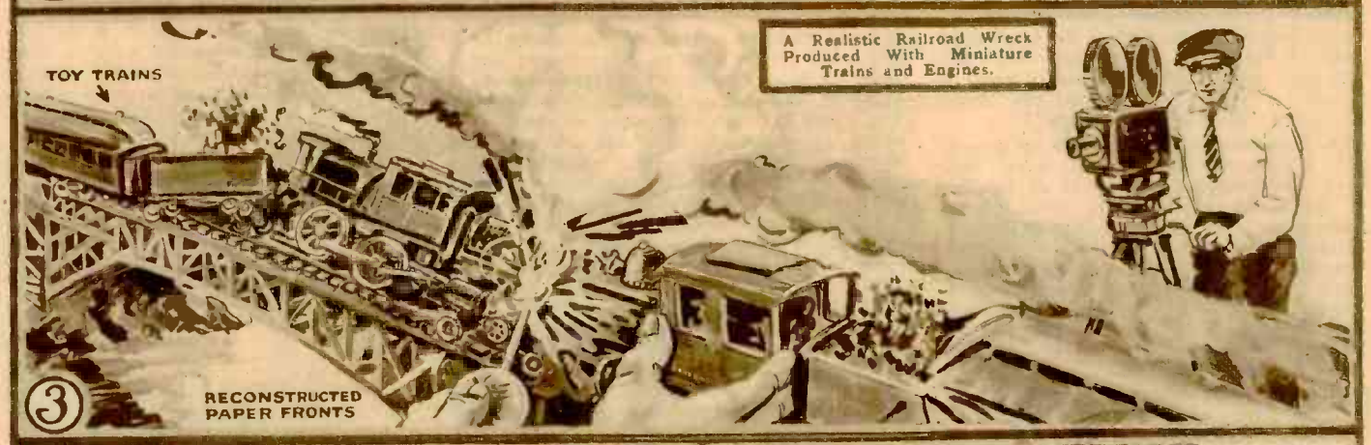
Possibly you have seen one or more of the latter day spectacular film plays, in which a dam bursts, and the impounded water rushes down through a valley obliterating entire towns in its onward rush. Some of these scenes have been photographed at least in part from the actual scenes, which of course required considerable "movie" engineering, owing to the large amount of water to be handled and other features. In one of these pictures which the writer saw a short time ago, the hero and heroine were observed running along the bottom of the valley, and as the water approached closer and closer in the form of a tidal wave of irresistible power, it finally outdistanced them and they were caught in the onward rush of the swirling waters and had to swim on the crest of the waves. This picture featured Miss Priscilla Dean in "Wild Honey." That was real.

Many of these deluge scenes, however, it is possible to photograph in miniature, the rushing waters throwing pebbles and sand before them, which when magnified and thrown on the screen, look exactly like the larger rocks and dirt which one would expect to see thrown upward by billions of gallons of water rushing toward them. Bursting dams and other spectacular scenes are usually photographed in miniature altogether, as it would of course cost an unprecedented amount of money to dynamite a real dam 75 to 100 feet high, and possibly several hundred feet in length.

One of the greatest film masterpieces produced with miniatures or models, is perhaps "The Battle of Jutland," in producing which models of the battleships and cruisers were moved from time to time, the cannons fired, etc., so that when the final film production was thrown on the screen, it would take an expert to tell whether the naval battle scene before them was bona fide or not. Waves were caused by blowing a strong draft of air over the water, and shells falling on the water were imitated by dropping pebbles or stones into the water from time to time.

MOVIE SCENES TO ORDER





The Thought Wave Detector

By THOMAS WILLING HICKS

YOU, of course, remember Monday, Nov. 8th, 1918, when great mobs of people in every large city in the highly civilized sections of the world, impelled by a powerful something coming to them from somewhere, began a frantic peace celebration—only to awake the next morning to the cold gray fact that the big Berthas still thundered "over there"; the rifles still cracked in the trenches; the machine guns still sprayed their hail of death; brother-man was, at that very moment, bayonetting his brother-man, while carnage and grim pestilence, arms entwined, danced the Devil's ballet of war.

Ninety-two hours later the thing really happened. You know, the armistice; peace; and then the celebration all over again,

But what whispered the coming event to the tense nerve lobes in the brains of the mentally active humans, scattered throughout the length and breadth of the intellectual zones of the earth? How could they "feel it in their bones" almost a hundred hours in advance? Where, and how did the "flash" originate? How was it "caught"?

On September the 16th, 1920, at exactly 11.50 o'clock in the morning, lower New York was rocked to the point of toppling by the bomb explosion in Wall Street. Three days, yes, even five days previously, Edward Fischer, a so-called sub-normal neurotic, constantly under a high nervous strain and extreme mental tension, had "caught the flash" and knew of, and gave warning to his friends of the coming disaster. How?

At exactly half past six o'clock (U. S. Central Time) on the evening of August 12th, 1917, the family of George B. Mosure, living three and a half miles southeast of the little village of Lynn, Washington County, Kansas, were all seated at the supper table. Suddenly, Mrs. Mosure, busily engaged in helping her baby daughter with a glass of milk, turned deathly pale and wailing "Oh, my poor, poor boy," swooned. When revived the first words spoken to her husband were: "Daddy, our John will never come back." Twenty-seven days later the Lynn, Kansas, telegraph operator borrowed the grocer's Ford and carried a message to the Mosure farm. Yes, it was from the War Department, Washington, D. C., and read, laconically, as follows:

> "Killed in action, Argonne Forest, Aug. 12th, 1917, private Mosure, John; age 21. Notify Mosure, George B., Lynn, Washington County, Kansas."

The family was, of course, not only deeply affected, but surprised—all but the mother. She had known it for twenty-seven long days—and nights.

Subsequent investigation and a careful check-up of the time difference between the Greenwich standard time zone in which the state of Kansas is located and the continental time zone in which the Argonne sector lays, proved that Mrs. Mosure had *instantly* received the "flash" and knew her son had been killed as he went over the top at the zero hour of the August 12th offensive in France. How?

If proven possible to foretell, or foresee, with scientific certainty the fluctuations of the New York Stock Market ninety hours, or even that many minutes, in advance of such movement, could the New York Stock Exchange, as now constituted and as at present operated, continue to exist?

The human brain, the brain itself, is a material substance, or a sort of a flesh-muscular-mechanical part which acts by registering the effect or the action of a metaphysical thought. The real substance of this brain part is, like all other matter and material things, composed of atoms—atoms gathered together in certain combination. The same is true of a piece of steel, or wood, or silver, or gold; all, are atoms; atoms in definite molecular combinations. Strike the steel bar with a hammer and the many molecules in the vicinity of the point struck, are badly jarred, disturbed; and they immediately reverse their position with respect to each other. At a speed incomprehensible to the human mind, the former combination is changed.

Exactly the same thing occurs when an electric current is suddenly passed through a piece of matter which we call wire. In the case of the steel bar the rearrangement of the molecules of the steel are manifested by vibration and we say "it made my fingers tingle." In the case of the electric current flowing through the wire, a rearrangement of the electrons which compose the atoms, that, in turn, go to make up the thing we call wire, instantly takes place. This jolting and rapid change in combination of the electrons stirred up by the electric current rushing through the wire is manifested by a perfect flood of electro-magnetic waves, which are, in turn, recorded on our eyes as light, and which register on our bodies as heat.

Science has segregated and tabulated five different forms of electro-magnetic waves, namely, light waves, heat waves, wireless waves, Gamma-ray waves and X-ray waves. The new wave to be added to this list, and the most important and far-reaching of all is—the *thought* wave.

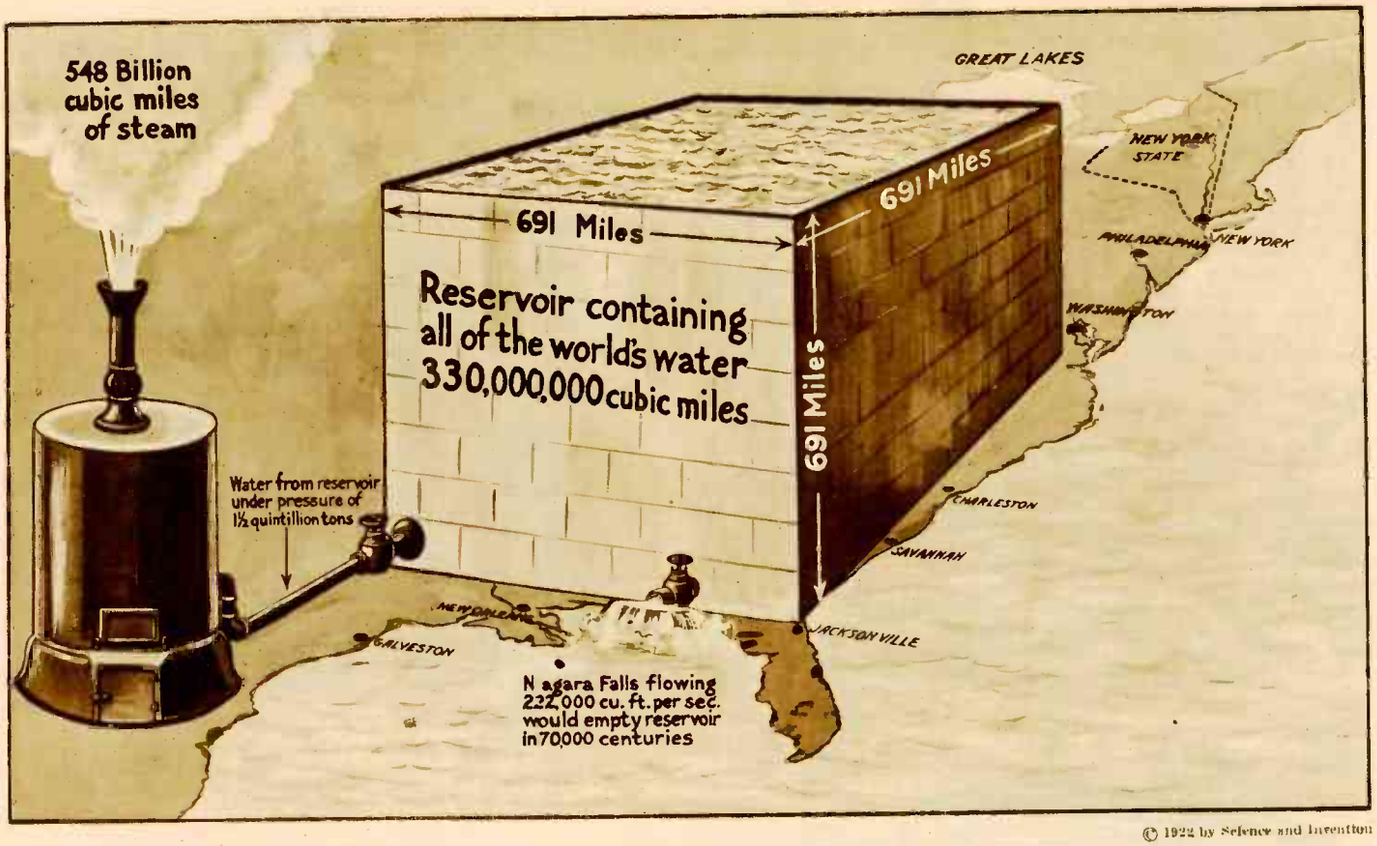
When that material thing composed of atoms and which we call "the human brain" is "struck" by a thought, here is what happens. The group of the brain cells is affected exactly as are molecules in the bar of steel when it is struck, or the wire when it is subjected to the electric charge. In all cases molecules of the steel bar, or of the wire, or of the mucous membranes of the brain, are jarred, disturbed, distorted realigned and rearranged. Take, for illustration, an ordinary horseshoe magnet. In charging it with magnetism molecules of the metal are polarized, as it were, in a certain position or direction and the magnet will pick up a nail, or any small iron object. Now strike this magnet enough sharp blows with a hammer, and then try to pick up even a very small piece and you find it powerless. The magnetic force is gone. The blow changed the position and condition of the electrons in its atomic structure and the magnetism went out with the electro-magnetic wave that flowed therefrom at the time the blow was struck.

Now the brain "struck" with a thought undergoes the same action. The former molecular combination of the part disappears and a new condition or combination is established. This, too, causes a wave—just as the tossing of a pebble into a pool causes a shock to, and a rearrangement of, the electrons composing the hydro-oxygen molecules that make up what we call water—and a visible wave results.

Now induce a healthy normal brain to perform the act of thinking. It thinks of some particular thing and a certain combination of the molecular structures of the brain cells is thereby formed. Now suddenly change the thought. Necessarily there is an abrupt and instantaneous readjustment and rearrangement of the electrons composing the atoms which make up the molecules of the brain. The result is the creation of an electro-magnetic wave—a wave caused by the mechanical act of the material brain registering a change in the condition of the mind, or a metaphysical thought—a thought wave.

(*Continued on page* 714)

"See, the Needle of the Galvanometer Has Swung to a Point at the Extreme Right of the Dial. From Past Observations I Know This Indicates That the Strongest Thought-Action in the Brains of a Majority of the Men Now Present on the Floor of the Exchange Is *the Buying Thought*. . . ."



Some Idea as to the Actual Amount of Water on Our Earth Can Be Gained From the Accompanying Picture, and Mr. Holmes Has Calculated That It Would Require a Gigantic Steel Tank 691 Miles on a Side, Forming a Cube, to Hold the 330,000,000 Cubic Miles of Water Comprising All Our Rivers, Lakes and Oceans. This Huge Reservoir Would Extend From Washington, D. C., to Jacksonville, Florida, and if the Water Was Allowed to Escape From This Huge Tank Over Falls Equivalent in Size to Niagara Falls, It Would Require Seventy Thousand Centuries for It to Empty.

How Much Water In Our World?

By CHARLES NEVERS HOLMES

WATER is both a necessity and a luxury. We cannot do without it. We drink it, we wash in it, we swim in it and we sail on it. It is everywhere about us. Water has not changed with the passing of centuries. Like air, it is vitally associated with the life of man.

Water is a gas united with a gas. Hydrogen, the lightest known gas, combines with oxygen, a very energetic gas. Accordingly, water's chemical name is "H_2O." That is, two atoms of H or hydrogen unite with one atom of O or oxygen. One atom of oxygen is about 16 times as heavy as one atom of hydrogen, but, inasmuch as these gases are combined in the proportion of H_2O, the amount of oxygen in water weighs only 8 times as much as the amount of hydrogen. Compared with air, water weighs about 773 times as much, a cubic foot of fresh water weighing about 62½ pounds.

Water is everywhere about us—upon the terrestrial surface, beneath the terrestrial surface, in the air. Upon the terrestrial surface, there are, of course, five great oceans, Pacific, Atlantic, Indian, Antarctic and Arctic. These five great salt-water bodies approximate a total area of 140,000,000 square miles, with an average depth of 2⅓ miles, or a total volume of about 326,000,000 cubic miles. Adding to this the amount of water in lakes and rivers, the total volume of salt and fresh water upon the terrestrial surface approximates 327,000,000 cubic miles.

There is a great deal of water beneath the terrestrial surface. There is water in the soil and there are underground streams. However, in all probability, neither the soil nor these streams are very deep. It is very likely that there exist extensive reservoirs of water underground, but it is unlikely that the comparatively small amount of water in the soil, and in underground streams and reservoirs, would appreciably increase the vast amount of water upon the terrestrial surface. And, likewise, the water vapor in the air is hardly to be considered in estimating how much water our earth possesses. It is true that our atmosphere extends to a height approximating 300 miles, but most of its moisture lies below a height of about 7 miles. However, the water both beneath the terrestrial surface and in the air adds something to the estimated 327,000,000 cubic miles of water upon the terrestrial surface. Accordingly, to allow for the additional water beneath our Earth's surface and in its air, as well as to correct any possible underestimation of the amount of water upon the terrestrial surface, an estimate of the tota volume of water which our earth possesses approximates 330,000,000 cubic miles.

Now, let us see what 330,000,000 cubic miles of water really signify.

The total surface-area of our Earth is about 197,000,000 square miles, and, therefore, were our Earth's surface wholly uniform, all of the water possessed by our World would completely cover it to a depth of about 1⅔ miles. If all of this vast amount of water should ascend into the air, and then descend to the terrestrial surface in a deluge of rain, falling everywhere, at the rate of 25½ inches a day, which is reported to have once descended upon a region in India, such a terrific rain would fall continually upon our Earth's surface for more than eleven years. If the Missouri-Mississippi river system were the only river in the World, and were this system to pour its waters into a reservoir vast enough to contain all of the terrestrial water, it would take, under conditions of maximum discharge from the Missouri-Mississippi, about 6700 centuries to fill that reservoir. And, if all of our terrestrial water were to descend upon New York City, not draining off, it would inundate that city under a flood approximating a depth of one million miles!

Wooden Water Pipes

Sequoia Sempervirens is the botanical name of the commercial California redwood, which is sawed into lumber for many purposes, not the least of which is watertanks.

This wood is held in high esteem by experts in the manufacture of tanks, because of its lightness, extreme durability and its fire-resistant qualities.

Cypress has for generations been held to be the wood most suitable for use in making tanks, but since redwood has come into common use for this purpose, the latter has met with even greater favor and is considered equal to if not superior to all-heart cypress of the best grade.

Numerous cases can be cited of redwood tanks that have been in daily use for fifty years and more. This wood is also used for making water pipe for gravity water lines and because of its cheapness as well as its lasting qualities is in extensive use for this purpose. Among orders which the Virginia Machinery and Well Co. have received for wood pipe is one from the Hamlet Water Co., of Hamlet, N. C., where the water for the town of Hamlet is conveyed for nearly two miles through redwood pipe.

The railroads of the West have used these redwood tanks for their water stations for years.

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

No. 10—The Secret of Tel-Hypnotism

(AUTHOR'S NOTE.—*The problem of the "Freedom of the Will" is a very old one. The modern biological theory is, however, that man is an automaton and that each of our actions is caused by some stimulus, either external or internal. Such being the case, the man who should learn how to use the proper stimuli, could compel all other men to do as he pleased, and so would become ruler of the world!*)

"SURELY, doctor, you don't mean to say that you believe in hypnotism?"

"Well, yes and no. I have no faith in the public performances of hypnotism. All those I have seen were obviously frauds. As to the books on hypnotism that I have read, I am convinced that the authors were sincere but that they were cleverly duped by their subjects. Of course, everything depends on what you call 'hypnotism.' If we use the word to express the influence which one mind exerts over another, everyone must admit that the thing exists, for we have daily proof that a weak mind can be controlled by a stronger one. When a father calls to his boy to cease his play and come in and do the chores, the boy comes reluctantly, against his will. The will of the parent here controls the will of the child."

"Yes, but through the medium of language."

"Not necessarily. A look or a gesture may suffice. All our acts are the automatic result of external or internal stimuli, and often inanimate objects act as the stimulus, as we see in the case of the alarm clock whose ring causes the sleepy and unwilling workman to get up against his will."

"Not against his will, because he set the alarm himself the previous night."

"True, he made up his mind beforehand to rise early, and this predisposition acts as the stimulus. But since we are on the subject of hypnotism, I will let you into one of my secrets which I had resolved never to reveal to any living man. Silas, I have discovered the secret of tel-hypnotism!"

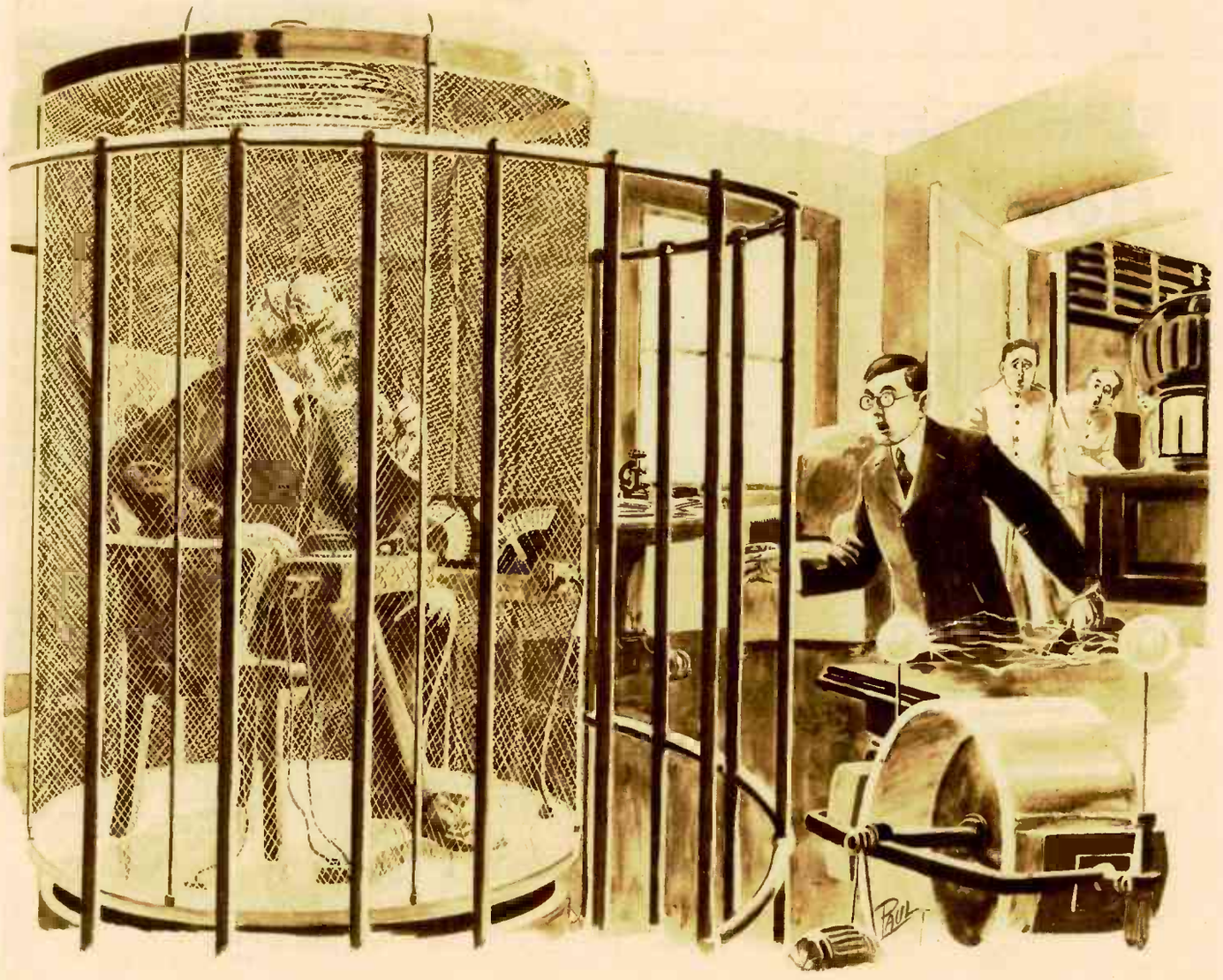
"Tel-hypnotism? What in the world is that?"

"Hypnotizing at a distance. I have found the means of hypnotizing people miles away and compelling them to do what I wish!"

"What! Impossible!"

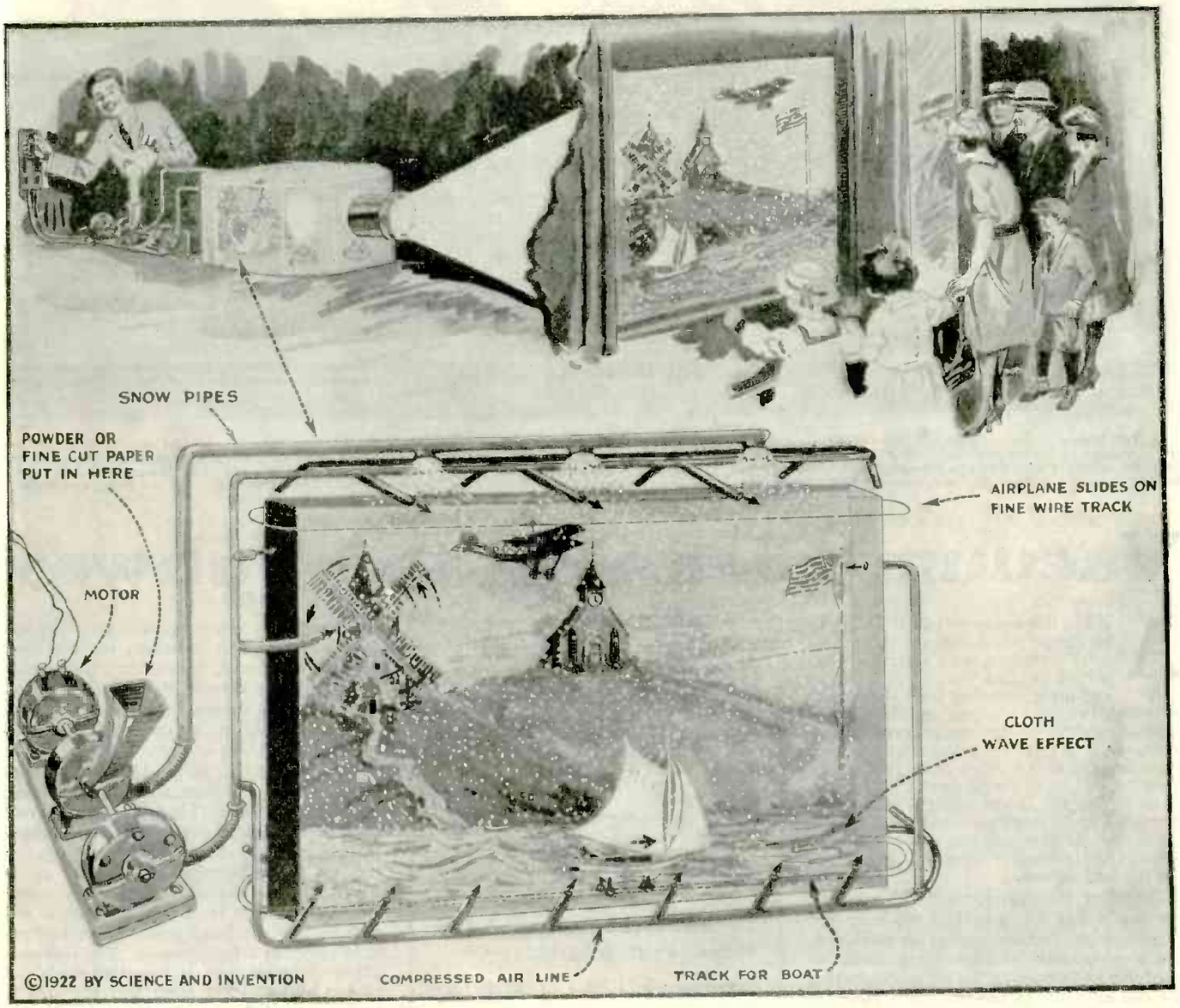
Doctor Hackensaw smiled. "Yes," said he, "I enjoy accomplishing impossibilities. You are doubtless aware that for many years learned men wrangled over the question of the 'Freedom of the Will,' whether we have any choice in our acts or whether they are determined by external causes just as a prestidigitator forces us to select a certain card in the pack when we believe we are choosing one for ourselves. The modern biological theory is that man is an *automaton* and that all our acts are the result of external or internal stimuli. We see, smell or hear something and we respond to the stimulus excited in our senses."

(*Continued on page* 681)



"'You Think I'm Crazy, Don't You?' Were the Doctor's First Words. 'Well, I Am Not. If I Stepped Out of This Cage for a Minute My Life Wouldn't Be Worth a Straw!' 'Why, What's the Matter?' 'The Matter Is That My Tel-Hypnotizer Has Been Stolen, and the Villain Now Wants to Murder Me, So as to Remain the Sole Possessor of the Secret.'"

Animated Picture Projector For Show Windows



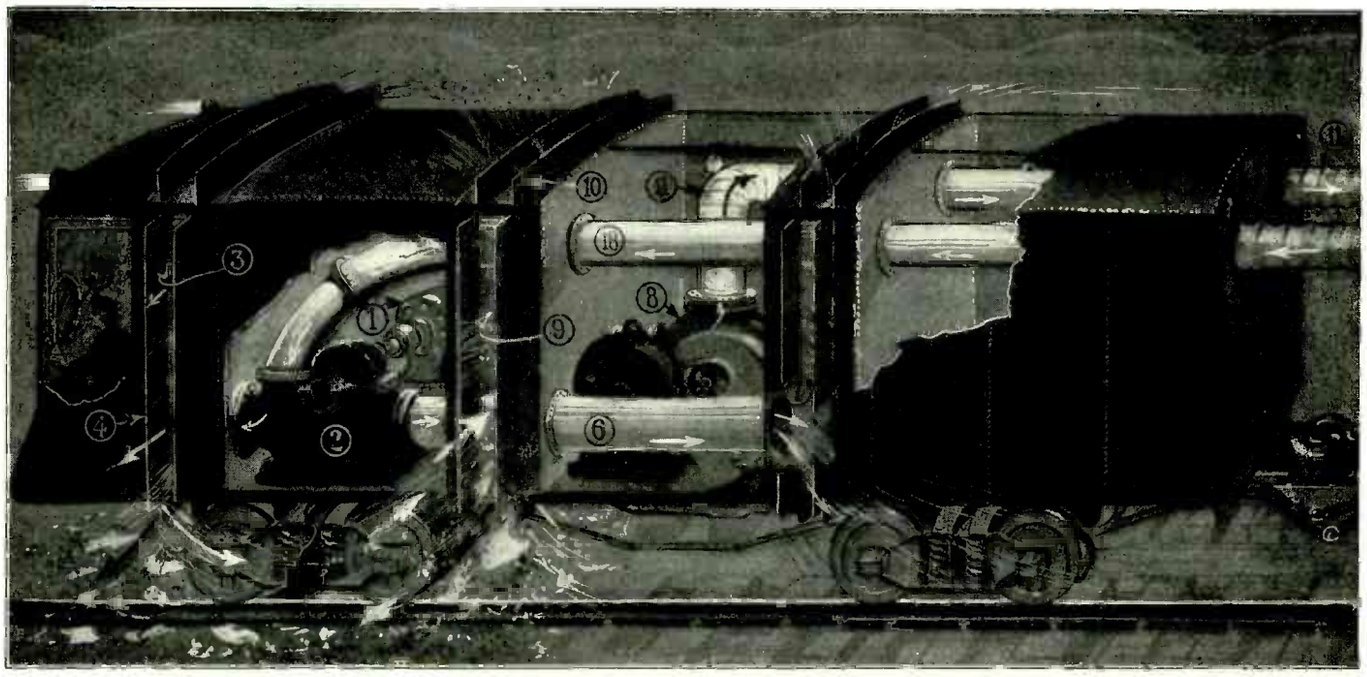
One of the Cleverest Animated Show Window Displays We Have Seen in a Long Time Is That Illustrated Above. Frederick W. Schmidt, of Philadelphia, Has Recently Taken Out a Patent on This Device, and Some of the Effects Obtainable With It Are Shown Above by Our Artist. Real Snow Scenes, Together With Moving Windmills, Clocks, Airplanes, Flags, Sailboats—All These Effects are Possible With This New Projector. The Outfit Comprises a Projection Lantern Similar to That Used for Post-Card Projectors, and the Animation Takes Place on the Picture Placed in the Rear of the Lantern, as Shown In the Upper Illustration. The Effect of Snow, for Instance, is Obtained by Placing Finely Cut Paper or Powder in the Hopper of One of the Blowers, so That This Material is Blown Out Through Nozzles Over the Top and Just in Front of the Picture. Separate Outlets From the Blower Line Cause the Sailboat to be Blown Along on Its Track, as Well as the Airplane; the Vanes of the Windmill are Likewise Caused to Rotate, and the Flag to Flutter in the Breeze.

ONE of the cleverest *animated picture* projecting machines we have seen in some time is the one here illustrated, which was recently patented by Frederick W. Schmidt, of Philadelphia. The possibilities and variations of Mr. Schmidt's idea are practically limitless. Briefly considered, the apparatus comprises a painted scene with certain parts made movable, such as the blades on a windmill, a small boat, an airplane, etc.; the picture is projected through the lens upon a screen in the show window by the reflection principle, similar to that used in the well-known post-card projectors. In other words, the light from powerful incandescent lamps is thrown upon the scene, and the reflected light is projected through the lens to the screen.

The moving parts of the scene, such as windmill blades, walking or dancing figures, etc., may be operated in a number of different ways, such as by clockwork or by electric motors. One interesting scene provided for in Mr. Schmidt's patent, is a snow scene. To produce the effect of falling snow, powder, such as flour, or else very finely cut white paper, is fed into the hopper on top of one of the small motor-driven air blowers, and this flour or cut paper is carried up to the openings in the air delivery pipe at the top of the scene, from whence it is blown out and downward, in a very realistic manner.

The boat shown in the picture herewith, is blown along its course by a series of air jets opening from one of the air delivery pipes, and the successive jets of air blowing against the sail of the boat, propel it along, the boat being placed on a little truck, or carriage fitted with wheels, running on a track. Among other possibilities with this ingenious animated picture device intended for show windows and other advertising purposes, are rising or setting sun and moon effects. Another pretty effect in the animated picture, is the waving flag, which is caused to flutter by a current of air from one of the supply pipe openings. An ordinary clock placed in a tower or other suitable position, gives a very realistic effect. It should have been mentioned that the track at the bottom of the scene runs continuously around the back, so that the boat or other moving device, to be propelled along the track by jets of air, can return to the starting point repeatedly and automatically. The picture and its attachments are placed in an airtight casing, which is provided with an exhaust port.

Another departure shown by Mr. Schmidt, is that where a scene is made to continually change by virtue of being painted on a long strip of cloth, which is mounted on rolls, these rollers being rotated slowly, either by air turbines propelled by jets of air from the blower system here shown, or else by an electric motor and suitable reduction gearing. In one of the scenes suggested by the inventor, for use in this animated picture frame, is one in which the scenery is made to move continuously, while an automobile stands in front of the scene and the wheels spin merrily. The audience think that the automobile is moving.



A 75 H.P. Motor (1) Drives a Blower (2). This Forces Air Into the Chamber (3) and Out Against the Walls of the Subway Tube Through Adjustable Baffle Plates (4), Regulated by Means of Handles (5) in the Motorman's Cab, if the Train Is Moving in a Forward Direction. If the Train Is Moving in the Opposite Direction the Air is Permitted to Pass Through Pipe (6) Into Chamber (7) and Then Out. A Reversed Blower (8) or Suction Pump, Driven by a 110 H.P. Motor, Which Sucks in the Air Through Chamber (9) Via Adjustable Baffle Plates (10), Creating a Cyclonic Action in the Area Between Baffle Plates (4 and 10). All the Paper and Refuse Is Sucked Up and Forced Through Pipes (11) to the Centrifugal Dust and Dirt Collector (12).

Vacuum Cleaning the Subway

A NEW invention which is about to be placed in operation in the New York subways, and which is warranted to clean the subways of dirt and dust, replacing the bad air with air which has been washed, deodorized, disinfected and otherwise made more wholesome, is now attracting attention. This immense cleaning device will be housed upon two adjacent motor-driven units on a train, or else will be driven by a motor unit through the subways at a rate of 12 miles per hour. At this speed it cleans not only the top and sides of the subway tubes, but the roadbed as well.

Analyzing the device, we could say in a few words that it is a cyclone producer and a pneumatic suction apparatus combined, and provided with additional auxiliaries for purifying and cleansing the air and collecting the dirt as well. In the first car a powerful blower is found, as our illustration clearly shows, near the front end. This blower sucks up air at the far end of the two-car unit, principally the air which has been partially or wholly purified and drives this with great force into one of two compartments, the particular compartment being the forward one, regardless of which way the train may be moving. A large flap valve in the pipe directs it to either compartment. This air is then expelled from the top, sides and bottom of the air compartment in all directions with much force, so that it is driven against the roadbed, side walls and roof overhead, disturbing each particle of flotative dirt. The blower, driven by a motor of about 75 horsepower, thus dislodges every particle of matter not floating in the surrounding structures.

Of course, the direction of this flow of air as well as its nozzle velocity is regulated by the operator of the train. It would be very unwise to have this air blown in all directions when the train enters a station as danger to passengers would be possible. Consequently, the baffle plates through which the air is exhausted are adjustable. They may either be left wide open or closed completely. The direction of the air flow is likewise regulated.

December Features in Science and Invention

Burning Water. By Joseph H. Kraus.

Automatic Radio Controlled Mail Planes. By H. Winfield Secor.

Remarkable Photos of Real Tornado.

What an Explosion Tells the Scientist. By Prof. Lindley Pyle.

New French Daylight Movies.

How to Use Your Camera. By Dr. Ernest Bade.

Awards to Prize Winners in "Combination" Contest.

Photography with Polarized Light.

Electric Tight-rope Walker.

Thief-trapping Booth for Banks.

Money in Ashes and Sawdust. By William R. Reinicke.

Mountain Air Piped to City.

Radio Tuning Devices and Circuits. By A. P. Peck.

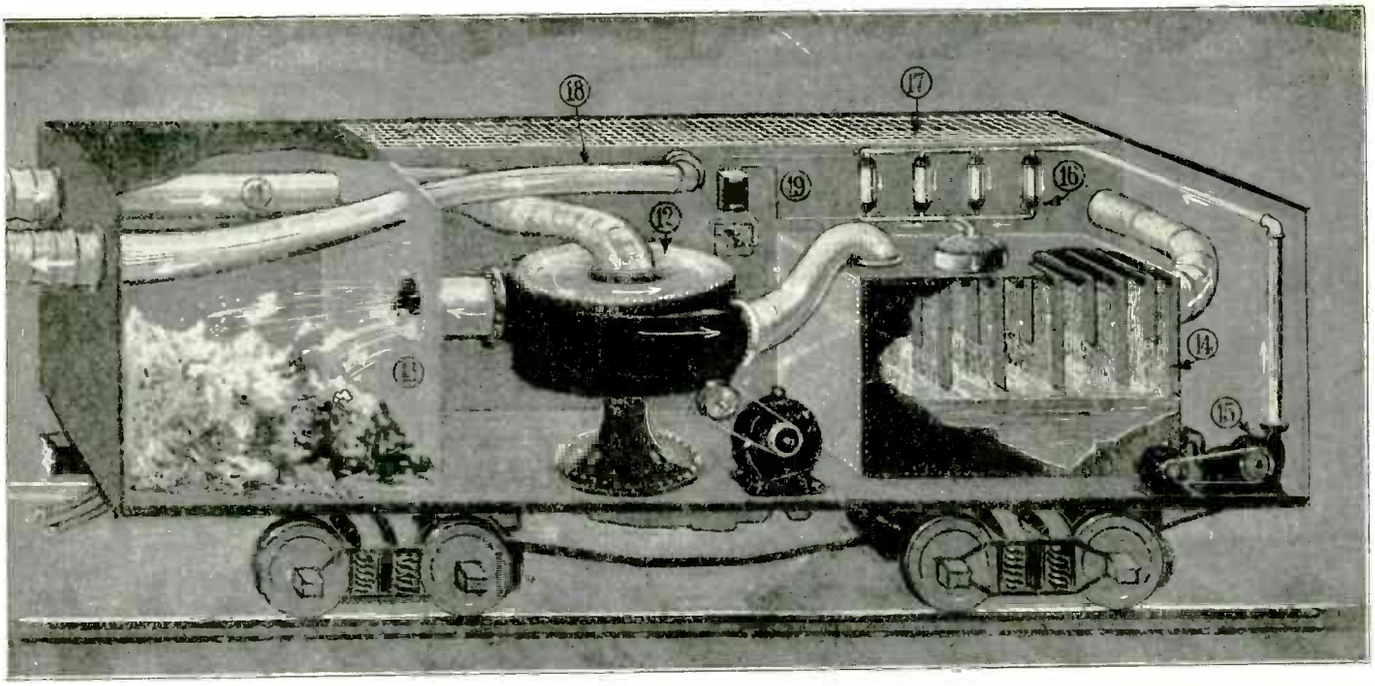
Between the two compartments which act as the distributing chambers for the compressed air source, is another compartment connected to a reverse blower. This, therefore, acts as an exhaust fan. It is driven by a 110-volt motor; similar nozzles permit it to pick up everything in sight.

It is evident that as the blower drives the air upon the tracks it creates a certain amount of air disturbance. This causes the dirt and dust to be cyclonically thrown all around. Following it is the opening of the suction fan conduit, the action of which fan picks up all the floating dirt disturbed by the compressed air. This suction is so powerful that it will pick up a whole Sunday newspaper and rip it to pieces in a few seconds. The contaminated dirty air now is forced through the blower and expelled from this car into a trailer car following it through flexible couplings. In this trailer car are centrifugal dirt collectors which extract the heavier dirt from the air. After this the air passes through a series of sieves to collect the finer particles of dust and following that, through an air washer.

If the humidity of the subway is quite high and it is not desired to increase this humidity the air is properly dried out before being permitted to escape by means of calcium chloride air driers. In the air washer a disinfectant may be placed, or ozonators subsequently used to free the air of any bacteria, simultaneously improving its healthful properties. Not only can the device be used for tubes or subways, but the roadbeds of railroads can be cleansed in the same manner. This will save railroad corporations the expense of having the roadbeds screened, which is done quite frequently at the present time.

Perhaps in the future we will be spending our nickel not for a ride in the subway, but just for a trip into a cooler atmosphere, free of dirt and dust.

The inventors of this unique system are Walter I. Smith and A. R. Burnett, who have organized a tunnel cleaning concern. They figure that the complete subway

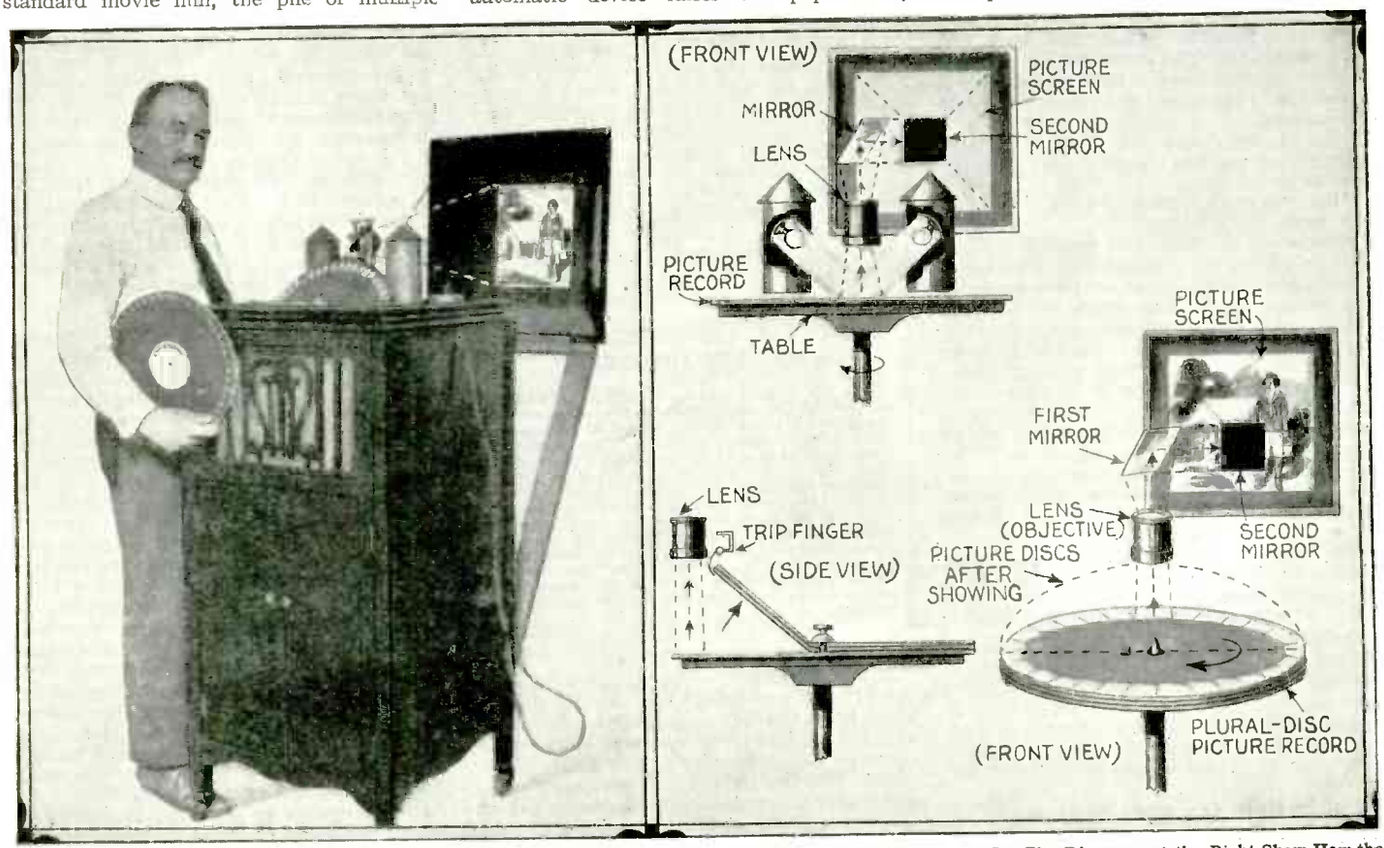


The Dirt Is Thrown Into Compartment (13) and the Air Itself Is Forced Through the Air Washer (14), Which Contains Water, to Which a Slight Amount of Disinfectant Has Been Added and Which Water Is Ozonized, After Being Pumped by Means of the Pump (15) Into the Ozonators (16), and Sprayed Into the Air-Washer. The Air Then Leaves the Air Washer to Enter Compartment (17) and Is Distributed Into the Subway Tube. A Portion of This Air Is Carried Back Again Through (18) to Feed Blower (2). The Electrical Controlling Devices (19) for the Ozonators (16) May Be Seen Upon the Wall. The Two Separate Cars Are Connected Together by Means of Flexible Pipes, as Illustrated. It Is Quite Obvious That the Minute Particles of Dirt Will Be Disturbed and Dislodged, Sucked Up by the Action of the Various Devices and the Air Itself Will Be Purified and Ozonated Before It Again Passes Into the Surrounding Atmosphere.

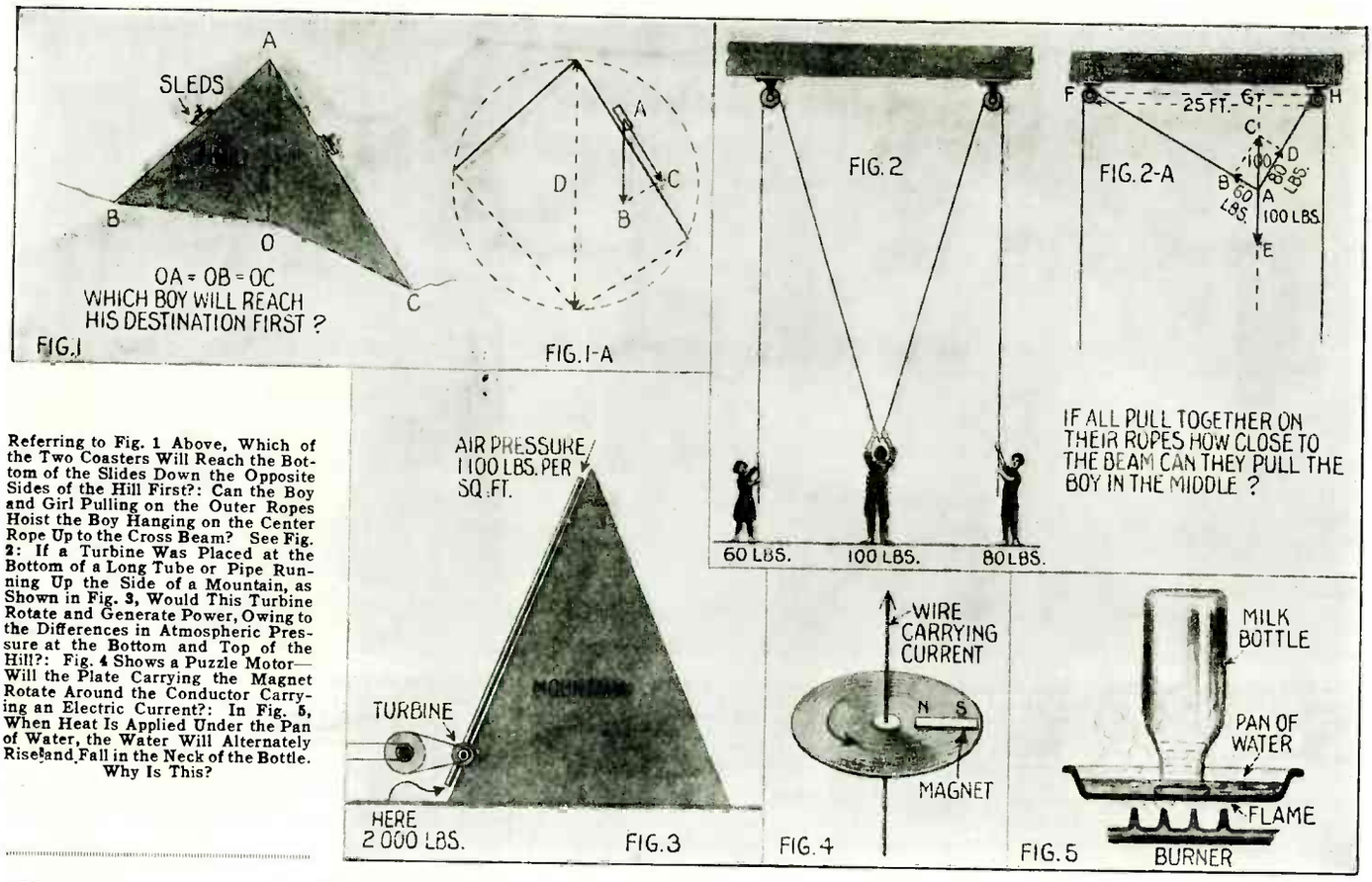
system could be cleaned once every eight hours. Such a thing as track walkers will be unknown, and there will be no hazard or loss of life when this cleaning device is in use. The first installation will cost about $30,000. The ozonating apparatus is, of course, not to be placed upon the first model, but will be a development of the original device.

A Movie-Phonograph

AMONG a number of other interesting inventions of C. Francis Jenkins, of Washington, D. C., is the combination movie-phonograph for the parlor here illustrated. The successive motion pictures are printed on flexible paper discs the same size as phonograph records, and to hold the equivalent of 1,000 feet of standard movie film, the pile of multiple discs need only be about ½ inch thick, the pictures being the same size as those on the standard films, approximately ¾ by 1 inch. A series of the paper discs are placed on the turntable, which is exactly like that in a phonograph, and after all the pictures on one disc, for example, have been projected, an automatic device raises the paper disc, exposing the one beneath it to be projected, and this action is repeated until the final picture on the last disc has been shown. The second mirror is introduced for making the final correction, due to the secondary arc travel of the pictures on the disc. A phonograph attachment for producing music can be operated simultaneously or separately.



The Newest Movie-Phonograph Is Illustrated Above With Its Inventor, Mr. C. Francis Jenkins, of Washington, D. C. The Diagrams at the Right Show How the Reflected Light From Two Small Lamps Is Caused to Reflect the Image Up Through the Objective Lens or to the First Mirror, Thence on to a Second Mirror and From That on to the Screen, Which Is Placed in the Top of the Phonograph Cabinet Lid. No Celluloid Film Is Used, the Pictures Being Printed on Paper, Any Fire Hazard Thereby Being Obviated.



Referring to Fig. 1 Above, Which of the Two Coasters Will Reach the Bottom of the Slides Down the Opposite Sides of the Hill First?: Can the Boy and Girl Pulling on the Outer Ropes Hoist the Boy Hanging on the Center Rope Up to the Cross Beam? See Fig. 2: If a Turbine Was Placed at the Bottom of a Long Tube or Pipe Running Up the Side of a Mountain, as Shown in Fig. 3, Would This Turbine Rotate and Generate Power, Owing to the Differences in Atmospheric Pressure at the Bottom and Top of the Hill?: Fig. 4 Shows a Puzzle Motor—Will the Plate Carrying the Magnet Rotate Around the Conductor Carrying an Electric Current?: In Fig. 5, When Heat Is Applied Under the Pan of Water, the Water Will Alternately Rise and Fall in the Neck of the Bottle. Why Is This?

Scientific Problems and Puzzles

By ERNEST K. CHAPIN

NO. 3 OF A SERIES

WHICH SLIDE WOULD BE MADE THE QUICKER?

TWO brothers, Tom and Dick, were out coasting. From the top of the hill down which they were sliding were two possible paths: one long and steep, the other somewhat shorter, and of more gradual slope. Both paths gave a straight slide from the top to their respective destinations.

"Bet I can coast the long steep side quicker than you can the short one," boasted Tom to his brother.

"Bet you can't," retorted Dick, and away they went.

Now when the boys had reached the end of their slides, they found that they were out of sight of each other, and consequently had no way of deciding which one was the winner. After disputing for some time, they went home and asked their father who he thought would win under such circumstances.

"Well," said he, "when we surveyed that hill last summer for the mining company, I happened to observe a curious fact which may help us to settle your argument. The top of the hill down which you coasted (see Fig. 1) and the ends of the two paths are all equally distant from a point directly below the top where you started."

With these facts in mind, and considering friction negligible, let us see if we can help them settle their dispute.

HOT AND COLD OBJECTS

Probably everyone has noticed that metal objects such as tools and metal door-knobs feel distinctly colder than non-metallic objects such as furniture and clothing. A thermometer, however, when placed in contact with these objects may register the same temperature. What explanation can you give for this?

HOW HIGH CAN THEY RAISE JOE?

Dad had just completed a dandy amusement device for his children. It consisted of a single rope hanging over a couple of pulleys attached, 25 feet apart, to a beam in the barn. Half way between the pulleys a second rope was attached to the first as shown in Fig. 2. "Now, then," he said to his children, "Mildred, you take hold of one end of the rope, John, you take the other end, and Joe can hang on to the middle one. Now if all jump up and down, throwing your weight on your rope you will have a splendid time sending each other flying into the air, and pulling each other up toward the roof."

"Oh, good," screamed Mildred. "John, I'll bet that if we pull together on our ropes we can haul Joe up to the top and bump his head on the cross-beam. Just for fun, let's do it."

"LOUD TALKER" CONTEST CLOSING DATE ADVANCED

In our August issue of SCIENCE AND INVENTION, we published the announcement of our Loud Talker Contest, and offered five prizes totaling $100.00. This contest was scheduled to close the 25th of September, but as we have only received a few letters, and believe that many readers no doubt have not been able to comply with the rules of the contest in building an efficient apparatus in time or in writing an article describing the instrument, etc., we herewith announce that this "Loud Talker" Contest is to be extended for a period of two months, or to *November 25th*. See August issue for details.

Now the question we would like to raise is: can Mildred and John together raise Joe up to the beam to which the pulleys are fastened; and if not, how close can they make him come to it? Mildred weighs 60 lbs., John 80 lbs., and Joe 100 lbs. To make our problem definite, determine the distance, below the beam, of the point where Joe's rope is attached, when the weight of all three children hangs on the ropes.

THE ATMOSPHERIC ENGINE

A hot dispute was started the other day in a tourists' camp out West when one of their number asserted that a great quantity of free energy could be obtained from the atmosphere by merely running a long pipe up the mountain, and connecting a turbine somewhere along its course, see Fig. 3. The author of this ingenious device explained that the pressure of the atmosphere at the base of the mountain was 2,000 lbs. per square foot, while at the top it was only 1,100 lbs. per square foot. This great difference in pressure, he asserted, would force air upward through the pipe and yield an indefinite quantity of energy by operating the turbine. What fallacy did the tourist overlook?

WILL HIS MOTOR RUN?

An inventor once planned to make all existing forms of electrical motors obsolete by introducing one of a new and better design of his own. He knew that a pole of a magnet experiences a sidewise push when in a magnetic field. He knew, also, that the field around a wire carrying a direct current is circular, of considerable strength near the wire but very weak at any great distance away. A N-pole placed in such a field tends to rotate in one direction around the wire while a S-pole tends to rotate in the opposite direction. So much he knew, and it is all very true indeed. "Now," thought he, "if I place a magnet on a plate free to rotate about its center through which a wire passes perpendicularly, surely the magnetic field about the wire will push the harder on the pole that happens to be nearer the center. By placing the magnet perpendicular to the wire it is evident that one pole will be in a much stronger field and will, therefore, make the plate turn around and around."

It was upon this principle, illustrated in Fig. 4, that he intended to design his motor. Would it work; and if not, why not?

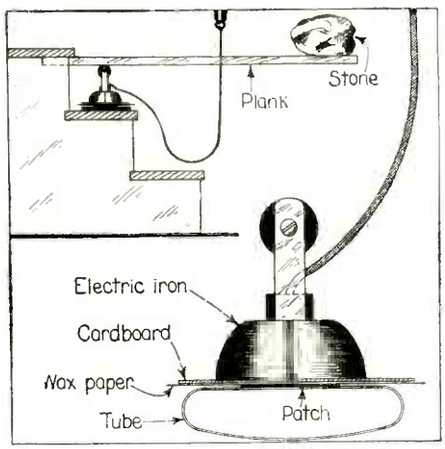
(*Continued on page* 703)

MOTOR HINTS

FIRST PRIZE $25.00

VULCANIZING WITH A FLAT-IRON

An easy method of vulcanizing a patch quickly and cheaply is outlined below and in the illustration. According to the drawing an electric flatiron is used. This is not necessary, however; any flatiron may be used.



Vulcanizing With an Electric Flatiron—It's Simple.

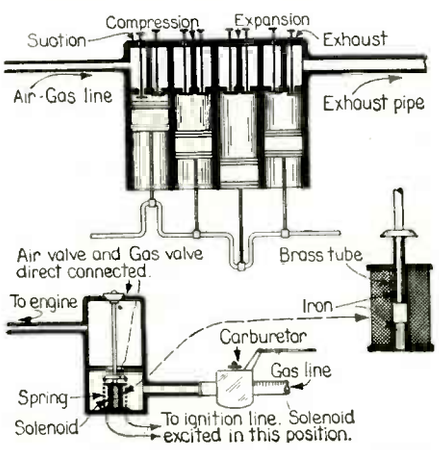
First clean and scrape the place to be patched thoroughly. Then apply a little vulcanizing cement, and over this put the patch. Pound this so as to exclude all air bubbles. Next apply over the patch a sheet of waxed paper. Over this put a piece of cardboard with an opening in it the size and shape of the patch, with the opening directly above the patch. If an electric iron is used, it must be heated before applying, the same as any other. The iron should be heated so that when moisture is applied, it will hiss and yet run off in globules. If a flatiron with a removable handle is used, it may be applied without the handle and with the weight directly upon it. Otherwise it should be arranged according to the diagram. This should be left on for twenty minutes. Upon removing the iron a well-finished patch will result.

Contributed by R. W. S.

SECOND PRIZE $15.00

FUEL ECONOMIZER

Motorists familiar with internal combustion engines know that as long as their engine is rotating, whether applying power in driving up-grade or with ignition turned off and gears in mesh and clutch in, driving down grade, fuel is used in amount equal to the travel of the cylinder pistons on the suction stroke. In the first case fuel is necessary in order to make the grade, whereas in the latter case it is wasted in being expelled through the exhaust as unburnt unused gasoline. In the former the engine does the work, in the latter the gravity action on the car on down-grade turns the engine without fuel or power being applied. The mechanism here shown will eliminate this waste and be a saving to the driver in gas.



A Magnetically Controlled Fuel Economizer Valve, Which Cuts Off the Gasoline Supply When Coasting Down Hills, etc.

Referring to the diagram shown, for every complete rotation of the crank shaft one full cylinder of gas and air mixture is used, whether exploded or not, the same following its regular course and passing out through the exhaust. With a magnet valve chamber as shown, only air would be drawn into the cylinders when ignition is turned off. A double-head piston valve, one at the air inlet, the other at the gas, direct connected, would permit the flow of gas in applying power and of air in going down grade with ignition off. With ignition on, a flux is obtained in the field surrounding the soft iron magnet, thus causing induced magnetism and pulling the air-head down, closing that inlet, also pulling the gas mixture-head down, opening that inlet against the compression spring. The reverse is true with ignition turned off when the magnetism is reduced or lost, and the compression spring forces the piston valve up, closing the gas inlet and opening the air. The solenoid can be connected to a switch of its own or else to the ignition switch.

Contributed by C. G. Lloyd.

[Editor's Note:—*Ignition should not be turned off while descending grades "on compression," as the muffler is liable to be blown to pieces, owing to the unburnt charges in the muffler being fired when the ignition is again turned on.*]

NOTICE TO CONTRIBUTORS

KINDLY note a change in this contest. For the coming months we would like to receive from our contributors articles on the following subject:

ELECTRICITY ON THE CAR

We believe that there are hundreds of new electrical ideas that can be incorporated in the car that our readers would like to know of. What we are particularly interested in are novel stunts, new devices, new kinks, and new hints made possible by the electric current.

In order to win a prize the first requisite is that the device or suggestion be practical. The term PRACTICAL will be the keynote of this contest.

You will be more apt to win a prize if you will design the device yourself, and make a photograph of it, sending the same to us. Ideas are all right, but the reader wants to see that the device actually has been made, and WORKS.

The following prizes will be paid:

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

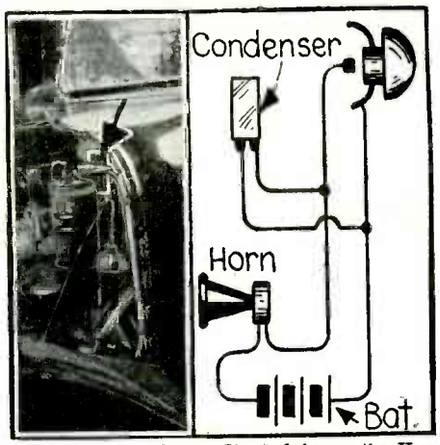
All other accepted articles which win no prizes will be paid for at the rate of $1.00. Each article submitted should not be longer than about one hundred to two hundred words.

Address all manuscripts to EDITOR "MOTOR HINTS," care of this publication.

THIRD PRIZE $10.00

CONSERVING THE HORN BUTTON

The motor-type horn pulls heavy currents on starting and when blown but for an instant causes sparking in the button that shortly causes it to make poor contact. After two buttons were ruined in this manner on a friend's car I cured the trouble by simply mounting a small telephone condenser on the back of the dash and connecting it across the horn button. This works perfectly, there is barely a trace of a spark at the button and quick response is always had from the horn, due to the contacts remaining clean and unburnt.



A Telephone Condenser Shunted Across the Horn Button Wires Saves Burning the Contacts.

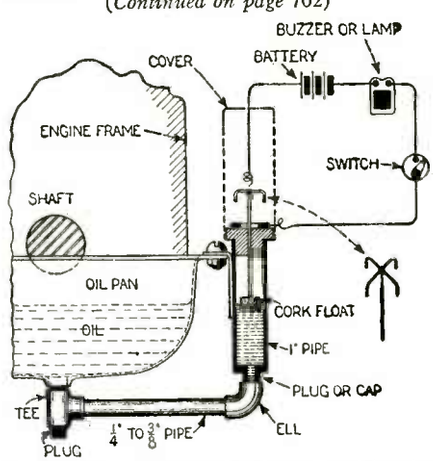
Contributed by Thomas W. Benson.

LOW OIL ALARM

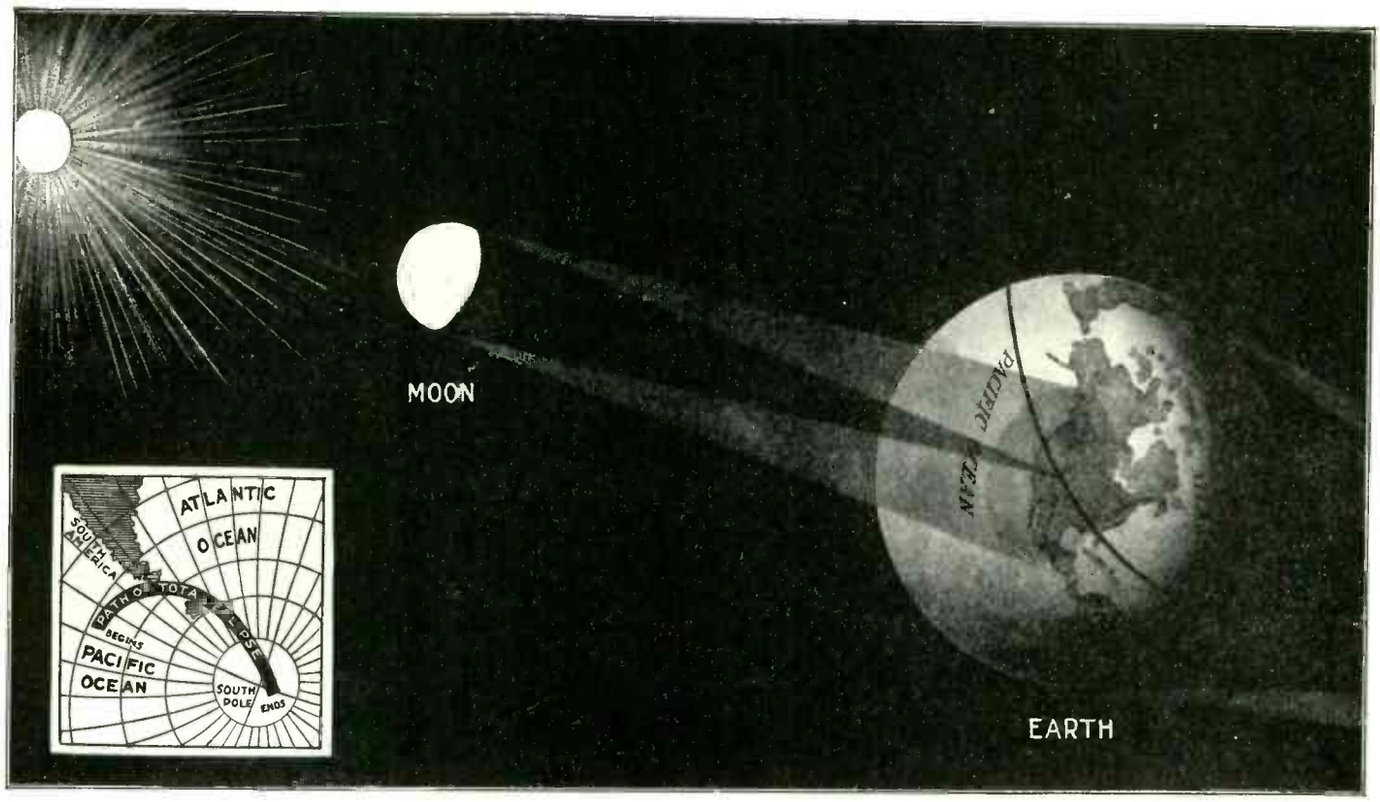
Frequently automobile engine bearings are burnt or scored due to the driver having neglected the oil in the engine, or in some cases, such accidents happen due to a sudden leak developed in the crank case. By means of a simple attachment here shown, a low oil level will at once indicate this fact by an alarm or by sounding a buzzer.

The auxiliary oil chamber can be constructed from a piece of 1-inch brass pipe, or else a piece of ordinary 1-inch iron pipe. The lower end is closed by means of a threaded cap or a metal plug driven in tightly and sweated with solder. The plug or cap has to be drilled and tapped to accommodate a ¼-inch pipe elbow, as shown in the drawing. This ell connects with a piece of ¼-inch brass or pipe to a tee fitting, screwed in the opening in the bottom of the

(*Continued on page 702*)



Automatic Electric "Low Oil" Alarm—a Practical and Valuable Idea.



In Regard to the Sphericity of the Earth, the Point Mrs. Lewis Makes in Connection With Total Solar Eclipses Is: The Position of This Dark Shadow Path on the Earth's Surface, Its Width, Length and the Duration of Totality as Seen from a Point Within This Path Are All Circumstances Computed by Astronomers from Formulas Based on the Assumption That the Earth Is Round, That It Is Rotating at a Certain Rate and That the Sun and Moon Are at Certain Distances from the Earth and of Certain Sizes. If These Assumptions Were Wrong, the Path Would Not Be as Shown. It Is an Unanswerable Argument. Some of These Paths Are Curved More Than Others, Especially in Polar Regions. See Insert Chart at Left Showing Path of Eclipse Visible Near South Pole. You Could Not Possibly Get Such a Curved Path on a Flat Earth. The Very Fact That It Is More Curved at the Poles Shows This. It Is Well to Note Also That Eclipses Have Been Observed in Polar Regions.

Popular Astronomy

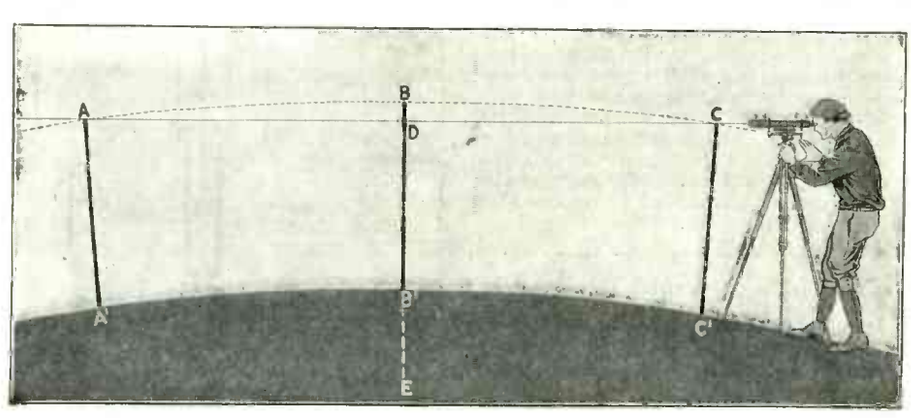
By ISABEL M. LEWIS, M.A.

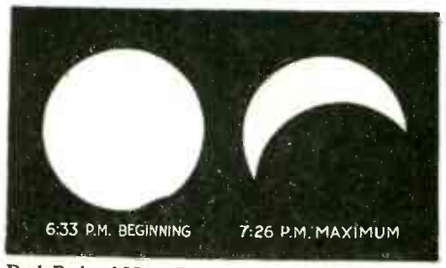
OF THE U. S. NAVAL OBSERVATORY, WASHINGTON, D. C.

Is the Earth Flat or Spherical? A Challenge to Flat-Earth Theorists

THE earliest recorded belief regarding the shape of the earth is the one that is naturally held by an uninformed child or an uneducated person of the present day who is not sufficiently advanced mentally to comprehend the more or less obvious proofs of the sphericity of the earth. Just as an ant on a large globe ten feet or so in diameter would see his small world as a flat surface, so the tribes and nations of all lands from earliest antiquity down through the middle ages saw the earth as a great, flat plain surrounded by lofty mountains, by a boundless sea or enormous ice barriers, according to their fancy, which was determined largely by their geographical position. The heavens above were generally considered to be in the form of an inverted dome revolving about the earth, which was, of course, the center of the universe, and in this dome were set like jewels the sun, moon, planets and stars fashioned, of course, for man's special benefit. So the masses believed. Down through the ages we find here and there a few men of greater intellectual caliber than their contemporaries getting imperfect glimpses or visions of the truth, though when they had the courage to express their views history tells us they were usually either regarded as harmless lunatics or punished with imprisonment or death. Anaxagoras was threatened with death and banished for teaching that the sun was a ball of fire; Giordano Bruno was cast into a dungeon and finally burned at the stake in the year 1600 for his heresy in believing that the earth went around the sun, and Galileo was taken before the Inquisition and forced to recant in 1633 his belief in the Copernican theory that the sun and not the earth was the center of the universe.

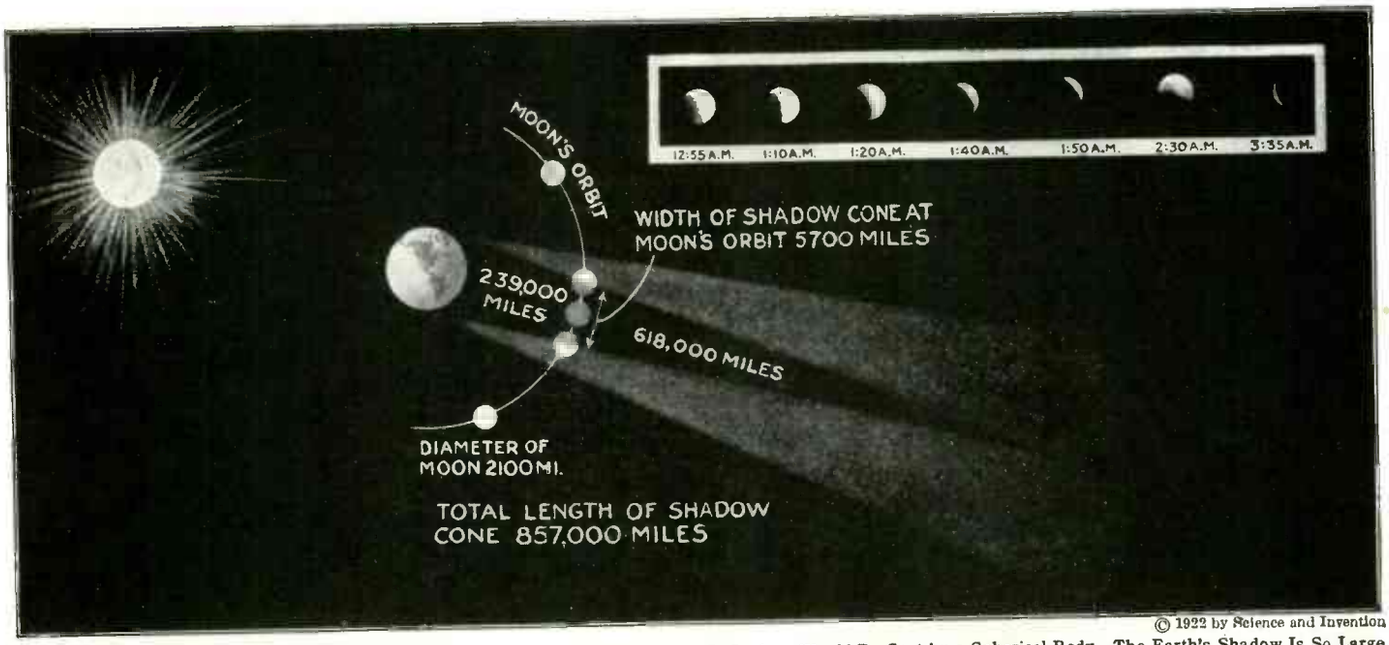
The most obvious difficulties that faced the believers in flat-earth theories were: to explain how the sun got around from the west to the east each night in time for its rising on the following morning; to account for the changes in position of the sun, moon and planets with respect to the earth and one another; to explain the cause of eclipses, the precession of the equinoxes and, when refined astronomical measurements revealed their existence, the nutation (nodding) of the earth's axis, the aberration of light and the parallax of





Dark Body of Moon Passing in Front of Sun Causing a Solar Eclipse. Note That the Moon Is Round and Stands Out Like a Ball.

Left: On a Level Plain Erect Three Rods in Line One Mile Apart and Cut Off the Tops at the Same Level, Using a Surveyor's Level. The Line Joining AC Will Then Pass Eight Inches or 2/3 Foot Below the Top of B When the Correction Is Applied for Refraction. The Diameter of the Earth Can Be Calculated From This Value Carefully Measured.



The Shadow of the Earth Cast Over the Moon as It Passes into the Earth's Shadow Is Such as Would Be Cast by a Spherical Body. The Earth's Shadow Is So Large at the Point Where the Moon Enters It That Its Circular Shape Is Not Very Pronounced but It Is Roughly Circular Though Very Hazy. See Insert Photo of Total Lunar Eclipse Above. It Takes the Moon Between Two and Three Hours to Pass Through the Earth's Shadow.

the stars. The last two are, of course, sufficient proof in themselves that the earth goes around the sun. All of these phenomena are readily explainable on the assumption that the earth is a sphere, slightly flattened at the poles, rotating on its axis and revolving around the sun in the same manner as the other planets, and they cannot all be satisfactorily explained on any other assumption.

To establish these facts beyond the shadow of a doubt was the work of some of the greatest intellects the world has ever known; chief among these were Copernicus, Kepler, Galileo, Newton, Bradley and, later, the great mathematicians and astronomers La Grange, La Place, Bessel, Le Verrier and Adams. Our wider vision of the universe of the stars, to which our sun belongs and in which it is but a single star, was given to us in more recent times through the discoveries of the modern astronomers dating back as far as the days of the Herschels. The wonders of the New Astronomy, as it is called, have been disclosed to us through the perfection of the telescope and, in later days, with the aid of the spectroscope and the photographic plate.

The brunt of the opposition of an ignorant, incredulous and intolerant world to a theory that removed man from his cherished hub of the universe and placed him in his proper position on a tiny world in a vast solar system, which was later found to be but a single unit in a universe of unimaginable grandeur, was borne by Galileo instead of by the originator of the theory, Copernicus, who lay on his deathbed when the first volume of his monumental work was handed to him.

With his first crude telescope Galileo discovered the mountains on the moon, the phases of Venus, which he had predicted in accord with the Copernican theory, and the four satellites of Jupiter. It is recorded that a friend, writing to Galileo of the discovery of the phases of Venus, remarked that even the most obstinate must now be convinced. To this Galileo replies in the wisdom of his greater experience: "You almost make me laugh by saying that these clear observations are sufficient to convince the most obstinate; it seems you have yet to learn that long ago the observations were enough to convince those who are capable of reasoning and those who wish to learn the truth; but to convince the obstinate—not even the testimony of the stars would suffice were they to descend on earth to speak for themselves."

The success of the early explorers in circumnavigating the world probably had as much to do with convincing the skeptical that the earth was round as the efforts of the astronomers. Yet, strictly speaking, circumnavigation is not in itself sufficient proof of the sphericity of the earth. It proves simply that the earth is a convex body, as does also the old familiar argument that ships at sea disappear from view, hulls first. A lemon-shaped or banana-shaped world could be circumnavigated as readily as a spherical world and, as a matter of fact, we know from geodetic surveys and from pendulum experiments which give the force of gravity in different parts of the world that the earth is not a perfect sphere, but an oblate spheroid, and is a sphere slightly flattened at the poles. Incidentally this flattening of the earth is an effect of the earth's rotation on its axis and an excellent proof of it, were any proof needed in addition to Foucault's famous pendulum experiment or the experiment with the gyroscope which demonstrate the earth's rotation beyond doubt to a person of average intelligence.

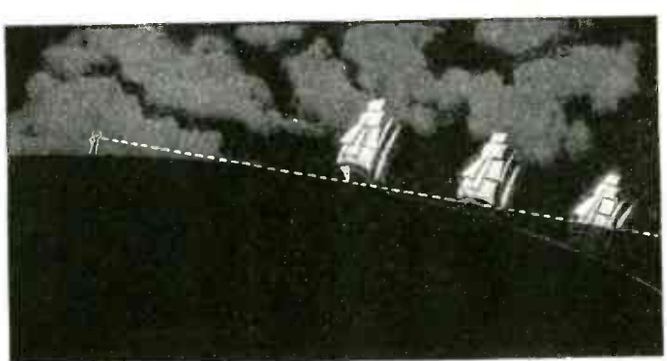
The flattening of the earth at the poles, or its oblateness, is very slight. It makes a difference of twenty-six and a fraction miles between the equatorial and polar diameters of the earth as determined from geodetic measurements of arcs of the earth's surface in different lands. On a sphere eighteen inches in diameter made to represent the earth the difference between the equatorial and polar diameter would amount to only one-sixteenth of an inch, and would be almost inappreciable.

As far back as 250 B. C. we find that Eratosthenes of Alexandria undertook to determine the size and shape of the earth by a method that was in principle the same as is now used in geodetic surveys of the earth. He observed that at noon of the longest day of summer at Syene in Upper Egypt there was no shadow at the bottom of a well, the sun being then vertically overhead. At Alexandria, however, on the same day of the year, the gnomon showed by the length of the shadow that the sun was 7° 12′ from the zenith. This, then, was the difference in latitude between Alexandria and Syene. The distance between the two places was then found by actual measurement to be 5,000 stadia. Having found the distance between the two places, both in arc and in linear measurement, the circumference of the earth follows directly from the proportion 7° 12′ : 360° : : 5,000 : x, in which x is the circumference expressed in stadia. The circumference of the earth as determined by Eratosthenes was, then, 250,000 stadia. Unfortunately, Eratosthenes fails to state which one of the many different kinds of stadia he employed in his measurements, so we cannot tell how closely he approximated to the true dimensions of the earth. Once the circumference is found the diameter of the earth is obtained by dividing the value for the circumference by π, the ratio of the circumference to the diameter.

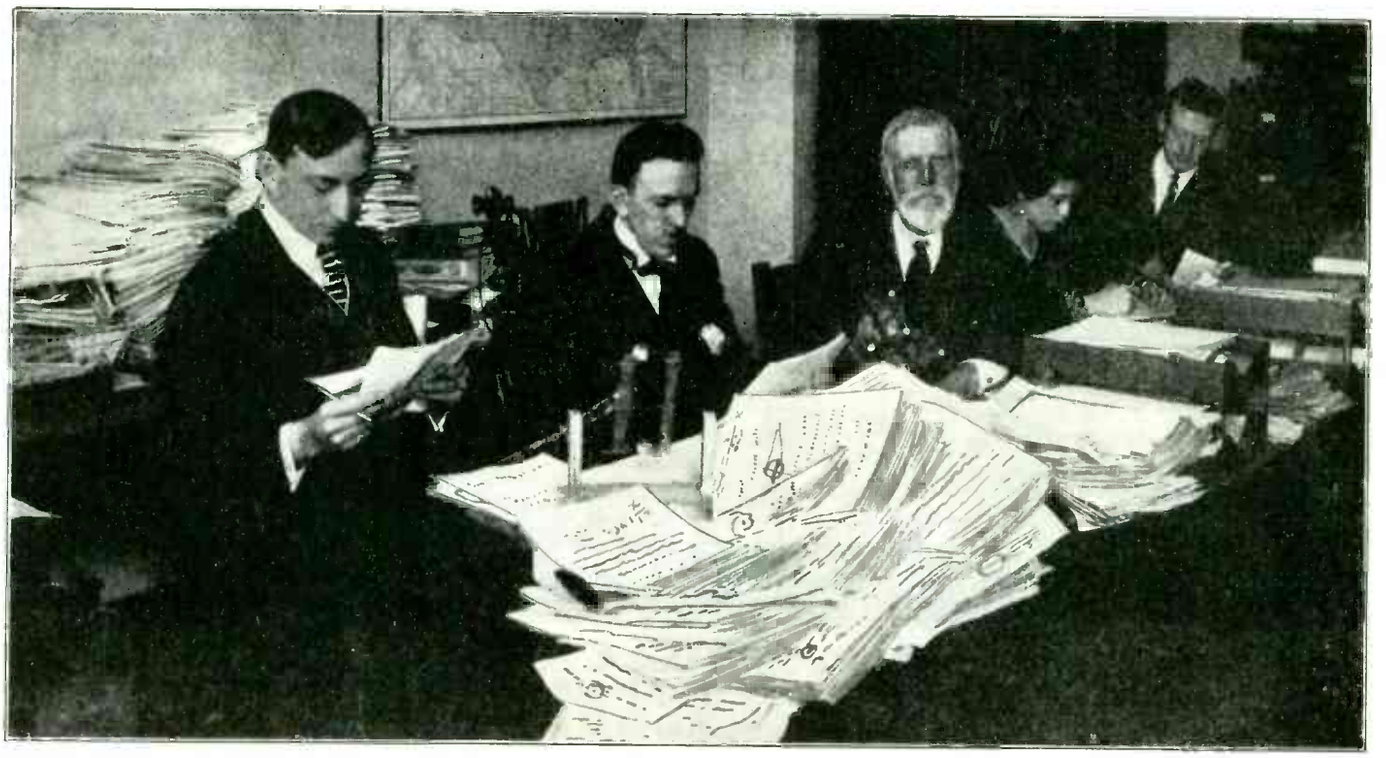
Many arcs of the earth's surface have been measured in modern times. The first measurement of any value was made by Picard in France in 1671 and it was the value of the earth's diameter obtained from this measurement that Sir Isaac Newton used in his well-known computation showing that the moon is held in its orbit by the gravitational attraction of the earth.

Among other measurements of arcs for determining the size and form of the earth we may mention that of the great Russo-Scandinavian arc more than twenty-five degrees in length extending from Hammerfest to the mouth of the Danube, the Indian arc about eighteen degrees long, the Anglo-French arc more than twelve degrees in length, and at least a score of other arcs in different parts of the world. These measurements have demonstrated the fact that

(*Continued on page 676*)



Illustrating the Well-Known Experiment Taught in the Schools and Which Tends to Prove That the Earth Is Round, Wherein We See First the Hull, Then the Sails, and Finally the Topmast Disappear from View as a Ship Sails Out to Sea. As Mrs. Lewis Points Out, This Very Interesting and Practical Experiment Does Not, However, Necessarily Prove That the Earth Is Round, Although It Does Prove That It Is Curved Instead of Being Flat.



The Task of Awarding the Prizes for the "Perpetual Motion" Contest Was Nearing Completion When This Photograph Was Taken. The Reader May Obtain a Slight Idea of the Immensity of This Problem by Glancing at the Mass of Literature on the Desks. Every Letter Was Given Full Consideration and After the Weeding-Out Process, Ballots Were Secretly Cast. The Awards in Every Case Were Unanimous. From Left to Right the Judges Are: H. Gernsback, Editor; H. Winfield Secor, Associate Editor; Dr. T. O'Conor Sloane, Associate Editor; Miss A. M. Buschen, Secretary, and Joseph H. Kraus, Field Editor.

"Perpetual Motion" Prize Contest Awards

WERE we in a position to award a prize of $50.00 to each of the sixteen thousand eight hundred and four contestants, we would gladly have done so. The answers which we received to the three problems given in the August issue of SCIENCE AND INVENTION MAGAZINE, and which problems are reproduced here, were very worthy indeed. In fact some were so clever that the decision in favor of the winners required more time than was anticipated. Many of the letters for this contest were written in pencil, a great many more were typed, but most of the communications were in ink. Drawings accompanied about twenty-five per cent of the replies.

Some contestants gave quite a fair explanation of the reasons why the various ingenuities would not work, and then set about explaining how the machines could be changed to make them operate, the latter explanations being as wild as the inventors' dreams. In cases such as these, the second portion of the letters was disregarded. Then again another group claimed that they had built perpetual motion machines which actually operated, and when we inquired as to photographs and further specifications, we were informed that the machines had been destroyed, when the inventors found that no prizes were being awarded for such devices. At least three hundred readers informed us that they had made several attempts at building machines which could run until they wore out. Seventy-five per cent of these had at last given up the quest for such a machine, but the other twenty-five per cent are even today busily engaged in designing and erecting motors which would forever solve the problem of the ages.

Some of those submitting manuscripts to this contest, gave us this information as a qualifying reason for their entrance into the contest. Although we would like to see all of the inventors develop a working model of a machine which will run, even for a week, without requiring power to operate the same, we are positive that they are spending both time and money in a hopeless pursuit; in fact, it promises as fair a return as an attempt to locate the pot of gold at the foot of the rainbow. Furthermore, such information, if given, would ordinarily tend to disqualify rather than make the writer more eligible for a contest of this nature. But as stated before, our contests are free and open; they contain no disqualifying or qualifying clauses, and as many entries may be made as desired. Each particular letter is judged for its own merits, and additional information to what is in those letters is barred in the weighing of the value of the particular explanations. Some readers took advantage of these facts and entered as many as fifteen explanations for each individual problem.

From some standpoints this contest was extremely amusing; some of the explanations were cleverly worded in the form of poetry; others appeared in blank verse; still others entered the ring incognito. Then again some of our contributors assigned characters into their explanations, making it appear that a father was explaining to his son the reason the perpetual motion devices would not operate. Then there were a few Hicksville effects in Yankee dialect, which were extremely comical, as was a Dutch and a Swedish impersonation. All of these explanations were very good.

A piece of blank verse submitted by an unknown author who answered all the problems in the same manner as he or she introduced him or herself, is given herewith.

TO THE SAGES

Masked,
I enter the Lists
To solve the problems
of the Ages.

Unknown,
Unnamed
Let me strive.

Winning,
To claim my laurels anon.

Losing,
To pass forgotten
Into the Silences.

Adieu

SECRETUS.

Perhaps it ought to be "Secreta," for the author may be a "she." At any rate he, or she, will know that we have not entirely forgotten.

There were eighty-four medical doctors who submitted explanations; twenty-one chiropractors; hundreds of college graduates, and many high school and public school teachers. The ladies showed a more marked turnout in this contest than in any other heretofore presented, there being three hundred and fourteen contestants of the fairer sex. Every one of these answers given by the girls was good, in fact their average rating was higher than the rating obtained by the men.

THE AWARDS

In awarding the prizes of $50.00 to the prize winner of each of the three problems, the judges cast their votes secretly. It may be well to mention here that in each award the opinion was unanimous.

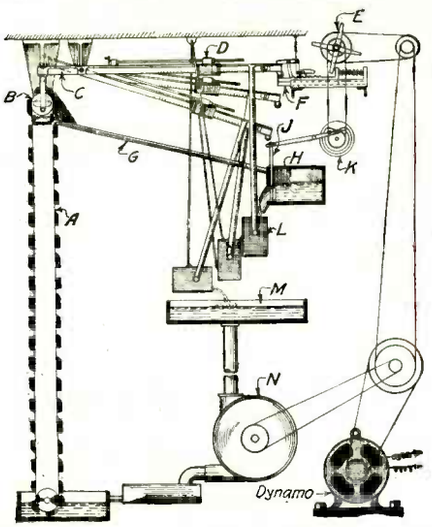


Fig. 1—According to the Inventor This Machine Is Supposed to Operate as Follows: The Endless Chain of Buckets A Are Filled With Water. They Turn on a Drum Fitted With a Crankshaft B Counterbalanced by Weights D Acting Through the Levers C on the Crankshaft. When Cam K Turns Water from the Reserve Tank H Is Permitted to Fill the Bucket L. This Rotation Also Causes E to Move Releasing the Trip at F. The Bucket L Now Moves Downward and at the End of Its Movement Tips Over, the Water Being Received in Trough M and Operating Turbine N, Which in Turn Drives the Dynamo. Water from the Endless Chain of Buckets Passes Down G to Fill the Reserve Tank Again. Read Now Why the Outfit Can't Work.

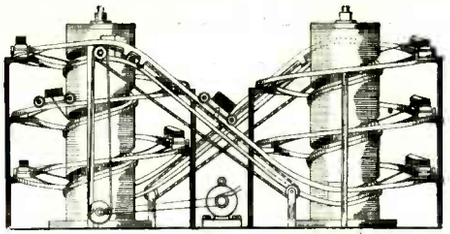


Fig. 3—The Inventor of This Device, Which Was Actually Patented, Reasons Thus: Five Cars Traveling Down a Long Spiral Track Should Surely Lift One of Those Cars Up a Relatively Short Rising Track. He Therefore Links the Descending Cars to a Drum, Motion From Which Is to Be Imparted to a Chain for the Purpose of Lifting One of the Cars Again. At First Glance This Reasoning Sounds Plausible; Then We Take Another Look and See That the Device Is Nothing More or Less Than an Attempt at Perpetual Motion. Our Readers Analyzed the Problem and Won a Reward.

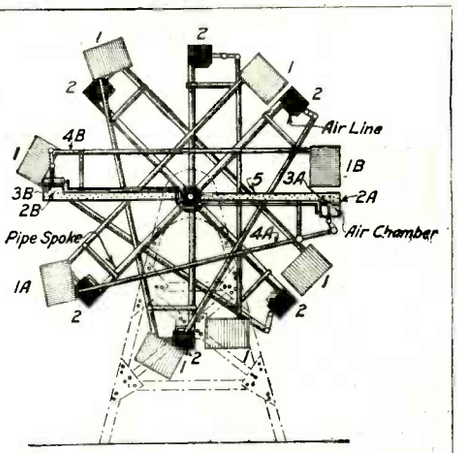


Fig. 2—The Picture of This Machine Was the Subject of the Cover Design in the August Issue. Here 1 Represents Weights, 2 Are the Cylinders in Which Pistons 3 Operate Through Levers 4. In This Diagram It Is Seen That the Piston 3A in Cylinder 2A Is Being Forced Upward by Weight 1A, Acting Through 4A Compressing the Mercury in This Piston and Forcing It Through the Tube 5 to Cylinder 2B. The Piston 3B Is Being Lifted Upwardly Forming a Partial Vacuum on That Side of the Machine, Caused by the Weight 1B Descending and Acting Upon the Piston 3B Through Levers 4B. The Reason That This Machine Cannot Operate Is Explained by Several Readers.

FIRST PROBLEM (PRIZE $50.00)

The first prize for the first problem, that is the machine with the water buckets, is given to Mr. W. C. Nicholson, of No. 431 S. Taylor Ave., Oak Park, Ill. Mr. Nicholson is now $50.00 richer. At the price at which used automobiles are selling at the present time, he could purchase about a half a dozen cars and start in the business of handling the same. In this problem many of the readers overlooked the fact that, as designed, the buckets on the endless chain could under no circumstances be balanced, except for a maximum of one-half turn of the crank shaft. Mr. Nicholson's explanation follows:

In this device I take it for granted that the inventor intends the crank shaft B to be a four arm crank shaft, similar to the crank shaft in a four cylinder automobile engine. This is not clearly shown in the sketch, though this would be the only or at least most plausible combination to produce a complete revolution by weights. It becomes apparent that when the operator proceeds to balance this chain of water-filled buckets, he must place the sliding weights D on the lever or levers C, that are intended to be on the *down stroke*, in such a position that they can both balance the water in the chain of buckets and the other levers with weights and buckets attached that are on the *upward stroke*. To get this desired balance the weights on the arms first mentioned, must be heavy enough and moved far enough toward the bucket end that they will balance both the water and the other arms in their upward movement. That would require the weights on these upward arms to be placed back near the fulcrum point to obtain the required balance.

Now if the machine is balanced as above specified, which is the only way a machine of that description could be balanced, it would operate as indicated until the long weighted arms reached the lower positions of their movement and there it would stop, until the weights were shifted up the inclined lever arms and a readjustment of balance established. The power consumed in the readjustment of these weights would offset any advantage gained by the other parts of the device. If the weights on the lever arms were all placed equally distant from their fulcrum point the result would be that they would simply balance themselves, and the weight of the water in the chain of buckets would reverse the intended operation of the machine until all the buckets were emptied into the lower reservoir.

FIRST HONORABLE MENTION
(First Problem)

The first honorable mention goes to Mr. Milton L. Braun, of 66 Spruce St., Asheville, N. C. Mr. Braun nearly won this prize, so we would suggest to him that he compete in our future contests. His explanation is given below.

Thanks to my high school course in physics I have never fallen victim to any perpetual motion device, but, on the other hand, I have been interested in the queries and schemes on the subject printed in your and other magazines, from the standpoint of picking out some of the fallacies, most of which are usually pretty close to the surface.

Though not perpetual motion, the following scheme is so near it, and so novel, that I'd like to pass it on to you. Out in China (my work is in connection with a mission school in China) the people realize that their donkeys cannot pull much load unless they are reasonably fed, although they may keep the animals quite alive on a few handfuls of straw per day. A Chinese student with a half-baked knowledge of Western science proposed a method of conserving the strength of his father's animals. In the cart was to be an electric motor or dynamotor. Being belted to one of the cart wheels, power was to be generated as the donkey pulled the cart down the road. Only a small fraction of this power was to be used in lighting the cart at night: the bulk of it was to be applied to the other wagon wheel so that the donkey would have no pulling to do, his main use being to guide the cart and to keep up the proper appearance of carts on a Chinese road. Under these conditions he could conserve donkey feed. How wonderful and how magic is an electric motor.

One main objection to the working of your Fig. 1 scheme is the apparent disproportionate weight of water to be lifted by the water in bucket L. If one motion of the lever, i.e. one L bucket, empties even three or four of the chain buckets, the raising of the remainder of the chain is involved. If the weight D is supposed to do this, how is the D, or neighboring D's, to be lifted having once fallen? The other L buckets are evidently to furnish this power. In other words, D and empty L bucket on one arm of lever equal weight of chain full of water. When part of that chain of water is transferred to bucket L, this arm of the lever must not only raise the chain, but also must raise the equivalent of another chain in the neighboring levers with their weights and empty buckets. And the chain buckets are ever filling! If a gear arrangement were used at B so that half the buckets attached to chain were emptied by one down stroke of lever the problem of raising the weights would still be present. It must be remembered that the falling L bucket, as it makes its arc toward the pivot of the lever, decreases its pulling ability. Then, under these conditions of equilibrium, there would not be enough force present to operate the trips to empty the L buckets. While ordinary friction is negligible the weight of an L bucket of water bearing down on trigger F is a decided retarding factor, as also is the compression of spring in releasing trigger. The dead stopping of chain and levers while each L bucket is being filled means the constant overcoming of inertia.

SECOND HONORABLE MENTION
(First Problem)

Mr. J. Harris Hardy explains this same problem in the following manner. Mr. Hardy hails from Crawford, Miss.

In Fig. 1 the inventor is very clever in his theory of exactly counterbalancing the buckets and their contents by a system of weights connected to the crank shaft. Now everything moves smoothly until the weight reaches the end of its movement, but right at this point it is necessary to have the weight returned to its first position. To return this weight requires the same amount of energy which was just liberated while it was traveling downward. But there is no extra energy in sight. He then places two other weights on the crank shaft with which to replace the first weight, and also to continue the work of counterbalancing the chain of buckets.

These extra weights, however, will only replace the above weight a fraction less than half-way, and also carry on their work of counterbalancing the chain of buckets and their contents. The spillway G and the reservoir H, in connection with the buckets L and the trough M and the turbine N are all means of further deception.

If he fills up the tank H and the buckets L and the trough M, as well as the standpipe and the turbine with water, there is a great deal of outside energy placed there which he can call on until it is expended. The whole of the water system from the point B, where it flows over the crank shaft to the reservoir at the bottom of the buckets, is filled with lost energy. Remember that a given amount of water requires just exactly the same

(*Continued on page* 685)

The Amateur Magician

By JOSEPH H. KRAUS

PROFESSOR Henri Hargrave had returned from a vacation at his summer retreat at Miami, Florida, and a week or so after his arrival, I was ushered into his presence in his palatial Long Island home. After we had exchanged confidences, and he had thanked me for letters from various magicians which I had turned over to him, he beckoned me to a chair, and excusing himself for a few moments, he retired to his laboratory. With the exception of a large black slate some distance to the left of me, there was little change in the room. That feminine touch, however, seemed no longer present and although Hargrave was not married, there was that indefinite something about the way his home was decorated, which usually made it so comfortable to the visitor. Hargrave had been gone but five or six minutes when he returned. Seating himself beside me, he said. "I haven't had much time to set things right, as yet, because I have been busy myself with two spirit-writing slates which I can assure you are going to interest not only the amateurs, but also the professional magicians. Strange to say, Old Top, even though many of the magical societies are thoroughly in favor of my continuing these contributions, there are a few individuals who can see no good in my disclosing my own original material. Nevertheless, the pleasant compliments which I have received from many associates, and the requests from magicians for apparatus similar to those I describe, make me believe that these original disclosures are of great value. As I have often stated, much of the mystery in magic is due to the presentation of the trick. I have found that some magicians employing apparatus of my own design would have thoroughly mystified yours truly, if I didn't remember having placed this apparatus within their hands. For instance, the Talking Skull apparatus was placed in a manikin on one occasion in England, where this manikin answered questions when placed in the lobby of a theater, and also when carried out among the audience, during a performance.

The Black and White Slates

"The two tricks which I am about to show you today are simply constructed, and present no difficulty whatever in their presentation. The line of patter talk which the magician employs is extremely important, and I always lay stress upon this point when building special apparatus for amateur or professional theatricals. A small trick is much more effective when properly presented, than a big spectacular stunt devoid of speech."

His Japanese valet had entered the room in response to Hargrave's ring. "Sing" commanded the inventor, "I am going to show Old Timer the slate. Will you bring forth the easel—Right there will do." Then turning to me he continued, "You see it is an ordinary slate but gifted with marvelous powers. For example——". He picked up a copy of a magazine, and pointing toward it said, "See that title, now watch the slate." I glanced in the direction indicated.

Slowly and for no reason whatever bold white letters similar to those on the magazine cover progressively formed themselves on the black slate, just as though a heavy white brush was being swept across the slate by invisible hands, the brush itself being likewise

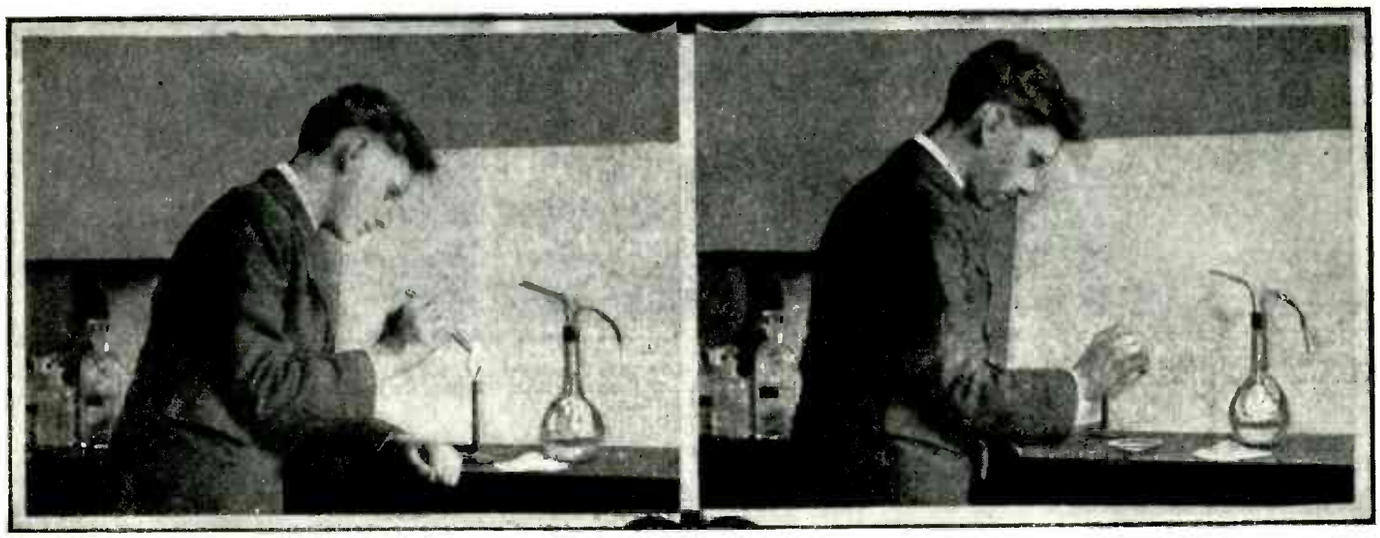
(*Continued on page 678*)

The Spirit Slate Upon Which the Writing Automatically Appears Is Really Made in Two Parts, the Letters Being Cut Out and Backed With a Black Tape Band, Which Band is Progressively Removed, Showing the White Background. The Writing Tennis Ball and Slate Trick Is a Cleverly Veiled Magnetic Appliance Almost Impossible of Detection. It Gives the Answer to Any Question by Writing Upon the White Paper in Bold Letters.

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

QUALITATIVE ANALYSIS—SEVENTH PAPER



Left—Caution Must Be Exercised Here When Making the Preliminary Tests Where a Substance Is Heated in a Closed Tube. Right—Treating for Chloric Acid by Cautiously Dropping a Bit of the Substance into a Watch Glass Containing 2 C.C. of Concentrated Sulphuric Acid.

IN this article we shall complete the scheme for the detection of acid constituents of unknown substances. As has already been pointed out when we speak of the analysis of acids we do not usually mean free acids but the acid radicals in combination with metallic bases. Every salt is the product of the neutralization in whole or in part of acid and basic constituents.

Group III.—In this group is included those acids whose calcium salts are soluble, but whose barium salts are insoluble. There are only two and only one is of importance. They are sulphuric acid and hydrofluosilicic acid.

To the solution under examination add calcium chloride. If a precipitate forms filter it off and use the filtrate for making the tests for the acids of this group. If no precipitate forms proceed with the solution itself.

Add to the solution barium chloride. A yellow precipitate which is soluble in hydrochloric acid may form. This is probably due to the presence of chromic acid. To confirm this add to the yellow acid solution a few drops of alcohol. If chromic acid is present the solution will turn green.

If the addition of barium chloride results in a white precipitate insoluble in hydrochloric acid, either sulphuric or hydrofluosilicic acid is present, and possibly both. In most cases this will be sulphuric acid only, for it is much more common than hydrofluosilicic acid. To confirm this fact heat the precipitate on charcoal with sodium carbonate using the reducing flame of the blowpipe. Place the residue on a silver coin and moisten. If the precipitate is barium sulphate, sodium sulphide will be formed in the reduction, and a black stain will be left on the coin. In case this does not occur, the acid is hydrofluosilicic acid.

Group IV.—In this group are two acids, hydroferrocyanic and hydroferricyanic. These are important in connection with the tests for iron salts. To the solution that may contain them add a few drops of ferric chloride solution which is free from ferrous salts. Hydroferrocyanic acid will give a deep blue color, while hydroferricyanic acid gives a brown color. These acids usually occur in the form of their sodium, potassium or ammonium salts.

To be sure that the ferric chloride reagent contains no ferrous salt add a few drops each of hydrochloric and concentrated nitric acids and heat. This will oxidize any ferrous salt to ferric form.

Group V.—In this group again there are but two acids, sulfocyanic and acetic. If a drop of ferric chloride is added to the neutral or slightly acid solution that is being tested a blood-red color, which is permanent after boiling, will appear, if sulfocyanic acid is present. The color will disappear upon the addition of mercurous chloride. The mercurous chloride reduces the ferric iron to ferrous form and this causes the color to disappear.

If a red color much less deep than the one above and which changes to a reddish-brown on boiling should appear, it would indicate the presence of acetic acid. The truth of this may be confirmed by applying the test for acetic acid already given under the acids of Group I.

Group VI.—This is one of the most important of the acid groups. It includes those acids whose silver salts are insoluble in dilute nitric acid. They are hydrochloric, hydrobromic, hydriodic, and hypochlorous acids.

First dissolve the substance to be tested in water and add a solution of silver nitrate followed by dilute nitric acid. If no precipitate forms, the acids of this group are absent. If a white precipitate forms it is probably silver chloride and shows the presence of hydrochloric acid, either free or combined. A yellowish white precipitate is silver bromide, and a yellow precipitate silver iodide.

Hydrochloric Acid.—In the presence of hydrobromic or hydriodic acid it may be uncertain whether hydrochloric acid is present or not. To make sure, add only a little silver nitrate, not enough to precipitate all of the acids present. Filter and add to the filtrate a few drops of chlorine water. This will set any iodine or bromine free. Then if carbon disulphide is added and the test tube shaken, a reddish-brown or rose colored solution will gather in the bottom of the test tube if these elements are present. A white precipitate, insoluble in dilute nitric acid, in the absence of bromides or iodides, is almost certainly due to chlorides.

Hydrobromic and Hydriodic Acids.—To a *dilute* solution, which may contain either or both of these acids, add a few drops of freshly prepared chlorine water. As already stated this will set the bromine or iodine free. If present these elements will immediately give a brownish tinge to the solution. Then add a little carbon disulphide and shake vigorously. The bromine or iodine will dissolve in the carbon disulphide and sink with it to the bottom of the test tube. If bromine only is present, the color will be a yellow to reddish brown. If iodine only is present the color will be a rose to violet.

If both of these acids are present the procedure must be somewhat different. Make a small portion of the solution strongly acid with sulphuric acid. Add a drop of carbon disulphide and a drop of chlorine water and shake. Continue to add chlorine water, shaking after each addition. The chlorine will oxidize the iodine to iodic acid which is colorless, and then the yellow solution of bromine in carbon disulphide will appear. The presence of iodine will be known from the violet color before it is oxidized.

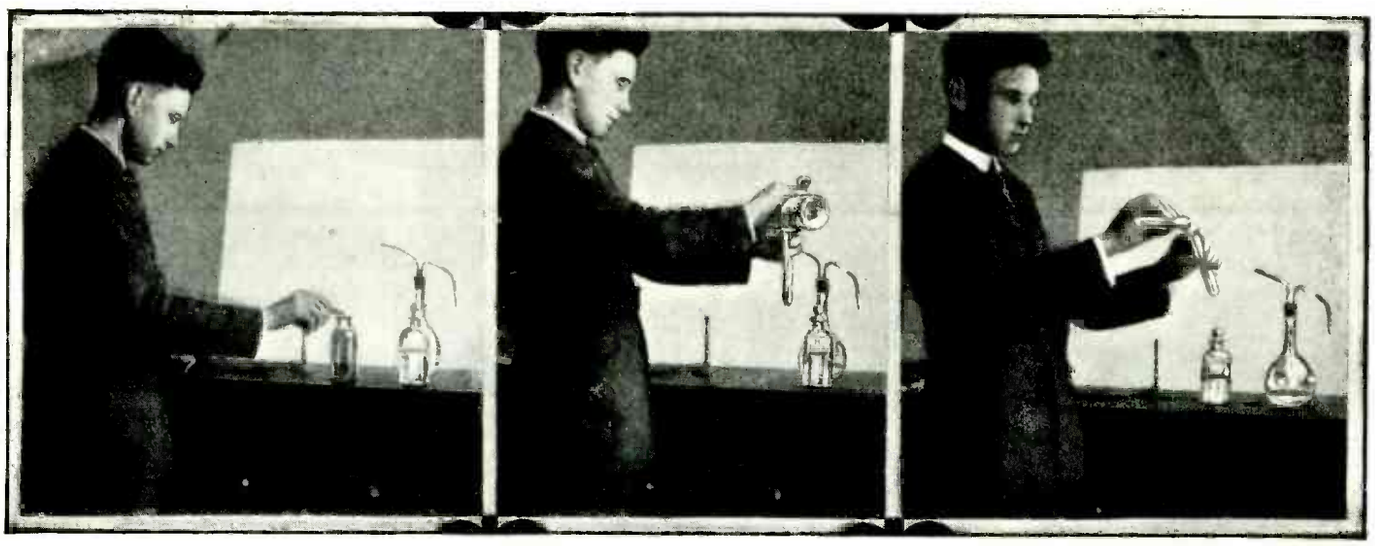
An additional test for iodine may be made by adding a little starch paste to a small beaker of water and then pouring into it some of the solution to which a little dilute sulphuric acid and chlorine water have been added. If iodine is present, a blue color will appear.

Group VII.—The important acids in this group are nitric, chloric, and permanganic.

Nitric Acid.—Make a dilute solution of the substance to be tested in one test tube. Carefully down the side of another test tube pour 2 or 3 c.c. of a freshly prepared solution of ferrous sulphate followed by an equal volume of concentrated sulphuric acid. The acid sinks to the bottom and two layers can be distinctly seen. Then pour down a few drops of the solution. If a nitrate is present a brown ring will appear at the junction of the two layers. This ring is unstable and quickly disappears.

Chlorates interfere with this action and if present must be removed by evaporating to dryness and gently heating the solid residue in the evaporating dish.

Chloric Acid.—On a watch glass place 2 c.c. of concentrated sulphuric acid and on it drop a small piece of the dry substance which is being tested. If chloric acid is present, a yellow color will appear and the peculiar odor of chloric oxide will be produced.



Left—Making the Starch Test for Iodine by Pouring the Iodine Solution into Very Thin Starch Paste and Obtaining a Blue Color. Center—Making the Brown Ring Test for a Nitrate. The Test Is Quite Sensitive and the Ring Clearly Defined. Right—Testing for Iron Salts. All of the Tests Here Shown Are Quite Simple.

When heated on charcoal, chlorates will always produce deflagration.

Permanganic Acid.—This acid and its salts always produce a deep violet color when dissolved in water. Since these compounds are strong oxidizing agents, they will oxidize sulphurous acid to sulphuric. Pass sulphur dioxide into a solution suspected of containing permanganates. If they are present the deep violet color will disappear and the resulting solution will contain sulphuric acid which may be tested for with barium chloride and dilute hydrochloric acid.

Organic Acids.—There is no systematic method of testing for organic acids. In each case special tests must be made. The presence of organic matter may be shown, however, by placing the substance under examination in a porcelain dish and heating to dryness over a Bunsen burner. Upon continuing the heating a charred residue will remain if solid organic matter is present.

SYSTEMATIC ANALYSIS

We now come to the most interesting part of chemical work. In it we shall employ all of the various methods and processes already described in the preceding articles on Qualitative Analysis. The various cases that may occur will be taken up in order.

If the substance being examined is a non-metallic solid, certain preliminary tests are always made. From the results of these tests very much can be told concerning the composition of the substance. If the amount of the substance at your disposal is small, you will have to be sparing in its use.

Heating in a Closed Tube.—In a narrow glass tube, closed at one end, place a little of the powdered substance and heat it in the Bunsen burner. A number of important results may be obtained.

1. If the substance carbonizes with the liberation of water and the odor of burnt sugar organic matter is present.

2. If the color is yellow when hot, white when cold, zinc oxide is present. If yellowish brown when hot, light yellow when cold, tin oxide. If yellowish red when hot, yellow when cold, lead oxide. If orange yellow when hot, ale yellow when cold, bismuth. Nearly black when hot, brownish red when cold, iron oxide.

3. If water is given off, water of crystallization or water mechanically enclosed is present.

4. If a gas is given off which kindles glowing splint into a flame, chlorates, peroxides or nitrates may be present. If sulphur dioxide, detected by its odor, is given off, sulphates or sulphites may be present.

If brown fumes of nitrogen peroxide are obtained, nitrates are present.

If carbon dioxide, which turns turbid a drop of lime water on the end of a glass rod, escapes, carbonates are present. If a gas burning with a blue flame, carbon monoxide, appears, oxalates or formates are present.

If hydrogen sulphide known by its odor and by its blackening of lead acetate paper is given off, sulphides are present. If ammonia, turning red litmus paper blue, escapes, ammonium carbonates are present, and sometimes cyanides.

If cyanides are present a poisonous gas cyanogen, which burns with a crimson flame, will appear.

5. If a black sublimate appears, arsenic is present.

If violet vapors appear, iodine is present.

If a shining mirror or globules form, mercury is present.

If a white sublimate, that is, a vapor which condenses to a white powder on the cold portion of the tube, appears, ammonium salts, arsenious oxide, mercurous chloride, mercuric chloride or antimony oxide may be present.

Heating with Concentrated Sulphuric Acid.—In a test tube put 2 or 3 c.c. of concentrated sulphuric acid and drop in a little of the solid substance being tested. If no action occurs, heat the tube cautiously The mere addition of a substance to concentrated sulphuric acid may be dangerous. Point the test tube away from everyone.

Results.—If carbon dioxide is formed, carbonates or oxalates are present.

If carbon monoxide, burning with a blue flame, forms, cyanides are probably present.

If hydrofluoric acid which etches glass escapes, fluorides are present.

Hydrogen sulphide shows presence of sulphides.

Sulphur dioxide shows presence of sulphites.

Hydrochloric acid giving a white precipitate with silver nitrate shows presence of chlorides.

Escaping chlorine, bromine or iodine will indicate chlorides, bromides, iodides, hypochlorites or chlorates. If the last is present, explosive chloric oxide will form. Be careful. If brown fumes of nitrogen peroxide appear nitrites or nitrates are present.

A number of the above gases are poisonous. Great caution should be observed in attempting to smell them. Particularly is this true in the case of carbon monoxide, cyanogen or any salts containing cyanides, hydrofluoric acid, and chlorine.

In the next article we shall complete the general procedure to be followed in the scheme of general analysis.

Alcohol Tested as a Motor Fuel

Little has been heard recently concerning the use of alcohol as a substitute for petrol as motor fuel, but the recent publication of the interim report of the Empire Motor Fuels Committee sheds light upon the investigations and experiments made during recent months.

This report, which deals mainly with experiments to ascertain the behavior of alcohol in internal combustion engines, under a variety of conditions, will provide valuable data for engineers, if and when the problem of economical production and distribution of alcohol is solved. These experiments were carried out with the aid of the Ricardo patent variable compression engine, and included a wide range of tests in four series, covering almost every possible condition of load, piston speed and compression ratio. They entailed many thousands of readings, but the main fact which emerges is that the thermal efficiency of alcohol is higher than that of gasoline or benzol. Further, it was found that the heat delivered to the cooling water, when driving on alcohol, was less than when using gasoline or benzol. The consumption of fuel is greater, however, with alcohol than with gasoline or benzol used under similar conditions but the consumption in the case of alcohol can be reduced by increase of the compression ratio.

Earlier experiments were carried out with 95 volumes per cent. alcohol, but subsequent experiments proved that the power output of the engine could be improved with alcohol containing a greater percentage of water.

MAY ENFORCE USE OF ALCOHOL FUEL

The French Government is contemplating the enforced use as motor fuel of a new mixture composed of alcohol, gasoline, cyclohexanol and phenol, partly in order to dispose of great accumulations of alcohol and partly to reduce the country's dependency for mineral oils on the United States, Great Britain and Holland. As a result of experiments a "carburant national" has been developed, the practical value of which is claimed to have been proven by tests. The formula is: Gasoline, 900; alcohol at 95°, 100; cyclohexanol, 17.5; phenol, 37.5.

Experimental Electro-Chemistry

By RAYMOND B. WAILES

PART VI.—POLARIZATION CURRENTS, DEPOLARIZERS, GAS BATTERIES, STORAGE BATTERIES

CERTAIN types of electric cells, or batteries as they may be called, produce *two* currents of electricity. A sheet of zinc and copper immersed in a dilute solution of sulphuric acid will produce an electric current when the two dissimilar metals are connected externally by a wire as shown in

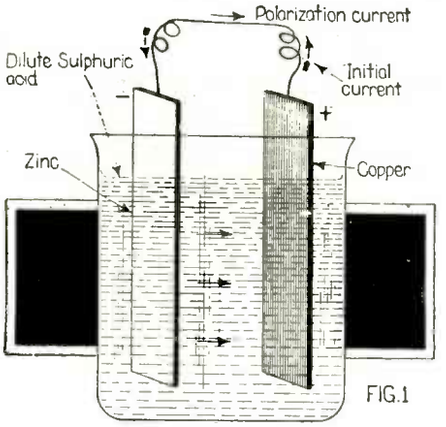


Fig. 1. A Simple Primary Cell. On Connecting the Zinc and Copper Electrodes With a Wire as Shown, a Current Is Generated. Bubbles of Hydrogen Soon Cover the Copper Electrode, However, and the Current Falls to Zero.

Fig. 1. The acid reacts with the zinc, forming zinc sulphate and hydrogen gas:

$$Zn+H_2SO_4=ZnSO_4+H_2$$

It can be clearly seen in the above chemical equation that the metal zinc replaces hydrogen in the sulphuric acid, forming zinc sulphate. The table of electromotive series (Part IV of this series) at once discloses the fact that hydrogen is replaced by zinc because zinc is more electro-positive than hydrogen, *i. e.*, it is farther up the series than hydrogen.

The hydrogen gas which is liberated collects upon the copper electrode and acts as a protecting medium against the acid. As the current produced varies with the size of the plates or strips used, it can readily be understood that the initial current which produces the hydrogen bubbles will soon die out, for the surface of the copper is gradually being protected from entering into the action by the hydrogen bubbles which collect upon it. The hydrogen bubbles also act as an electrode in themselves and tend

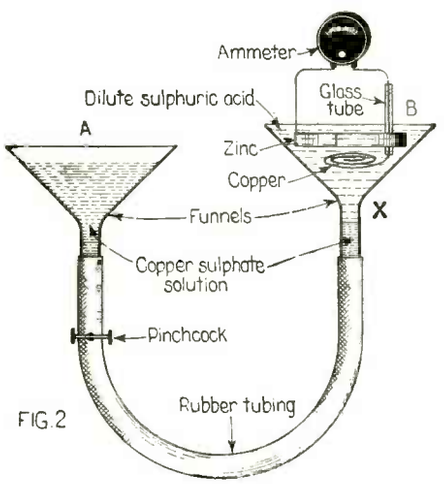


Fig. 2. The Instant Effect of a Depolarizer Can Be Shown by Using the Above Simple Apparatus. As the Current Which the Battery in Funnel B Is Producing, Dies Down Owing to Polarization, Funnel A Is Raised, Thus Bringing the Copper Sulphate Depolarizer into Action. The Current Then Builds Up.

to produce a current in the *opposite* direction to which the initial current flows. This opposite current or counter current is called the *polarization current.*

Since the polarization current is caused by the formation of a hydrogen film about the copper electrode, the polarization current and also the gradual weakening of the initial or direct current can be rectified by simply stirring up the sulphuric acid electrolyte which will dislodge the bubbles of gas. This, however, is a remedy and not a cure, for they will appear again as soon as the liquid is quiet. Certain chemical agents called *depolarizers,* if added to the electrolyte of the cell, will remove any hydrogen gas which is deposited, by combining with it.

In the dry battery or cell, manganese dioxide is used to prevent the deposition of hydrogen gas on the anode or positive electrode (which is a rod of carbon instead of a copper sheet as in the case of the simple cell described).

On discharging a dry cell, the following chemical reaction occurs:

$$Zn+2NH_4Cl=ZnCl_2+2NH_3+H_2.$$

The NH_4Cl is ammonium chloride or sal ammoniac. It, together with zinc chloride is used in the manufacture of the cell. The zinc chloride reacts with the NH_3, or ammonia to form a non-reactive chemical salt. If a dry battery, which has been discharged in excess of its capacity, be split apart, the characteristic ammonia fumes are apparent. The cell in this case is operated far beyond its rated output and the depolarizer is sidestepped or does not have sufficient opportunity to act, so to speak.

The hydrogen gas which is liberated reacts with the black manganese dioxide (MnO_2) which is in the cell body as follows:

$$H_2+2MnO_2=Mn_2O_3+H_2O.$$

It is simply changed into water, H_2O. This is equivalent to stirring up the acid electrolyte in the simple wet cell described.

The detrimental effects of polarization can be strikingly shown by using the apparatus as shown in Fig. 2. Here, two funnels are connected by means of a length of rubber tubing. Funnel B contains a coiled strip of zinc and a spiral of copper. The copper can pass through a glass tube as shown. The funnels should be clamped to a ringstand and should stand at the same height. A copper sulphate solution is poured into funnel A until it reaches a point X in the stem of funnel B. The pinchcock should then be screwed tight or closed. More of the copper sulphate solution is poured into funnel A, filling it. Dilute sulphuric acid should now be poured into B, covering the zinc-copper couple. The acid added should just cover the zinc and its level should be the same or in a line with the copper sulphate solution in funnel A. The ammeter which is connected with the couple (as shown) will indicate a current, which generally decreases in strength as polarization sets in. The ammeter will clearly show this drop in current output. Upon unscrewing or opening the pinchcock or clamp and raising funnel A, copper sulphate will rise up through funnel B and come in contact with the copper spiral, thus surrounding it with copper ions, and the weakened current will return to normal again.

Simple cells such as have been described are called primary cells. Storage batteries are called secondary cells. This is so because, virtually, the polarization current is made use of, the polarization current being also called the secondary current. The secondary cells have their current output dependent entirely upon the polarization current—just what the primary cells endeavor to avoid.

An uncharged storage battery has a lead electrode and another of lead sulphate, both being immersed in sulphuric acid. No current is produced, for similar metals are present. Upon the passage of a current (the charging current) through the whole the following reaction takes place:

$$2PbSO_4+2H_2O=Pb+PbO_2+2H_2SO_4.$$

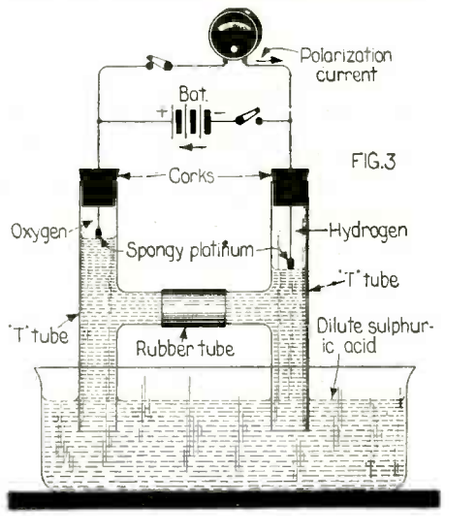


Fig. 3. With This Simple H Tube and Spongy Platinum Taken from an Automatic Gas Lighter, the Polarization Current or Reverse Current Can Be Measured.

The water comes from the sulphuric acid. The lead sulphate ($PbSO_4$) plate becomes the lead plate (Pb) on charging, the lead plate gets coated with lead peroxide (PbO_2), which is brown (so-called purple). When the charging is complete, the cell will give a current when the plates are connected by a metallic conductor. The current which flows can be said to be a true polarization current, for it is an after effect of a primary current or charge.

It will be seen that in the last chemical equation, sulphuric acid, H_2SO_4 is formed. As the cell continues to *charge* or as the plates form under the action of the current, this sulphuric acid gradually builds up or becomes stronger. Since pure sulphuric acid is heavier than water, it would naturally be thought that the electrolyte in the battery becomes heavier, i. e., the specific gravity is

(*Continued on page 721*)

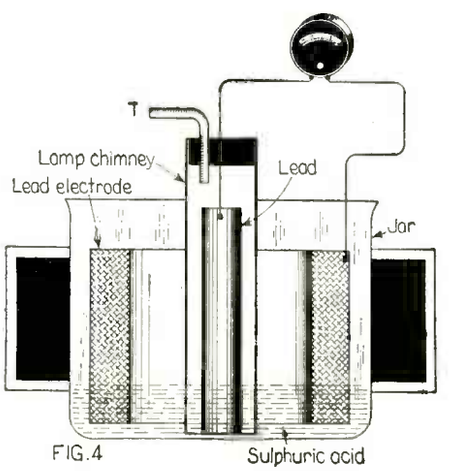
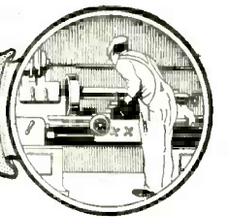


Fig. 4. A Simple Gas Battery. Illuminating Gas Is Led Through the Tube T.

THE CONSTRUCTOR



Rain and Wind Machine for Amateur Stage

By L. B. ROBBINS

AMATEUR theatricals, as a rule, are bare of many effects produced by legitimate companies because of the lack of the necessary apparatus. To produce the effect of rain and violent winds the professional makes use of a complicated machine, but the amateur can build a machine capable of producing both those effects separately or simultaneously and at small cost. The device is easily operated and in the case of a well staged production, will well pay for the trouble incurred in building it.

Two revolving drums are set upon a heavy wooden frame. First build the frame, making four end sections as shown in the detail sketch. These are of wood 2 inches by 6 inches and 36 inches high. Braces of 2" x 4" stock hold it rigid. These four uprights are then separated as indicated in side view drawing and are assembled and braced by two long 2" x 6" timbers and cross braces. Each pair of uprights should be about 30 inches apart with about 12 inches of space between them. Bore a 1 3/16 inch hole in each upright, 30 inches up from the bottom, to act as a bearing.

The effect of wind is produced by a slatted wooden drum 2 feet long and about the same diameter. Cut out two wooden disks and nail strong, smooth slats to them so as to form the drum as shown. The slats should be at least 2 inches apart, sandpapered smooth to remove all roughness and splinters and painted with shellac. A pine flange bolted to the exact center of each disk forms the socket for the axles, which are short pieces of 1¼ inch galvanized pipe. Be sure they are in an exact line so they will run true in the bearings. The back of the inside disk should have an axle somewhat longer than the front end. Prevent the axles from unthreading by tapping in set screws through the sides of the flanges.

A spring between two washers makes the drum bear against the front upright.

Tack a strip of silk to one edge of the base, throw the piece over the drum and tack the other end to a stick which is held taut by two spiral springs secured to the opposite side of the base. Provide a crank out of pipe fittings to fasten to the projecting axle by which the drum may be revolved.

The rain drum consists of a hollow, round box the same size as the wind drum but solidly constructed. Tack some corrugated cardboard, metal lathing or fine chicken wire around the entire inside. Then put in a few handfuls of dried peas, beans, shoe buttons or other light hard pellets and nail on the cover. Two flanges and pipes form axles for this drum. Arrange them, however, so there is but little end play between the drum covers and the uprights.

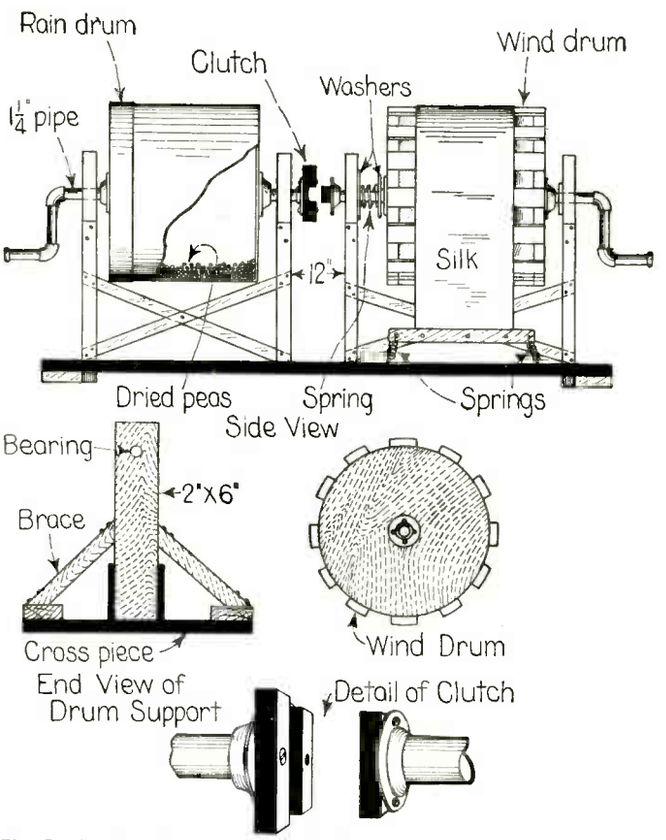
The clutch consists of a slotted block of wood bolted to a pipe flange which is fastened to the axle of one drum and a narrow block of wood bolted to a flange on the other axle. This block should fit easily into the slot in the larger block. When in normal position they should clear by at least two inches. Pushing in on the crank of the wind drum connects them so both drums are revolved with one crank.

When a storm is to be indicated in the play the operator commences by turning the wind drum slowly. The friction of the silk on the slats produces a moaning sound rising to a shriek as the speed of the drum is increased.

If rain is desired the operator turns the rain drum slowly or rapidly according to the intensity of the sound desired. The pellets clatter and bounce off the rough surface inside the drum and produce the audible effect of rain drops pattering on the window.

If wind and rain are wanted in combination the operator pushes in on the rain drum until the clutch connects the two and then turns the crank. With that, wind and rain intermingle and produce the effect of a wild storm, much to the delight of the audience.

Lightning for night scenes may be produced by means of an arc lamp in which the carbons are rapidly separated and again brought in contact with each other. A resistance must, of course, be inserted in series with the device.

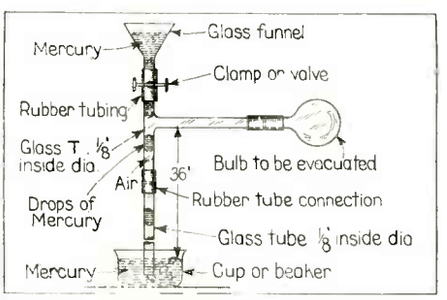


The Combination Rain and Wind Machine for Amateur Stage Productions, Illustrated Above, Is Simple to Build and Can Be Made in Different Sizes According to the Dimensions of the Stage, and the Show Itself. The Small Model of This Machine Proves Very Useful in Staging Miniature Productions With Marionettes or Dolls.

Efficient Vacuum Pump

Here is a diagram of a Sprengel type mercury vacuum pump which can easily be constructed by the experimenter. The necessary materials are a glass funnel, a tee tube, not over ⅛-inch bore, a piece of glass tubing 36 inches long, not over ⅛-inch bore, a beaker or cup, a spring clamp, and a piece of rubber tubing.

The funnel is connected to the tee tube with a short piece of heavy rubber tubing with the clamp between. The long tube is then connected to the tee tube with its end in the cup to receive the mercury. The bulb to be evacuated is connected to the tee tube as shown. In operation the funnel is filled with mercury with the valve closed, the cup being likewise filled to a point a trifle above the end of the tube. Then connect the bulb to be exhausted by means of a heavy air-tight piece of rubber tubing and open the valve for an instant. A drop of mercury will run down the tube, driving the air out before it. The air in the bulb expands and on opening the valve again, the air is again driven out of the tube. By continually opening and closing the valve for some time, a nearly perfect vacuum will be obtained. For best results the tee tube should be 36 inches above the level of the mercury in the cup.



The Diagram Above Shows How a Simple Mercury Vacuum Pump of the Sprengel Type Can Be Constructed by the Experimenter.

Contributed by B. B. GARDNER.

Babbitt Bearings for Models

HEREWITH are several types of bearings for use in building model machinery. They can be used in making electric phonographs, motors, small steam engines, picture machines, etc. They are especially adaptable to inventors, or anyone who likes to experiment with gears, pulleys, etc. For constructing these the only material required is babbitt, which can be procured from any hardware store at about 15 cents to 25 cents per pound. This cheaper grade is as efficient for the work as the more expensive quality.

For general work there are two types of bearings which are most satisfactory. The first is just a plain bearing with a single hole through the center for a shaft, and an oblong hole at each end for screws or bolts (Fig. 1). The oblong hole permits the bearing to move slightly, and makes it easier to get the shafts in line. The second is a two-piece bearing, and should have two or three layers of paper between the upper and lower half (Fig. 3). This allows this form of boxing to be taken up when it wears a good deal, and consequently there need be no play or lost motion in a bearing of this type.

The simplest way to make these boxes is to take some stiff mud or clay and press it flat on a smooth surface. Then press a wooden frame of the size you want the box to be gently into the mud. Be sure to press the mud around the outside of the frame to prevent the babbitt from running under it.

If you desire to make several boxes identically alike, it can be accomplished as shown in the diagram (Fig. 6). If the hole for the shaft is cast at the same time as the boxing, the shaft will have to have a coating of soap or grease, or the babbitt will stick to it. As a general rule, it is best to cast the bearings the size and shape wanted, and then drill the holes, afterward using a wooden rasp for dressing them up and putting on the finishing touches with the smoothest side of a blacksmith's rasp.

By means of wooden pegs stuck up in the mud, the holes for the bolts or screws can be made when the babbitt is poured into the mold. These pegs can easily be extracted after the babbitt is cool as they are somewhat charred by the same.

For making the frames, cigar-box wood is efficient, or even tin may be employed. If there is no top or bottom to the frame, the mud on which they are placed will act as a bottom, and the babbitt can be poured in at the top.

The Accompanying Drawings Show Various Forms of Cast Babbitt Bearings for Model Machinery, and These Bearings Are Frequently of Value in Building Small Dynamos and Motors.

These frames of which we speak are simply bottomless and topless boxes. In other words, the four sides of a box of the required size are fastened together, and the whole is then pressed into soft mud, the mud being packed around the outside so that it adheres closely to the wood. The shaft in the form of a wooden peg can then be inserted into the mud in its proper position.

FIG. 1

FIG. 2

FIG. 3

FIG. 4

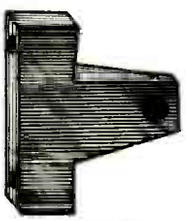


FIG. 5

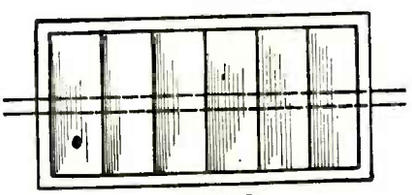


FIG. 6

FIG. 7

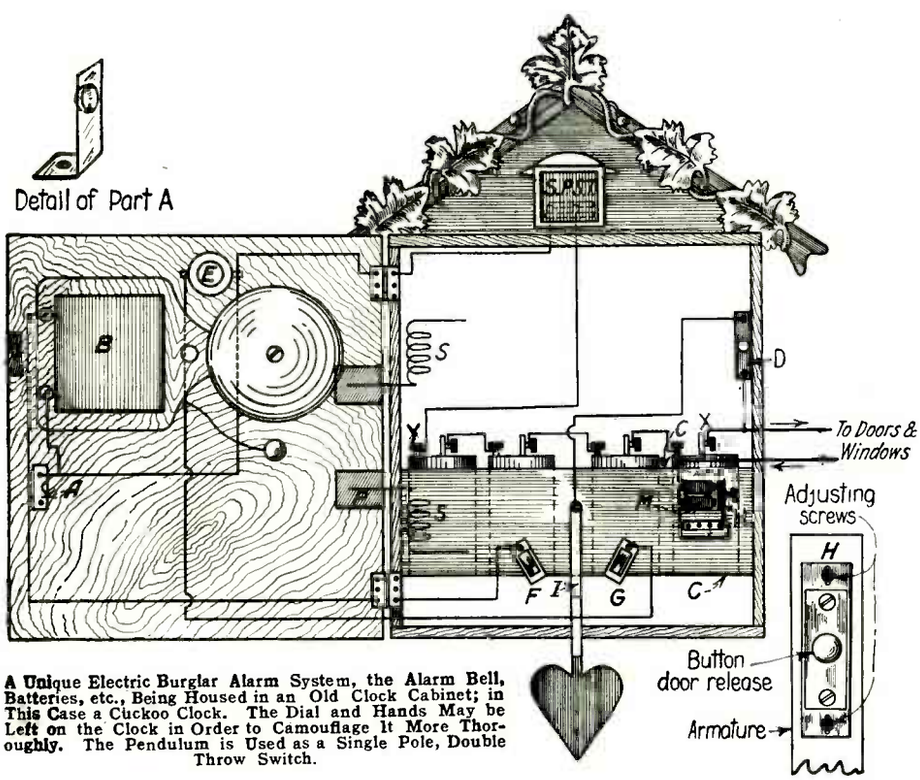
Bearing Fig. 2 is a design which I find particularly adaptable to model work where gears are to be employed. The bearings shown at Figs. 4 and 5 are nearly alike, except that Fig. 5 is intended for vertical work, where the shafts must be fastened to the wall. Fig. 7, which is suited to vertical work, can also be used for horizontal purposes.

Contributed by ROY L. GIRDING.

Unique Burglar Alarm System

We herewith describe a very elaborate burglar alarm which, when viewed by the layman, holds him in awe. It appears to the casual observer to be an ordinary cuckoo clock, which indeed is its basis. The face of an old clock is sawed off; the works removed; and the alarm placed therein. When door or window is open, current flows from battery X through window or door burglar alarm spring, through magnet coils M, through armature H, which is in contact with A (when door of clock is closed), thence through hinge and S.P.S.T. switch, back to battery at Y. This magnetizes coils M, attracting armature H, which fastens in a catch A. The door is now released and forced open by springs SS, made from mouse traps. This part of the circuit is now open due to A and H being separated, but, the door being open, allows the burglar alarm door-push contact D to close its respective circuit, which is from the battery X through D to the pendulum of the clock I, and if the pendulum is at F, the circuit is completed through the hinge to one binding post of the bell, from the other binding posts of the bell, to the upper hinge of the front of the clock, through S.P.S.T., a single pole single throw switch, in the cuckoo compartment of the clock and back to battery at Y. If the pendulum is at D, the circuit of the light E is completed. The device acts as a constant ringing alarm. In order to reset the alarm it is merely necessary to shut the door. For precautionary measures, it would be advisable to place a small hole at the side of the clock just a little above armature H, so that, should an open circuit occur inside of the clock, or the batteries on rack C suddenly become exhausted, it is merely necessary to insert through the hole a small nail pressing on the armature, and thus releasing the door.

Contributed by CHARLES H. MILLER.



A Unique Electric Burglar Alarm System, the Alarm Bell, Batteries, etc., Being Housed in an Old Clock Cabinet; in This Case a Cuckoo Clock. The Dial and Hands May be Left on the Clock in Order to Camouflage It More Thoroughly. The Pendulum is Used as a Single Pole, Double Throw Switch.

Actino-Chemical Demonstrations

By RAYMOND B. WAILES

ACTINO - CHEMISTRY is the production of chemical reactions and changes by the influence of light. Its effects are of the type which are always remembered, due to their beauty and weirdness. The experiments themselves entail little apparatus and only a few chemicals.

Light will influence and cause chemical reactions to take place, and conversely, chemical reactions can be accompanied by the production of light, a reversal of the former process. Both of these types will be discussed.

ACTINOMETERS

The intensity of light can be measured chemically. For this simple experiment a solution of 5 grams of mercuric chloride (mercury bichloride, poison) is dissolved in 100cc of water. To this solution a solution of 4 grams of ammonium oxalate in 100cc of water is added, in subdued light or in a dark room, and the mixture filtered if it is cloudy. When several cc. of this mixture are placed in a test tube and exposed to the sunlight or the light from a nitrogen-filled or arc lamp, crystals of calomel make their appearance in the tube, carbon dioxide gas being liberated at the same time. The use of a stronger light source causes a denser precipitate. By weighing the calomel precipitate or measuring the carbon dioxide produced, the amount of light which fell upon the tube can be ascertained, with a proper standard.

This reaction progresses, under the influence of light:

$$2\,HgCl_2 + (NH_4)_2C_2O_4 = 2\,HgCl + 2NH_4Cl + 2CO_2$$

The tube containing the above mixture forms a simple Eder's actinometer.

PHOTOCHEMICAL EXTINCTION

Many substances absorb light rays. Liquids which are seemingly transparent, do not conduct different rays or wave lengths of light to the same degree. This can be shown by the following experiment, the apparatus used being shown in Fig. 1.

Here a shallow tray such as a photo-developing tray is used. It is divided by microscope slides or other glass partitions, cemented in place by a rubber cement, such as a tire cement. Divisions A, C and D are filled with the above-mentioned mercuric oxalate solution, while the cell B is filled with water. By allowing light to strike the dish in one direction only, falling upon side AB, and then passing through to C and D, the property of photochemical extinction can be shown.

The light passing through cell A causes the white precipitate to form in it, showing the presence of light. In passing through this solution the actinic rays are "used up," so to speak, for the solution in tray C is not affected by light, for a white precipitate does not form. Tray B containing water, the light passes through it and causes the solution in D to become milky. The solution in A causes a photochemical extinction, prohibiting the light from acting on the solution in C.

ACTION OF LIGHT UPON SILVER CHLORIDE

If a solution of table salt is added to a silver nitrate solution a white curdy precipitate of silver chloride forms. This silver chloride breaks up on exposure to light and forms chlorine gas and a lower chloride of silver, the resulting chloride being of a dark color, so that the change can be visually detected.

If some of the silver chloride is made as above, filtered and washed with water in an obscure light and placed in a test tube as shown in Fig. 2, it will readily darken when exposed to light. If a stopper carrying a wire supporting a strip of filter paper wet with a solution of starch and potassium iodide is placed in the mouth of the test-tube, the paper will turn blue and the silver chloride at the bottom of the test tube will turn from gray to a violet color.

If several drops of mercuric chloride are added to some freshly precipitated silver chloride and the experiment performed again, no blackening or coloration will occur.

CRYSTALLO-LUMINESCENCE

When certain solutions crystallize faint flashes of light can be seen as each crystal is born. Strong solution of sodium fluoride or arsenious acid can be used, but the results, as the experimenter will find, are not wholly satisfying, as the light emitted is very pale and forms only under proper conditions.

TRIBO-LUMINESCENCE

This actino-chemical phenomena can be observed when a salt, such as uranium nitrate or acetate is shaken in its glass container. Certain types (tribo-luminescent) of sphalerite, a mineral zinc sulphide, also show tribo-luminescence when rubbed together.

Salophen (acetyl para-amido-phenyl salicylate) produces a strong tribo-luminescence when the powder is subjected to friction. By placing a bit of this substance on the ground part of a glass stopper and twisting the stopper in its bottle a glow can be seen.

THERMO-LUMINESCENCE

This production of light is due to heat. Fluorspar, when crushed and raised to a rather high temperature over an iron plate, will glow in the dark. This experiment is easily performed, using a Bunsen burner to heat the plate.

PRODUCTION OF ELECTRICITY BY ACTINO-CHEMICAL MEANS

The combined action of light influencing a chemical reaction, and the resulting chemical action producing a current of electricity, can easily be shown, using the apparatus shown in Fig. 3.

A U tube is filled with a 1% solution of sodium chloride or common salt (1 gram salt in 100 cc. water). Two copper foil electrodes, cut as large as possible to fit the U tube, are held in the tip of a Bunsen burner flame. This operation coats them with copper oxide. They are immersed in the 1% salt solution, forming an electrolyte, as shown, and are connected with a galvanometer or other sensitive electrical indicating instrument.

Black paper caps are made to snugly fit the limbs of the U tube. A hole punched in the top of each cap permits them to be raised, exposing the entire surface of each foil electrode to the light, while still connected with the indicating instrument.

Starting with both caps down, thus keeping each copper foil electrode from the light, a current of electricity can be generated by raising *one* paper cap. On lowering it the galvanometer needle returns to zero. Raising the *other* cap sends the pointer swinging to the other side of the galvanometer scale. A strong source of light must be used, and also a sensitive indicating instrument, such as a millivoltmeter.

If instead of using the paper caps, we fit a projection lamp with a shutter, so that light therefrom will be projected first upon one side of the U tube, and then upon the other, and we rotate this shutter rapidly, we will find that the galvanometer will oscillate back and forth, as the light strikes the different arms of the U-shaped tube and their oxidized copper foils.

If the experimenter finds that it is rather difficult to build a revolving shutter and a lamp-house, rotating mirrors could be used for reflecting sunlight upon the cells. This process will be far less expensive, but the light would not be as constant, and consequently differences in reflection would always be noticed, except if all the records on each type of cell were taken on a clear, cloudless day, the mirror reflecting northern light instead of direct sunlight. The paper caps, as shown in the above diagram, could be mounted on two opposite ends of a rocker arm. A crank with a shaft mounted off center and connected to this rocker could be employed when it is desired to alternately raise and lower the paper caps.

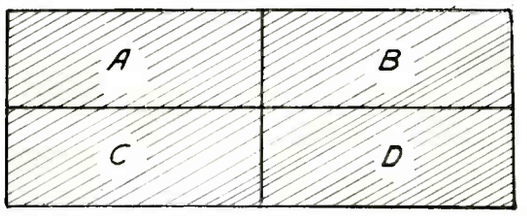


Fig. 1

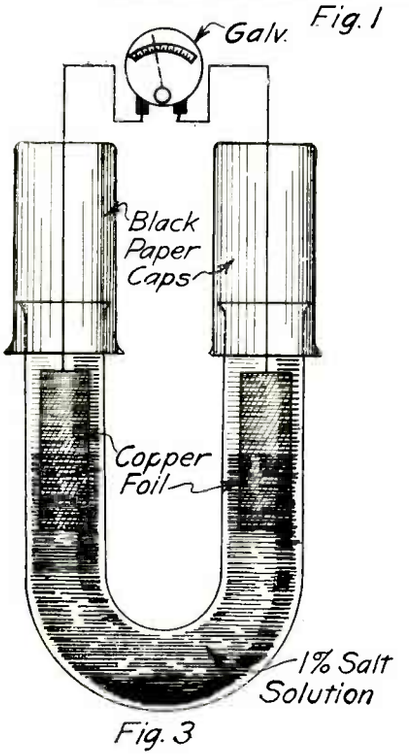


Fig. 3

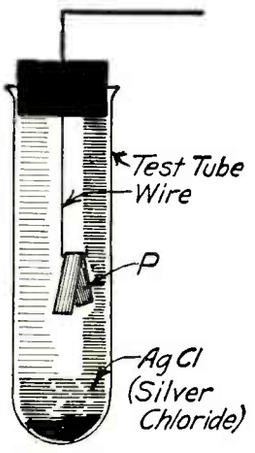


Fig. 2

Fig. 1. A shallow Photo-Developing Tray Can Be Used to Show Photochemical Extinction. Fig. 2. Silver Chloride Blackens on Exposure to Light, the Blackening Being Approximately Proportional to the Intensity of the Light. Fig. 3. Using This Simple Cell, Light Produces a Chemical Reaction, and the Chemical Reaction Causes an Electric Current to Be Set Up.

HOW-TO-MAKE-IT

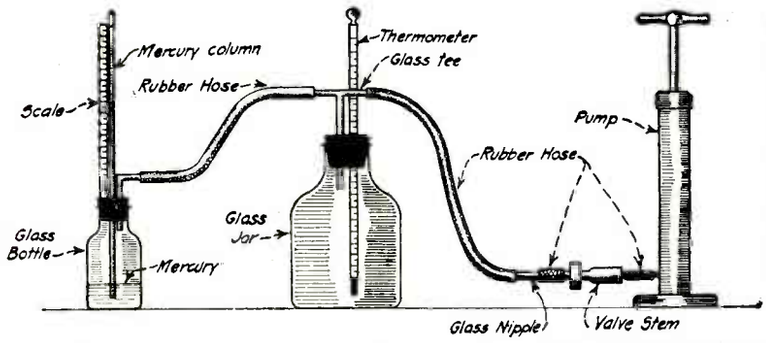
This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. 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, $15.00

VACUUM PUMP AND GAUGE

An inexpensive vacuum pump can be easily made from a single cylinder automobile pump.

The rubber hose is cut off about four inches from the end, to which the coupling is attached.



An Inexpensive Vacuum Pump Can Be Easily Made from a Single Cylinder Tire Pump, as Shown in the Accompanying Illustration. With Experimental Apparatus, Water Can Be Made to Boil at a Temperature of 170 Degrees, Fahrenheit.

An old valve stem is sawed off near its base and filed off so it will fit tight in the rubber hose that is attached to the pump. The valve stem must be placed in a reverse position. The coil spring is removed from the valve inside the pump, so the valve can work freely. In some automobile pumps reversing the rubber washer will serve the purpose, in others simply soldering a piece of tubing to the air vent is more satisfactory.

The four-inch piece of hose, with coupling attached, is now screwed on to the valve stem and the vacuum pump is complete.

The vacuum gauge is made by sealing one end of a glass tube, 36 inches long and about 3–16 inch inside diameter. A two-hole rubber cork is placed on the tube near the open end, the cork is pushed into a 6-inch bottle (a small olive bottle will do), the tube is then adjusted in the cork so that its bottom will be ¾ inch from the bottom of the bottle.

Remove the cork and tube from the bottle, taking care that the cork is not moved on the tube. Pour mercury in bottle to a depth of one inch, then turn the open end of tube up and fill to within ¾ inch of top, with mercury; fill slowly, so as to avoid air bubbles; now fill the remaining portion with melted paraffin and let it cool. When the paraffin has solidified, turn the tube right side up and push cork firmly in bottle, then heat the bottle gently to melt the paraffin. The mercury will force the melted paraffin out of the tube.

Place a yard-stick or a piece of cardboard marked off in inches alongside of the tube and secure it to the tube with small wires.

Now insert a glass ell in the cork and attach the rubber hose from the pump to the ell; by working the pump the mercury will fall rapidly. A large glass bottle may be placed between the pump and the gauge, connected by two glass ells or a large tee.

Place a thermometer in the large bottle and pour enough water in to cover the bulb on the thermometer; heat the bottle until the water boils. Note the temperature. The pump is then connected to the bottle and the vacuum gauge. By working the pump the water will boil violently as the air is withdrawn.

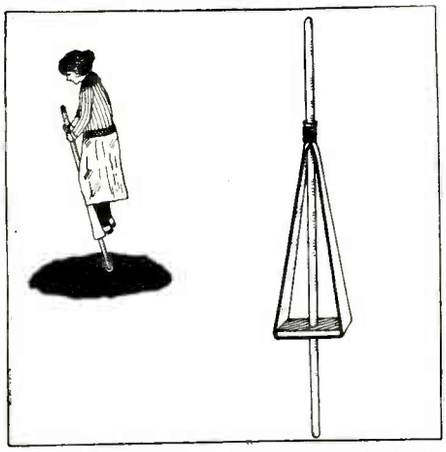
Water can be made to boil at a temperature of 170° F., with this simple apparatus.

Contributed by JOHN E. BYRON.

SECOND PRIZE, $10.00

A SIMPLE POGO, OR JUMPING STICK

At the present time one of the sports which is attracting almost universal interest is the Jumping Stick, otherwise called "Pogo" Stick. I have constructed one of these devices which I found to be nearly as efficient as the more expensive sticks now found upon the market, with which I can take surprisingly long leaps.



The Popular "Pogo" or Jumping Stick Is Easily Constructed, as Shown in the Illustration Above, the Resilient Step or Foot Rest Being Suspended on a Piece of Old Inner Tube Instead of Springs.

Securing a mop handle, a piece of old inner tube, and a small board. I went about it in the following manner: The board was ¾ of an inch thick and cut 3 inches wide and 1 foot long. A piece of old inner tube was secured to this, which inner tube was approximately 3 feet long. Small tacks and leather washers sufficed to hold the inner tube in place.

A hole was then drilled through the center of the one-foot piece of wood, and a similar hole was cut out in the inner tube, so that a mop handle could pass through it freely.

The inner tube was then tied by means of wire to the mop handle in such a manner that the horizontal piece of wood was nearly a foot and a half from the ground.

Contributed by ROMAN BLASKOW.

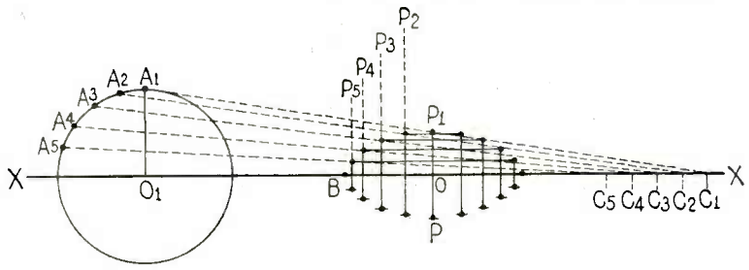
THIRD PRIZE, $5.00

AN EASY WAY TO CONSTRUCT AN ELLIPSE

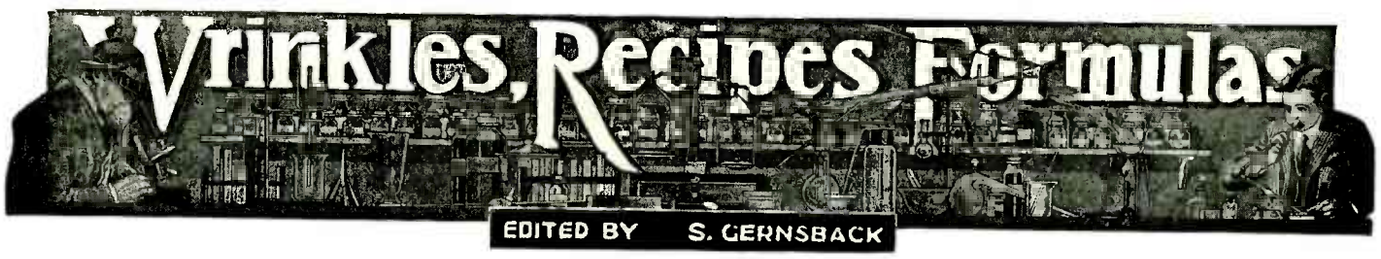
The draftsman in his great variety of work is occasionally required to draw an ellipse of any size with reasonable accuracy. The geometric rules as found in books treating on various methods for constructing this curve, are not readily applicable to the ordinary man, especially one who is not acquainted with geometry.

Draw any line such as XX. Erect a perpendicular on this line as PP. Lay off OP and OP, each equal in length to half the short diameter of the ellipse. Lay off OB on XX equal in length to half the long diameter of the ellipse. With any point O_1, as a center on XX, draw the circle with a radius equal to OB or half the long diameter of the ellipse. Also draw OA, perpendicular to XX. Through the points A and P, draw a line intersecting XX at C. Spread your dividers a distance equal to AC. Without changing the position of the dividers, place one point of the dividers on any point of the circumference of the circle as at A_2, then place the other point on XX. Proceed around the circumference marking these points by indenting the paper with the points of the dividers. Let these two points be A_2C_2 and draw a line through them. Now draw a series of lines such as A_3C_3, A_4C_4, A_5C_5, etc., by the same method as was used to draw A_2C_2. Spread the dividers to a distance A_1P_1. Without changing the dividers, one point of the dividers on A_2, mark P_2 on A_2C_2, with the other point of the dividers. Similarly mark P_3, P_4, P_5, etc., on each line. The points P_1, P_2, P_3, P_4, P_5, give ¼ of the required ellipse. Having thus plotted ¼ of the ellipse, it is an easy matter to plot the rest of it. Simply draw a series of horizontal and vertical lines through each of the points P_1, P_2, P_3, etc., and transfer these points properly on each line with your compass or dividers. If the distance A_1C_1 is too large a spread for your dividers or compass, a strip of paper with distance A_1C_1 marked thereon, will serve equally well.

Contributed by EDWARD A. BAYERS.



An Easy and Accurate Way to Construct an Ellipse of Any Size Is Shown in the Accompanying Diagram. There Are Simpler Ways of Making an Ellipse, Perhaps, but This One Gives Reasonable Accuracy in a Short Time.



THIS MONTH'S $5.00 PRIZE

HOW TO RESTORE WORN AND BURNT SOLDERING IRONS

Soldering coppers, commonly called "irons," finally after being used a number of times, get into such a condition as to require filing into shape; which is one of the most disagreeable jobs that a workman can have. The condition in question is due to the effects of frequent re-heating and cooling off with an occasional burning off of its tin coating through overheating; the result is that a sort of case-hardening or alloy between the copper and tin is produced that prevents a file (even a new one) from working to its full efficiency; thus making it take a very long time to do the dressing, as all teeth clog up badly and will not cut into the hard surface.

After putting up with this state of affairs for some time, the writer tried out a horseshoers' old rasp with large rounded teeth standing up at a right angle to the main body of metal. In use it was found that these rounded teeth edges cut right into the case-hardened surface and removed it very quickly, but left too rough a surface for tinning. All roughness was next filed down smooth with an ordinary medium coarse file. Many persons when filing copper, brass or other soft metals have trouble in working with them as, after a few strokes, their files will become clogged up with metal, refusing to cut besides causing scratches on the surface being filed.

In cases of this kind, smooth work may be done provided the file has been well oiled. The oil prevents the cutting teeth from clogging and it also allows the metal to yield easily. Oil your file every few minutes and clean it with a file card (to be found in any hardware store) frequently and all metal work will be smooth. The writer believes that a rough toothed wood rasp or one used by shoemakers, would prove to be well suited for cutting through the case-hardening on burnt and worn soldering irons.

If there are many pit holes in the metal that are deep, there is no need to remove them all with the rasp as such a course entails a loss of metal in the iron and makes it lose its heat quicker. To tin your iron, heat it to nearly a red heat, wipe it on a piece of old carpet kept especially for this purpose and rub it in a mixture of resin and solder; the point will now take on a brilliant coating of tin if the iron is hot enough. To tell whether any soldering iron has the right temperature, touch the point with a stick of solder and it will melt instantly.

Contributed by W. S. STANDIFORD.

MUSICAL GLASSES

The easiest way to settle difficulties about the notes given by musical glasses is by actual experiments. Strike the edge of a tumbler near the rim, lightly with a wooden penholder. Then pour in a little water and strike it again. It will give a higher note than it did at first. You can easily pour different quantities of water into each of a dozen glasses and tune them to give the notes of an octave on the piano.

The manner of playing tunes on such a set of glasses is usually to run a wet, well-resined finger round the rim of each, when a thin continuous note is given out. This, however, requires practice.

Contributed by W. R. REINICKE.

MUSICAL TUBES

To make a set of tubes that will sound like bells when struck, tubes of brass or copper do very well. The only difficulty is to hang them up so that they may vibrate freely. Make a trial with a piece of tube about 18 inches long and one inch diameter. Drill two small holes through the wall of the tube, about one-eighth of an inch from one end and diametrically opposite to one another. Thread a piece of string through these two holes and hang the tube up. When struck by a wooden mallet, or, better, by one of the hammers made for pianos, it will give out a note. Other notes can be made from shorter or longer pieces of piping.

Contributed by W. R. REINICKE.

MAKING A FIRE OF LEAVES

Where material for the camp fire is not easy to obtain it is quite a simple matter to make a good blaze with leaves and very small stuff. To make sure that the fire burns well it should be built in a special way. First of all secure two lengths of wood which are three or four feet long and rather stout. Drive one of these upright into the ground, where you wish to have the fire and then place the other one on the ground with one end just touching the base of the first stake. Now start to pack the leaves round the central stake pressing them well down so as to get a compact mass. When a fair-sized heap has been secured carefully draw out the stakes and you will then have a continuous opening running from the lower part of the pile to the top. Light with a little paper at the lower hole and the flames roar up the opening which acts just like a flue. Soon you have a splendid fire which, on account of its compactness, glows with red heat for a long while. In fact, properly constructed a leaf fire is better for cooking many things than one built of wood.

Contributed by S. LEONARD BASTIN.

ASPIRIN FOR FLOWERS

It has been recently discovered that nearly all kinds of flowers keep fresh for a much longer time if they are placed in a solution of aspirin and water. Each vase is filled with water slightly off the chill and an aspirin tablet is then put in. The cut blooms are duly arranged and it will be found that the aspirin solution has a wonderfully stimulating effect. Even kinds that do not as a rule keep well in water last a good while with the aid of aspirin. Flowers which are worn for personal adornment should have small wads of cotton wool soaked in aspirin wrapped round the stalks. This may be protected with a little tinfoil. Badly wilted blossoms revive magically if their stalks are placed in a warm aspirin solution.

Contributed by S. LEONARD BASTIN.

A STOVE IN A TENT

Campers out often feel the cold at night, especially if the weather is wet and chilly. Here is a way of fixing up a stove in a tent which is quite safe and does not involve the least risk of fire. In the first place get a metal bucket and put this upside down on the floor of the tent. With a stick mark out the circle around the outside of the pail. Then start to dig down inside this line, taking out the earth to the depth of about two feet. From the camp fire collect a quantity of glowing embers. These should be packed into the hole you have dug out and pressed down very firmly. Go on until the hole is quite full and then take the bucket and put it still inverted right over the opening. Pack soil round the line where the bucket joins the ground in order to keep any fumes from the smouldering embers from escaping into the tent. The bucket will then start to radiate heat and it will continue to do so for a good many hours.

Contributed by S. LEONARD BASTIN.

SNAILS AS BAROMETERS

Snails are extraordinary indicators of changes in the weather. Several years ago, Mr. Thomas, of Cincinnati, who was known as an accredited observer of natural phenomena, gave some interesting accounts of weather-wise snails. They do not drink, but imbibe moisture in their bodies during rain, and exude it at regular intervals afterwards. Then a certain snail first exudes the pure liquid; when this is exhausted, a light red succeeds, then a deep red, next yellow, and lastly a dark brown. The snail is very careful not to exude more of its moisture than is necessary. It is never seen abroad except before rain, when it is found ascending the bark of trees and getting on the leaves. The tree-snail is also seen ascending the stems of plants two days before rain: if it be a long and hard rain they get on the sheltered side of the leaf, if a short rain on the outside of the leaf. Another snail has the same habit, but differs only in its color: before rain it is yellow, and after it, blue. Others show signs of rain, not only by means of exuding fluids, but by means of pores and protuberances; and the bodies of some snails have large tubercles rising from them before rain. These tubercles commence showing themselves ten days previous to the fall of rain they indicate; at the end of these tubercles is a pore; and at the time of rain these tubercles, with their pores opened are stretched to their utmost to receive the water. In another kind of snail, a few days before rain a large and deep indentation beginning at the head between the horns, and ending with the jointure at the shell appears. Other snails, a few days before the rain, crawl to the most exposed hill-side, where, if they arrive before the rain descends, they seek some crevice in the rocks, and then close the aperture of the shell with some glutinous substance; this, when the rain approaches, they dissolve, and are then seen crawling about.

Contibuted by W. R. REINICKE.

CHRISTMAS DECORATIONS—DANGERS OF COTTON WOOL

Cotton wool is often used in connection with the Christmas festivities. The material is, of course, highly inflammable, and many serious accidents have occurred as a consequence. By treating the wool with a strong alum solution it may be rendered practically non-inflammable. Make a solution of about two ounces of alum to the pint and well soak the sheets of cotton in the solution. They should then be hung up to dry. Before they are quite dry spread the sheet on a flat surface and go over it, pulling it up a little so as to restore the fluffy appearance. The alum crystals which appear when the drying is complete rather add to the effect, as they give a frost-like appearance.

Contributed by W. R. REINICKE.

World-Time Clock for Radio Stations

By DR. ALFRED GRADENWITZ

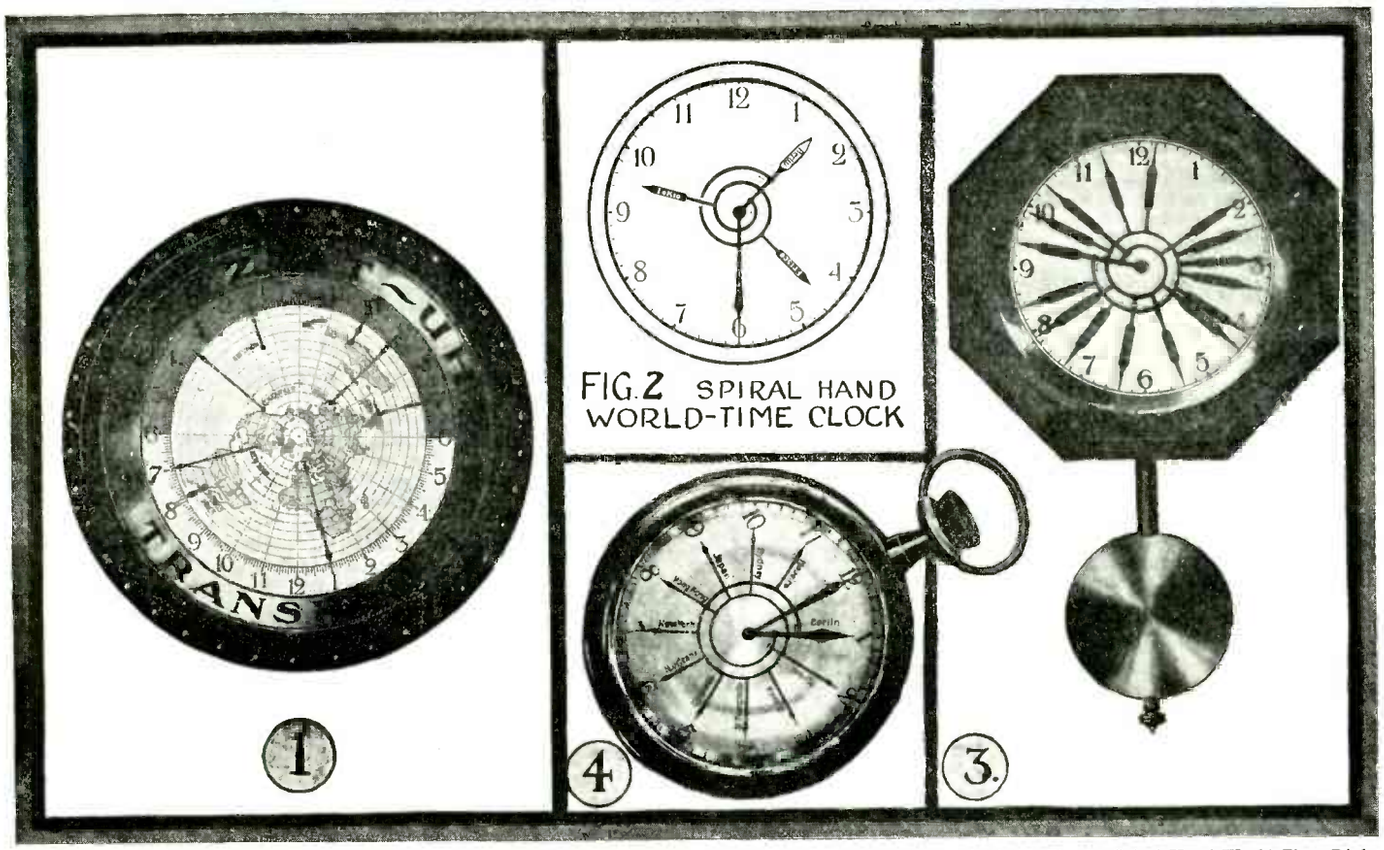


Fig. 1—World-Time Clock: Upper Half in the Dark, Lower Half Illuminated. Hands Rotate Along With Flattened Globe. Fig. 2—Spiral-Hand World-Time Dial. Fig. 3—Ordinary Clock Transformed into World-Time Clock. Fig. 4—Ordinary Watch Transformed into World-Time Watch (With Zone Time)

THOSE inspecting the recently opened Transradio Central Station (Berlin, Germany), both in the "Europe" and in the "America" Hall observed a remarkable clock, the dial of which was half in darkness and half lighted. On inquiring into the special uses of these clocks, they were told that radio operators, by a glance at them, could tell at a moment's notice, where on our globe there happened to be day and where there was night. "World-Time Clocks" such as these have been designed by R. Hirsch, an engineer of the German Wireless Telegraph Company, and are likely to prove useful in many ways, especially to radio operators. Several types of them have been constructed, of which the following is a short description:

It will, of course, be readily understood that, on account of the present world-wide telegraph service, a knowledge of the time difference between the sending and receiving places has assumed greater importance than ever. Just think of press telegrams from one continent to the other, which at prearranged hours of the morning or evening, should arrive at their destination, in order to be handed to the printer in time, or of exchange quotations which must reach customers at given hours. An accurate knowledge of the local time of addresses in all these cases—and many others—is the foremost condition of a prompt supply of messages over considerable distances.

Ever since radio-telegraphy has been able to bridge distances of fifteen degrees of longitude, which is the zone corresponding to one hour's time difference, has there been a necessity of accounting for the time of day or night in connection with wireless sending and receiving stations. In fact, a knowledge of local time has in the case of wireless telegraphy become even more important than in cabling, both because of the greater distances bridged direct, and on account of the special ease of transmission during night hours.

The World-Time Clock represented in Fig. 1 comprises a 24-hour stationary dial, on which there rotates a world-map carrying a number of hour-hands, each corresponding to the place it is fixed to. The world-map can be considered as a globe, the northern half of which has been flattened down, while the outlines of continents have been so projected as to make the meridians appear as straight lines starting from the North Pole, and the degrees of latitude as circles, which, however, attain their maximum diameter at the South Pole, instead of at the equator. As seen from our figure, the deformations of the familiar map pictures even on the southern hemisphere are nowhere so considerable as to interfere with the ready identification of the world's principal places.

This clock, which, in accordance with the west-east rotation of the earth, must rotate from the right to the left, comprises a special clockwork taking the hour-hands around once in twenty-four hours. The upper half of the dial is kept in the dark and the lower is strongly lighted, thus allowing the shifting of day and night on the globe to be realized at a glance.

Another scheme designed by the same inventor enables any ordinary twelve-hour clock or watch to be converted into a world-time chronometer, without any alteration of the clockwork, gearing or case. Figs. 2, 3 and 4 show such time-pieces after conversion into world-time clocks.

Each of these clocks or watches, in addition to its normal hour-hand, corresponding to local time, is fitted with several hour-hands rigidly connected with the former, at the proper angular distance, and sharing in the rotation of the normal or local hand. The hour-hand corresponding to London, England, which shows a time difference of one hour as compared with Berlin, e. g., lies at 30 degrees from the Berlin hour-hand. If, progressing westward, across Madeira, New York, San Francisco, etc., ever new hour-hands be recorded, until, after one turn of the earth's circumference, Berlin is reached again, the feet of all these hour-hands are found to lie on a spiral of two turns. In fact, the hour-hand of a twelve-hour dial obviously has an angular speed double that of any point on the surface of the earth, so that a 30 degrees difference on the dial, as between

(*Continued on page* 684)

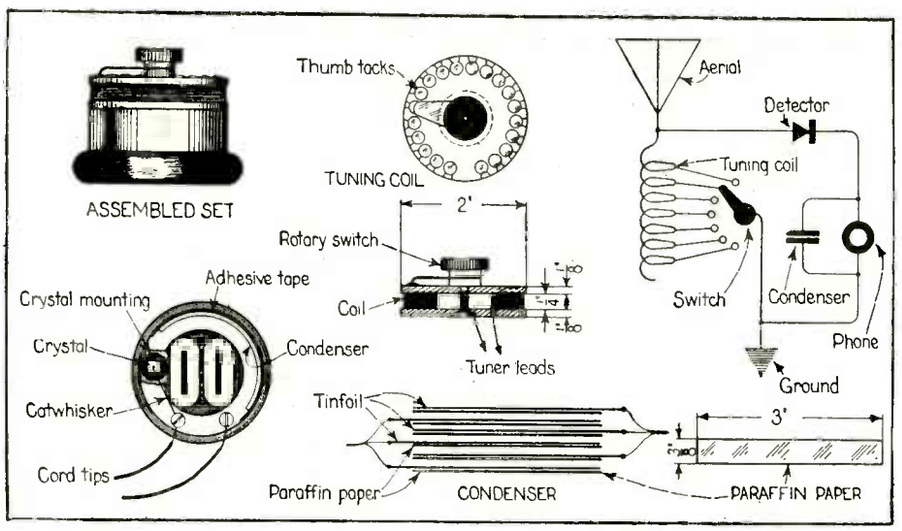


Diagram Above Shows Constructional Details and Wiring Diagram of Pocket Radiophone Receiving Set. All the Parts are Mounted Within or on Watch-Case-Type Receiver Shell.

Actual Photograph of Pocket Size Radiophone Receiving Set Which Won Sixth Prize.

The Simplest Radio Outfit Contest

By E. S. GUNN

(WINNER OF SIXTH PRIZE, $25.00, IN $300.00 RADIO RECEIVING SET CONTEST)

BELOW is described a very simple radio receiving set, consisting of a crystal detector, a tuning inductance, a fixed condenser and phone. The entire set is contained within the phone case, and on the back of the same. The set, when completed, is small enough to slip in one's pocket, and, when a good crystal is used in the detector, is ready for use at any time, two leads being provided to which are connected the aerial and ground.

To make the tuning inductance, a small bobbin 2 inches in diameter, and with a groove ¼ inch wide by about ½ inch deep, is necessary. This may consist of two round pieces of cigar-box wood, 2 inches in diameter, separated by a piece of ¼-inch wood, about 1 inch in diameter. The three pieces should be glued together and allowed to set until hard. Twenty small thumb-tacks are driven half way into one side of this bobbin, as is shown in the accompanying diagram. Through the center of the bobbin a hole is drilled to allow for the passage of the bolt which holds the switch arm. The lower end of this hole, on the opposite side of the bobbin to that on which the switch points are placed, should be counter-bored so that the nut which holds the bolt in position will be slightly below the surface of the bobbin.

A small hole should be drilled in the lower side of the bobbin, through which one end of the wire to be wound on the coil is passed. The winding consists of 500 turns of No. 28 enameled magnet wire, with a tap every 25 turns. To wind, pass one end of the wire through the hole spoken of above, and wind 25 turns on the core. End the twenty-fifth turn near the first thumb-tack, and form a loop about 1 inch long in the wire. Continue for the next 25 turns, and end near the second switch point. A loop is made here in the same way as the first. Continue this for the full 500 turns. Now, beginning with the first switch point, cut the wire so that it will just reach to the thumb-tack and have a little left over. Scrape the wire thoroughly and wind around the thumb-tack two or three times. Now press the thumb-tack down firmly to make good contact with the wire. Do the same with the other 19 points. The end of the wire is to be fastened to the twentieth point.

To make the condenser, cut six strips of paraffin paper ⅜ inch wide by 3 inches long, and six strips of tin-foil, slightly narrower, but ½ inch longer. Combine these strips as shown in the diagram, having the lugs of the adjacent strips of tin-foil project on opposite sides. Press the unit together and wrap with paraffin paper, leaving the lugs protruding. Cut two pieces of magnet wire about 2 inches long, scrape the ends bright, and attach one to each end of the condenser by folding the lugs over the wire and tying with thread. This condenser is mounted inside the receiver as shown.

To make the detector, cut a strip of electricians' tape about 3½ inches long by ⅜ inch wide, and fold over several times to make a pad about ¾ inch long by ⅜ inch wide. This is pressed down between the receiver magnets and the shell, as is shown. Upon this is placed a mounted crystal which should be of such size as to make a snug fit. A wire should be soldered to the crystal mounting for connection.

Next remove the receiver connections very carefully, and connect each end of the magnet winding to each side of the condenser. One side of the condenser is then connected to the crystal holder, and the other side to one of the receiver binding posts, which projects through the back of the shell. This same post is also to be connected to the switch arm of the tuner. The detector cat-whisker wire is connected to the other binding post, which also connects to the end of the wire in the tuner. These two binding posts also serve for aerial and ground connections and short lengths of flexible wire should be fastened thereto. After all connections are soldered, glue the bobbin securely to the back of the receiver.

Be very sure, in constructing this set, that none of the parts of the condenser or the detector touch the diaphragm.

To use this set connect the two leads provided to the aerial and ground, adjust the detector, place the diaphragm and cap on the receiver, and the set is ready to use. Tuning is accomplished by turning the switch arm over the contact points.

Feature Articles in November "Radio News"

The Radio Patent Situation. By John B. Brady.

Radio Antennæ and Their Uses. By James Ashton Greig, B.S., E.E.

Radio Photography. By Austin Riu.

Short-Wave Directional Wireless Telegraphy. By C. S. Franklin.

Tremendous Possibilities of Radio. By J. P. Glass.

Start a Radio Chart and Double the Fun of the Game. By Armstrong Perry.

Story of Mahlon Loomis, Pioneer of Radio. By S. R. Winters.

Construction of a Multi-Range Receiver. By Kenneth Harkness.

With the Sea-Going Ops.

Young Inventor Perfects Modulator

When the three-electrode audion or vacuum tube, the invention that made radio telephony possible, came into being along in 1912, it set to working the mental machinery of Reginald A. Heising, a young physicist working for a degree as Master of Science in the University of Wisconsin.

"If I could put into a vacuum tube the amount of energy produced by the voice and get it out many times amplified in the form of high frequency power in an antenna, what an advance it would be," thought this young scientist.

Armed with his degree he went to work on this problem in the research laboratories of the Bell System operated by the Western Electric Company. Six weeks after he started, his first patent establishing the basic principle of the Heising modulation system was applied for. Since that time he has been engaged in perfecting the discovery. How well he has solved the problem was proved by the award in 1921 to him of the Morris Liebmann Memorial prize by the Institute of Radio Engineers. This is the highest tribute which the radio fraternity can bestow upon a fellow scientist.

Glass Bottle Regenerative Receiver

TO make this set, procure a wooden base, 2 inches thick, by 6 inches wide, and of sufficient length to mount all the instruments.

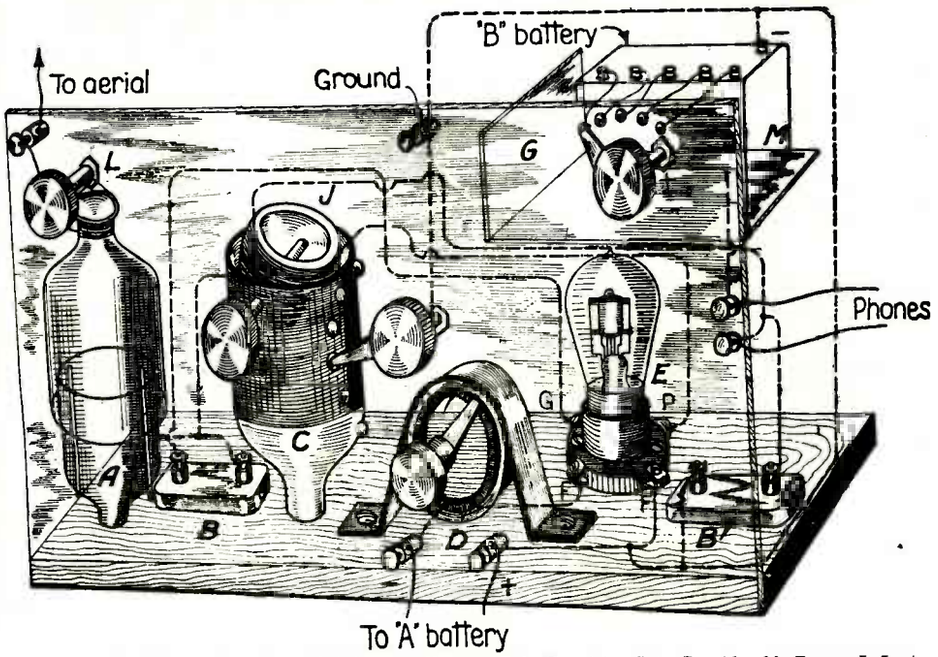
The variable condenser is composed of two bottles, one slightly smaller in diameter than the other. Cut the bottom off the larger of the two, and coat the inside with tin-foil. Coat the outside of the smaller bottle with tin-foil, and at equal distances around the bottle paste four strips of waxed paper to keep the two sheets of tin-foil from touching each other. The smaller bottle is mounted by drilling a hole through the base, and sealing the neck of the bottle in it with insulating compound. The larger bottle is slipped over this, and is raised and lowered by means of a cord fastened to its neck, the upper end of which passes over a roller in the top of the cabinet. At the end of the roller is fastened a knob and dial, and by turning this the capacity of the condenser is varied.

The stator of the vario-coupler is composed of a bottle from which the bottom has been cut off. It is fastened in the base the same as the smaller bottle of the variable condenser. The rotor is a section cut off a smaller bottle, which will just rotate within the stator. Holes are drilled in the sides of the stator and rotor in such a position that a rod may be passed through them, which is used to turn the rotor.

The rheostat is composed of a section about 1 inch long, cut from the same bottle as the rotor of the vario-coupler. This is wound with resistance wire as is shown in the diagram. Cut a circular piece of wood which just fits inside the rheostat. In the center of this bore a hole, and pass a rod through it which carries an arm making contact with the resistance wire. This rod also passes through the panel and carries on the end a knob and pointer.

The instruments are mounted in a cabinet, the front of which is made of a piece of window glass, drilled for the various switches, etc. A switch is used to vary the amount of inductance in the primary of the vario-coupler.

In the upper right hand corner of the cabinet is fastened a small box that contains the "B" battery, which is controlled by a switch mounted on the panel.



It Is a Well Known Fact That With Present Vacuum Tube Receiving Sets, Considerable Energy Is Lost Through Leaky Insulation, Such as Wood and Other Similar Materials. An Ideal Insulation Is Glass and For Those Who Have a Little Patience and Skill in Cutting Bottles and Drilling Holes in Glass, Here Is a Good Suggestion for Building a V. T. Regenerative Set of Glass Bottles, With a Glass Switch Panel.

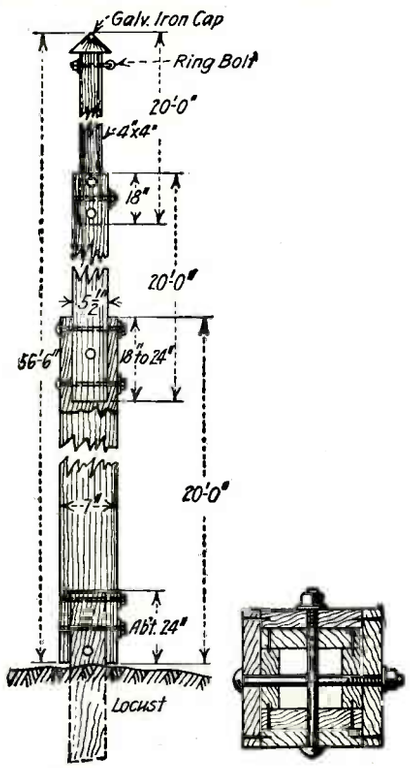
Besides the instruments above described, a vacuum tube, a socket, and two fixed condensers are used in the circuit.

The hook-up is also given herewith.

Contributed by T. H. HALSTEAD.

Radio Aerial Pole

If you cannot buy a solid flag pole, of the length you need for your aerial, make your own as shown in the sketch. This pole is made with ¾ inch boards cut to the proper width. The top piece is solid, 4 inches by 4 inches tapered down to about 3 inches at the very peak. Each connecting section is bolted together with three wagon bolts.



For the ground post, use a piece of locust or oak cut square two or three feet long to fit the first section of the pole. A pole of any desired length can be made by simply adding the necessary sections. The cross-section drawing shows how this rather rigid pole is built up. Needless to say, the pole should be well guyed and given at least two coats of paint and one of varnish.

Contributed by HENRY FREY.

All of Us Who Desire a Good Radio Mast Cannot Purchase a Flag Pole or Procure a Tree of Sufficient Length for Such Purposes. Here Is a Suggestion on How to Build a Radio Mast From ¾ Inch Lumber, the Top Section Being Made From a Solid 4 by 4 Inch Strip. A 2 by 4 Inch Stick Will Do if the Pole Is Particularly Well Guyed; or the Top Section May Be a Small Flag Pole or Else a Section of 1¼ or 1½ Inch Pipe.

INCREASING THE SENSITIVENESS OF A GALENA DETECTOR

The sensitiveness of a galena crystal can be materially increased by subjecting the crystal to the action of the flash of an electric arc. The operation is quite simple if one has easy access to a 600-volt D. C. circuit. From such a circuit a ½ inch arc can easily be obtained by slowly opening a knife switch controlling five 125-volt lamps in series.

Proceed as follows: hold the crystal between two small strips of fiber and insert it between the blade and the jaw of a knife switch so as to make contact and light the lamps; galena being a fairly good conductor will permit the lamps to shine at almost full brilliancy. Open the switch blade slowly and turn the crystal a few seconds inside of the arc so as to flash the exposed crystal surfaces. Next change the position of crystal and repeat the operation till the crystal has been flashed all over.

Caution: Do not hold the crystal in the arc too long; two or three seconds at a time is sufficient. If held in the arc too long the galena will decompose and burn, giving off a strong odor of burning sulphur. An over-flashed crystal will be injured and show a brownish sulphurous deposit on its surface, while a properly treated one will still keep its bright luster.

Galena is a common lead-sulphur ore (PbS) and gets easily tarnished from careless handling and exposure to dust and moisture. The flashing process affords a simple and rapid means of thoroughly drying and cleaning the surfaces of the crystal. It will be found that a galena crystal thus treated will show considerably greater sensitiveness.

Contributed by CHARLES VIVIER.

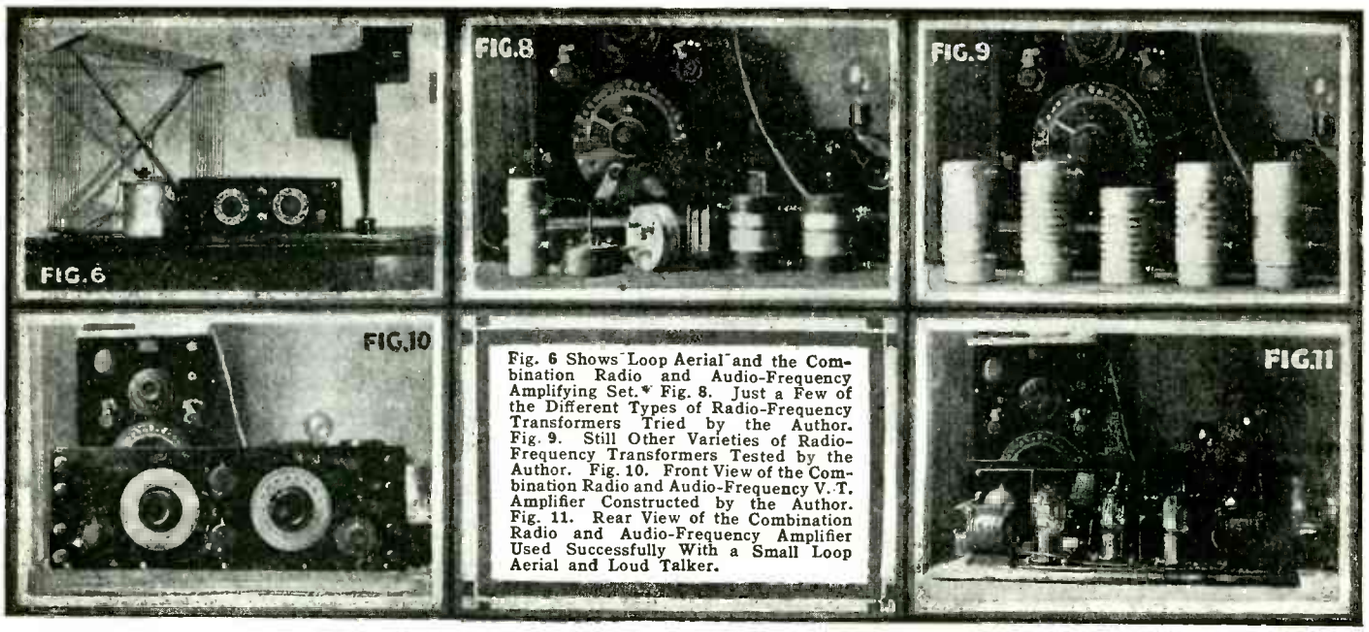


Fig. 6 Shows Loop Aerial and the Combination Radio and Audio-Frequency Amplifying Set. Fig. 8. Just a Few of the Different Types of Radio-Frequency Transformers Tried by the Author. Fig. 9. Still Other Varieties of Radio-Frequency Transformers Tested by the Author. Fig. 10. Front View of the Combination Radio and Audio-Frequency V. T. Amplifier Constructed by the Author. Fig. 11. Rear View of the Combination Radio and Audio-Frequency Amplifier Used Successfully With a Small Loop Aerial and Loud Talker.

Some Practical Data on Radio-Frequency Amplification

By ROBERT E. LACAULT

THE present article deals with the cascade system of radio-frequency amplification, which, although not so efficient as the super-regenerative one, gives fair results when properly used. It is hoped that the data given here will be of some use to those who are interested in the question.

The experiments to be described were started long before any radio-frequency transformers were on the market and good results were obtained. We have since tried almost all of them and found that in most cases they do not perform what is claimed for them. These experiments showed us that an amateur can make himself a radio-frequency amplifier that will work well. In most cases the transformers that are being sold do not *transform* on short wave-lengths, but merely act as condensers, and poor condensers at that, the windings being insufficient to cover the bands of wave-lengths it is claimed they do. Several of them have been designed for amplification on 360 meters and they are good to receive broadcasting stations, but on short wave-lengths the amplification drops to a very small value.

Upon opening the transformers we found, in most cases, imbedded in paraffin wax, either a self-supporting winding or a straight iron core, upon which was wound in slots, cut in a former, some very fine wire. Some others were wound in slots cut in a disc of fiber, and it was easy to see that only a few have been originally designed, while the others are just copies of these.

The accompanying photographs show various types of transformers which were made by the author and compared in different circuits, the results obtained being shown in the table, together with the characteristics. On 200-meter wave-lengths it is difficult to get transformers to work well and we found that the tuned circuit system is better and more flexible, as it is possible to use, as inductances, some coils, which may be plugged in to cover the desired band of wave-lengths. It should be noted that all the experiments have been carried out using a loop aerial 22″ square, which is shown in one of the photographs.

Fig. 1 shows a circuit which works well and consists of two stages of radio-frequency amplification and detector. Of course, an audio-frequency amplifier may be added to operate a loud speaker. The only drawback in an amplifier of this kind is the necessity of tuning each stage separately; however, the advantages, namely, selectivity and greater amplification, are, we think, worth the trouble of such tuning, especially if one considers that with the tuning condenser of the loop circuit, this makes only three controls, which is the same number as in a regular regenerative receiver. The circuit of Fig. 1 is well adapted to reception with loop aerial, but may be used with an ordinary set. If one does not want the added controls, some transformers may be used as in Fig. 2. The transformers may be wound on formers equipped with pins and fitting into V.T. sockets so that one may easily be substituted for another to cover different sets of wave-lengths.

The transformers that we found best are those wound in sections with the primary between the divided secondary. Fig. 3 shows those which worked best on 200 meters. The effective range over which the amplification was constant was found to be about 175 to 240 meters. The next band of wave-

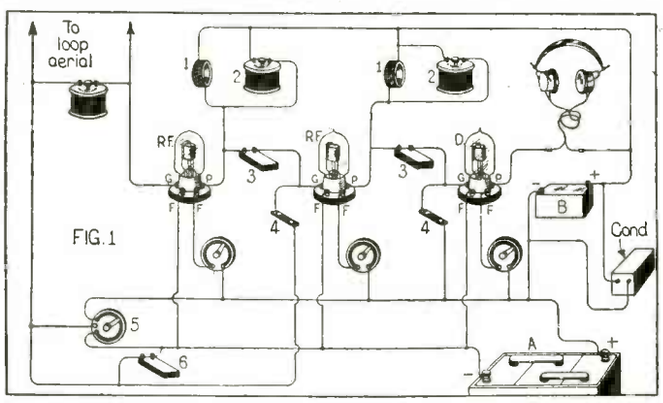


Fig. 1 Is a Radio-Frequency Amplifier Circuit Using Tuned Plate Circuits Which Gives a Very High Amplification. Only Two Stages May Be Used, for Oscillations Start Easily in Such an Amplifier and Become Difficult to Control. The Coils 1 Must Be of the Proper Size for the Wave-Length That Is to Be Received. In This Circuit 1 Represents Honeycomb Coils; 2, Some Small Variable Condensers of About .0003 M. F.; 3 Are Some Fixed Condensers of About .00025 M. F. Capacity, While the Resistances 4 Are Grid-Leaks Having a Value of 1 Megohm. The Potentiometer 5 May Be of Any Type Having a Resistance of 200 to 400 Ohms. The Condenser 6 Acts as a By-pass for the Oscillations, and May Be of About .002 M. F. Type.

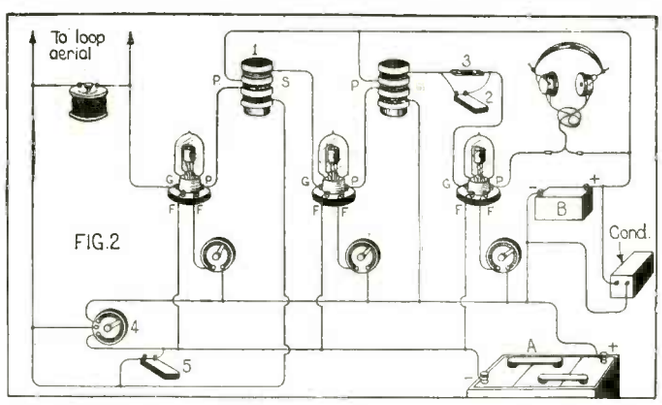


Fig. 2 Shows the Connections of a Radio-Frequency Amplifier Using Transformers Between the Tubes. These May Be Constructed According to the Data Given in This Article and as Many as Three or Four Stages May Be Used to Increase the Sensitiveness of the Amplifier. The Last Vacuum Tube on the Right is the Detector, Which May be Followed by an Audio-Frequency Amplifier if Very Loud Signals Are Desired to Operate a Loud-Speaker. The Constants of the Circuits Are as Follows: 1 Is a Radio-Frequency Transformer; 2 Is a Grid Condenser of .00025 M. F. Capacity; 3 Is a Grid-Leak of About 1 Megohm; 4 Is a Potentiometer of 300 to 400 Ohms; and 5 Is a .002 M. F. Fixed Condenser.

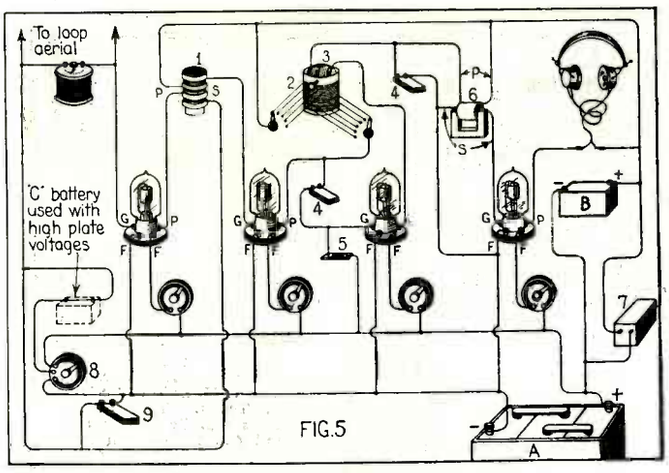


Fig. 5. Combined Radio and Audio-Frequency Amplifier. First Stage of Radio-Frequency Uses a Transformer, While the Coupling Between the Second Stage and the Detector Tube Is Made By Means of a Vario-Coupler, the Secondary of Which Should Be Wound in the Same Direction as the Primary. The Following Are the Constants of the Circuit: 1 Is a Radio-Frequency Transformer; 2 Is a Coupler With Units and Tens Switch; 3 Is the Secondary of Coupler Wound With 20 Turns; 4 Is a Fixed Condenser of .00025 M. F. Capacity; 5 Is a Grid-Leak of About 1 Megohm; 6 Is an Audio-Frequency Transformer; 7 Is a 1 M. F. Condenser; 8 Is a 300 to 400 Ohm Potentiometer; and 9 Is a .002 M. F. Fixed Condenser.

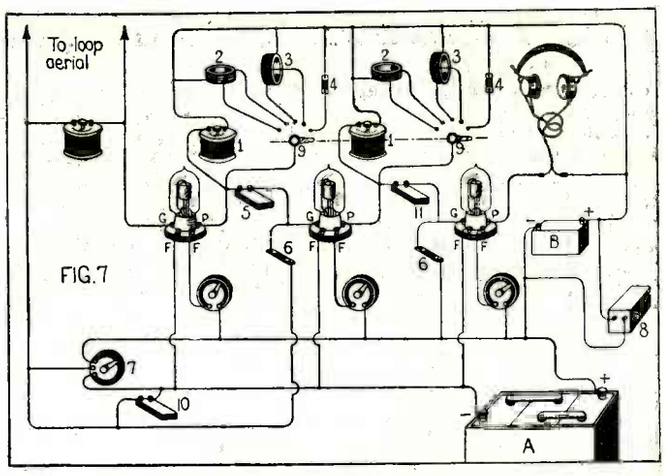


Fig. 7. Such an Amplifier May Be Used for Any Wave-Length. A Switching Arrangement Is Used, Which Changes the Tuned Circuit Coupling for Short Waves to the Resistance Coupling for Longer Waves. The Switches May Be of Any Type and Equipped With a Rod Moving Them All Simultaneously. In This Circuit 1 Is a .0003 M. F. Variable Condenser; 2 is an L 75 Honeycomb Coil With a Tap at the 40th Turn; 3 an L 200 Honeycomb Coil With a Tap at the 100th Turn; 4 a 70,000-Ohm Resistance; 5 a .00025 M. F. Fixed Condenser; 6 a Grid-Leak of About 2 Megohms; 7 a 300-Ohm Potentiometer; 8 a 1 M. F. Condenser; 9 Are Switches Mounted on the Same Shaft; 10 is a .002 M. F. Fixed Condenser; and 11 is a .00015 M. F. Fixed Condenser.

lengths is covered by the transformer No. 2 of Table 1. It has seven slots, as shown in Fig. 4, and covers the range 200 to 400 meters. From about 360 to 575 meters the same size former is used, but with 30 turns in each slot, that is, 90 turns for the primary and 120 for the secondary. For the next band of wave-lengths up to 800 meters, 40 turns in each slot is suitable. Above this length resistance coupling may be used. If it is desired to receive the broadcasting stations only, transformers may be made that will amplify best at 360 meters. They should be of the same design as described previously with only 5 slots cut on the former and wound with 84 turns for the primary and 126 for the secondary. As may be seen in the drawings, the sections of the primary are sandwiched in between those of the secondary. To pass the wire between the various sections it is best to cut on the former a longitudinal slot, in which the wire lies, passing under the sections of the primary. See Fig. 4. For the winding No. 38 or 40 silk-covered wire is suitable.

A radio-frequency amplifier, using transformer coupling and feed back, is shown in Fig. 5. This set consists of two stages of radio-frequency, detector and one stage of audio-frequency amplification. The transformer is used in conjunction with a vario-coupler to obtain a regenerative action, and added amplification, with the detector tube. Another set which was recently in operation but which has been discarded since the advent of the super-regenerative circuit is shown in Fig. 6. It consists of two stages of radio-frequency, as illustrated in the diagram, Fig. 1, with detector and two stages of audio-frequency amplification. In New York City, on the small loop described previously, we can get stations in Connecticut, New Jersey and Pennsylvania, while sometimes on good nights stations up-state and in Massachusetts come in readable.

The diagram Fig. 7 is that of an amplifier that was designed to cover the whole range of wave-lengths from 160 meters up to 25,000 meters. It is a combination of the tuned circuit and resistance system. By means of switches mounted on the same shaft and operated by a single knob, different values of inductances can be introduced in the circuit and connected in parallel with a variable condenser providing the necessary means of tuning in each stage. Two different coils mounted at right angles cover the range from 180 to about 1,000 meters, while the resistance coupling is used for the long wave-lengths.

Such a system is practical for the amateur who can only afford to build one amplifier, and it may be so constructed as to have two or three stages of radio-frequency amplification. If more than two stages are used, a separate potentiometer should control the grid potential of the first tube. From all these experiments we concluded that the most efficient system of radio-frequency amplification on short waves was the tuned circuit coupled system, giving greater selectivity and amplification, both of which are highly desirable in an amateur station. If one is willing to sacrifice a little of the efficiency for a gain in simplicity the transformers will offer a convenient means of coupling, although the necessity of changing the various transformers is also a complication that is to be taken into consideration; soldering of the contacts is also necessary for good results.

When high amplification is desired, a higher plate voltage will be necessary with the use of C or grid battery connected, as shown in dotted lines in Fig. 5. However, a B battery of 45 to 80 volts is quite sufficient. It is generally necessary to connect a by-pass condenser of large capacity across the B battery, as the resistance of the cells increases with age and introduces in the plate circuit an undesirable damping effect. In fact, if an amplifier is properly constructed and if good batteries are used it should be silent. When noises are heard they are generally caused by defective cells in the B battery, irregular current from the A battery, or bad contacts somewhere. The presence of bad contacts may be ascertained by knocking the table; this causes violent crackling sounds in the telephone, showing that some wires are not well fastened and vibrate. The batteries may be verified with a voltmeter and replaced if ineffective.

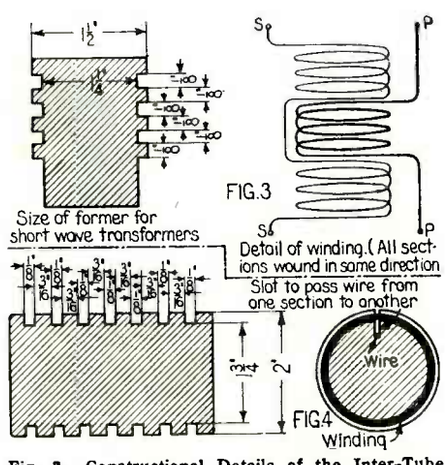


Fig. 3. Constructional Details of the Inter-Tube Transformers Are Given in This Sketch. As May Be Noted, the Primary Winding is Wound in Sections Sandwiched Between Those of the Secondary.

As it is important to have maximum potential impressed upon the grid of the first tube the tuning of the loop or secondary of the tuner should be made with as much inductance and as little capacity as possible.

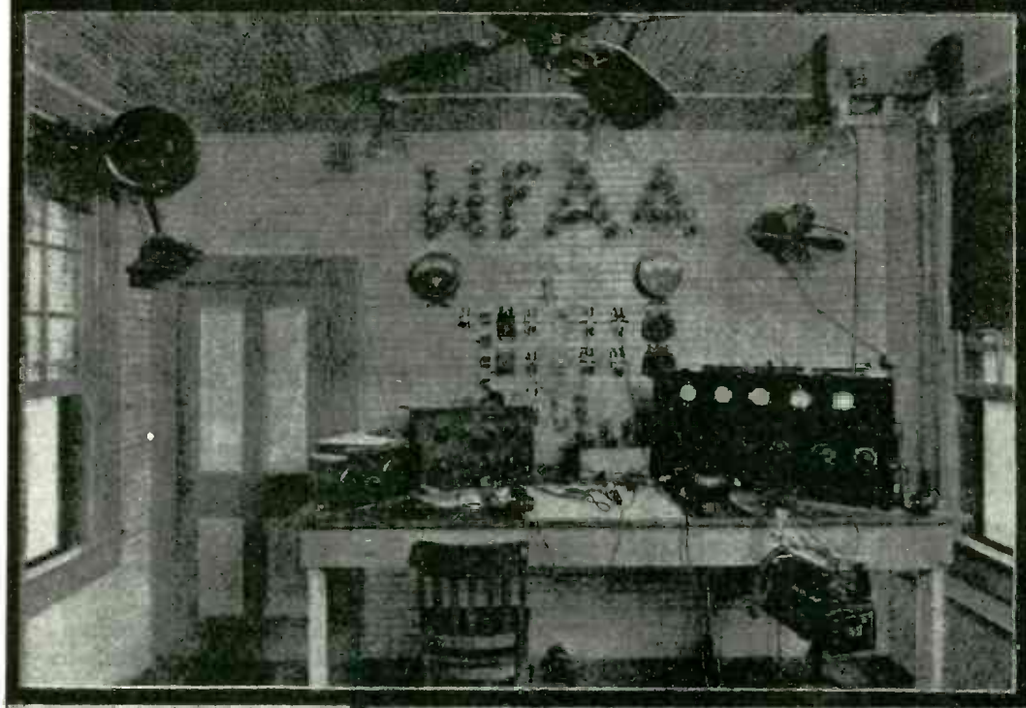
In resistance amplifiers, which amplify wave-lengths above 800 meters when tubes with low internal capacity are used, the resistance of the plate circuit should be non-inductive of 80,000 ohms each, with a B battery of 80 volts. The coupling condensers may be of .00025 M.F. capacity, as shown in Fig. 7. In such a circuit the variable condensers should have a very low zero capacity and be tuned to minimum when the resistance coupling is in use.

All these experiments were carried out with tubes having low internal capacity, such as the AP or Myer's RAC3 audion. If other makes of tubes are used the results may not be the same, but it would be easy to change the windings of the transformers slightly to meet with the characteristics of the tubes.

TABLE I

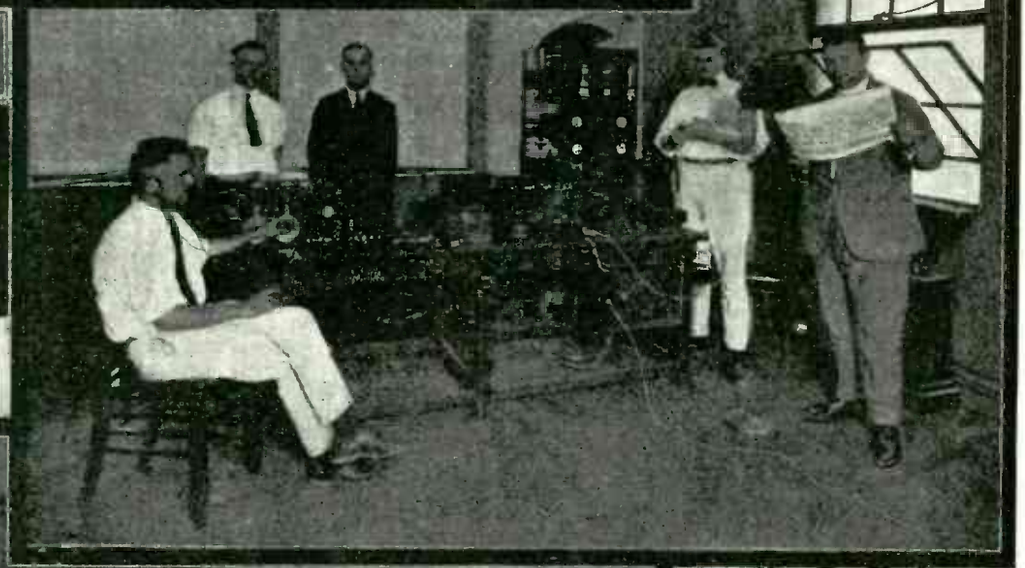
Transformer No.	Characteristics	Effective Range of W. L.	Observations
1	3 Slots. Prim. 36t. Sec. 60t.	175–240	Tube oscillates but may be easily controlled with potentiometer.
2	7 Slots–A. Prim. 60t. Sec. 90t.	200–400	Same as above.
3	5 Slots. Prim. 80t. Sec. 90t.	340–460	Only $\frac{1}{16}$" space between each section. Fairly good. Oscillates on about 375 M. Can be controlled.
4	7 Slots–B. Prim. 51t. Sec. 60t.	200–375	Same as No. 1.
5	Wound in 1 layer. Prim. between 2 sections of secondary Prim. 70t. Sec. 120t.	290–430	Good.
6	Flat. Prim. and Sec. wound in 2 slots close together. Prim. 120t. Sec. 180t.	460–650	Circuit does not oscillate over entire range.
7	Wound in 1 layer. Prim. and Sec. side by side. Prim. 50t. Sec. 80t.	200–300	Oscillations difficult to control.

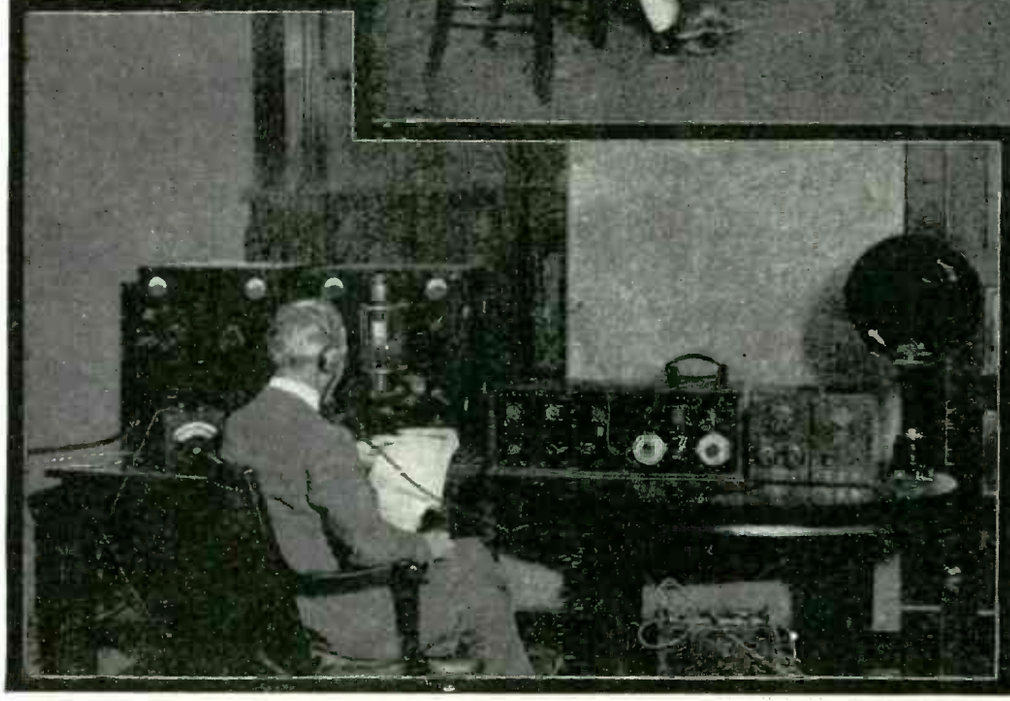
BROADCAST STATIONS



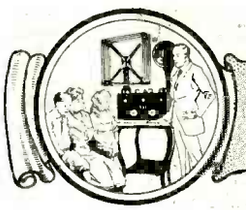
WFAA Broadcasting Station of the Dallas News, and Dallas Journal (A. H. Belo & Co.), at Dallas, Texas. This Station Furnishes a Daily Program on 360 and 485 Meters. A 100-Watt Transmitter With Aerial and Counterpoise, Gives a Range of 250 Miles Consistently, Max. 1,500 Miles.

WGV, Broadcasting Station of the Interstate Electric Co., New Orleans, La., Transmits a Daily Schedule of Weather, Lectures, Market Reports, Music, News Bulletins and Special Features, With Chapel Service on Sundays. Reported Heard a Thousand Miles.





WOE Broadcasting Station of the Arkansas Light & Power Co., Pine Bluff, Ark. This Station Broadcasts Baseball Scores Daily from 6.30 to 7.30 P.M. on 360 Meters. They Radiate 5¼ Amperes and Have Been Heard in Nearly Every State in the Union.



RADIO BROADCAST

THERE are so many broadcasting stations which have forwarded information, that we regret we have only space enough to print a very few. Those stations which have been courteous enough to submit photographs will find that the photos will be published in due time. The stations listed on this sheet will not be published in the next issue. We would suggest to our readers that the map locations indicated on this page are for the special supplement map given free with the May issue of SCIENCE AND INVENTION. At a great expense this list of the stations has been practically completed as far as commercial broadcasting stations are concerned. We will present our readers with additional information on the new stations as it is brought to our attention. Address all communications to Editor Radio Broadcast, c/o SCIENCE AND INVENTION MAGAZINE, New York City.

ADDITIONAL BROADCASTING STATIONS NOT PREVIOUSLY LISTED

Call Letter	Name	City and State	Wave Length	Map Location
KFAY	W. J. Virgin Milling Co	Central Point, Ore.	360	H-4
KFBH	Thomas Musical Co	Marshfield, Ore	360	G-3
KFBJ	Idaho Radio Supply Co	Boise, Idaho	360	H-10
KFBK	Kimball-Upson Co	Sacramento, Cal	360	M-4
KFBL	Leese Bros	Everett, Wash	360	B-6
KFBM	Cook & Foster	Astoria, Ore	360	D-5
KFBN	Borch Radio Corp	(Portable.) Cal	360	
KFDB	John D. McKee	San Francisco, Cal	360	O-3
WIAZ	Electric Supply Sales Co	Miami, Fla	360	AD-45
WJAN	Peoria Star-Peoria Radio Sales Co	Peoria, Ill	360	N-34
WJAP	Kelley-Duluth Co	Duluth, Minn	360	F-31
WJAQ	Capper Publications	Topeka, Kansas	360	P-28
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360	K-50
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa	360	M-47
WJAT	Kelly-Vawter Jewelry Co	Marshall, Mo	360	P-30
WJAU	Yankton College	Yankton, S. Dak	360	L-27
WJAX	Union Trust Co	Cleveland, Ohio	360	L-41
WJAZ	Chicago Radio Laboratory	Chicago, Ill	360	M-35
WKAD	Charles Looff (Crescent Park)	East Providence, R. I.	360	K-50
WKAG	Edwin T. Bruce, M.D.	Louisville, Ky	360	Q-37
WKAH	Planet Radio Co	West Palm Beach, Fla	360	AC-45
WKAJ	Fargo Plumbing & Heating Co.	Fargo, N. Dak	360	F-27
WKAK	Okfuskee County News	Okemah, Okla	360	T-28
WKAL	Gray & Gray	Orange, Texas	360	Z-30
WKAM	Hastings Daily Tribune	Hastings, Nebr	360	N-26
WKAN	Alabama Radio Mfg. Co	Montgomery, Ala	360	W-37
WKAP	Dutee W. Flint	Cranston, R. I	360	K-50
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R	360	
WKAR	Michigan Agriculture College	East Lansing, Mich.	360	K-38
WKAS	L. E. Lines Music Co	Springfield, Mo	360	R-30
WKAT	Frankfort Morning Times	Frankfort, Ind	360-485	N-36
WKAV	Laconia Radio Club	Laconia, N. H	360	H-49
WKAW	Turner Cycle Co	Beloit, Wis	360	L-34
WKAX	William A. MacFarlane	Bridgeport, Conn	360	L-48
WKAY	Brenau College	Gainesville, Ga	360	U-40
WKAZ	Landau's Music & Jewelry Co.	Wilkes-Barre, Pa	360	L-46
WLAB	George F. Grossman	Carrollton, Mo	360	P-30
WLAC	North Carolina State College	Raleigh, N. C	360	S-45
WLAD	Arvanette Radio Supply Co.	Hastings, Nebr	360	N-26
WLAF	Johnson Radio Co	Lincoln, Nebr	360	N-27
WLAH	Samuel Woodworth	Syracuse, N. Y	360	J-45
WLAJ	Waco Electrical Supply Co	Waco, Texas	360	Y-26
WMAD	Atchinson County Mail	Rock Port, Mo	360	O-28
WMAH	General Supply Co	Lincoln, Nebr	360	N-27
WMAM	Beaumont Radio Equipment Co	Beaumont, Texas	360	AA-29
WNAL	R. J. Rockwell	Omaha, Nebr	360	N-28

ELABORATED LIST GIVING TIME AND NATURE OF BROADCAST (Continued from previous issues)

Call Letter	Name	City	State	Wave Length
WBAZ	Times Dispatch Publishing Co. Weather, lectures, market reports, music, vocal and instrumental talent, baseball scores, news bulletins on Mondays, Wednesdays and Fridays 7.45-9.30 P. M. Tuesdays, Thursdays and Saturdays 7.45-8.00 P. M. Consistent range 500 miles. Maximum 1,000.	Richmond,	Va	360
WBL	T. & H. Radio Co. Lectures, market reports, music, vocal and instrumental talent, sermons, special features, daily except Sunday, 8.50 A. M., 9.50 A. M., 10.50 A. M., 11.50 A. M., 1.15 P. M., 7.00-8.00. P. M. Sundays 4.00-5.00 P. M. Consistent range 400 miles. Maximum 1,500.	Anthony,	Kansas	360
WBS	D. W. May, Inc. Lectures, music, vocal and instrumental talent, sermons, baseball scores, news bulletins and special features, Mondays, Wednesdays and Fridays 7.30-8.00 P. M. Sundays, 9.00-10.30 A. M., and 1.00-3.00 P. M. Consistent range 50 miles. Maximum to date, 100.	Newark,	N. J	360
WBT	Southern Radio Corp. Weather, time signals, lectures, market reports, music, vocal and instrumental talent, sermons. baseball scores, news bulletins every day except Sunday, 11.00 A. M., 6.00 P. M., 8.00-10.05 P. M. Sundays 11.00 A. M. and 8.00 P. M. Consistent range 300-500 miles. Maximum 1,500.	Charlotte,	N. C	360
WBU	City of Chicago. Lectures, news bulletins, special features Mondays, Wednesdays and Fridays 10.15 A. M., 12.45 P. M., 3.30 P. M., 4.45 P. M., 7.30 P. M., Tuesdays, Thursdays and Saturdays 10.15 A. M., 12.45 P. M., 4.45 P. M. Consistent range 300 miles. Maximum 500.	Chicago,	Ill	360
WBZ	Westinghouse Elec. & Mfg. Co. Bedtime stories, time signals, lectures, market reports, music, vocal and instrumental talent, sermons, baseball scores, news bulletins, special features every day except Sunday, 7.30-9.00 P. M. Sundays 8.00-9.00 P. M. Consistent range 1,500 miles. Maximum 2,000.	Springfield,	Mass	360
WCAB	Newburgh Daily News. Weather, lectures, music, vocal and instrumental talent, sermons, baseball scores, news bulletins, and special features 9.15-11.00 A. M., 12.30-12.50 P. M., 2.15-2.30 P. M., 4.15-4.30 P. M., 7.30-9.00 P. M., on Mondays, Tuesdays, Wednesdays and Fridays. Thursday and Saturday evenings have been given to WBAY, the new station of the A. T. & T. Co., and WJZ of Newark. Consistent range 100 miles. Maximum 600.	Newburgh,	N. Y	360
WCAC	John Fink Jewelry Co. Lectures, music, vocal and instrumental talent, sermons and special features every day except Sunday, 5.00-6.00 P. M., Friday 8.00-10.00 P. M. Sundays 3.00 P. M. Consistent range 200 miles. Maximum 1,000.	Fort Smith,	Ark	360
WCAH	Entrekin Electric Co. Weather, lectures, market reports, vocal and instrumental music, sermons, baseball scores, news bulletins and special features Tuesdays and Fridays 7.00-9.00 P. M., Wednesdays, Thursdays and Saturdays 7.00-8.00 P. M. Every day except Sundays, 4.30 (weather reports) Sundays 10.30 A. M. and 12.30 P. M.	Columbus,	Ohio	360
WCAJ	Nebraska Wesleyan University. Weather, lectures, market reports, vocal and instrumental music daily at 12.00 M., daily except Saturdays and Sundays 4.00 P. M., and on Tuesdays and Thursdays 9.30 P. M. Consistent range 100 miles. Maximum 700.	University Pl.,	Nebr.	360
WCAK	Alfred P. Daniel. Lectures, music, vocal and instrumental talent, sermons and special features daily 7.00-7.15 P. M. Wednesdays 8.00-9.00 P. M. Sundays 3.00-4.00 P. M. Consistent range 150 miles. Maximum 500.	Houston,	Texas	360
WDAA	Ward-Belmont School. Lectures, music, vocal and instrumental talent, sermons. Irregular hours by announcement in press.	Nashville,	Tenn	360
WDAC	Illinois Watch Co. Weather and time signals 12.00 M. and 9.15 P. M. daily. Consistent range 300 miles. Maximum 600.	Springfield,	Ill	485
WDAE	Tampa Daily Times. Lectures, market reports, music, vocal and instrumental talent, baseball scores, news bulletins and special features Wednesdays and Saturdays 8.00-10.00 P. M. Eastern time. Maximum range 1,000 miles.	Tampa,	Fla	360-485

(To be continued in the next issue—Save these as they will not be repeated.)

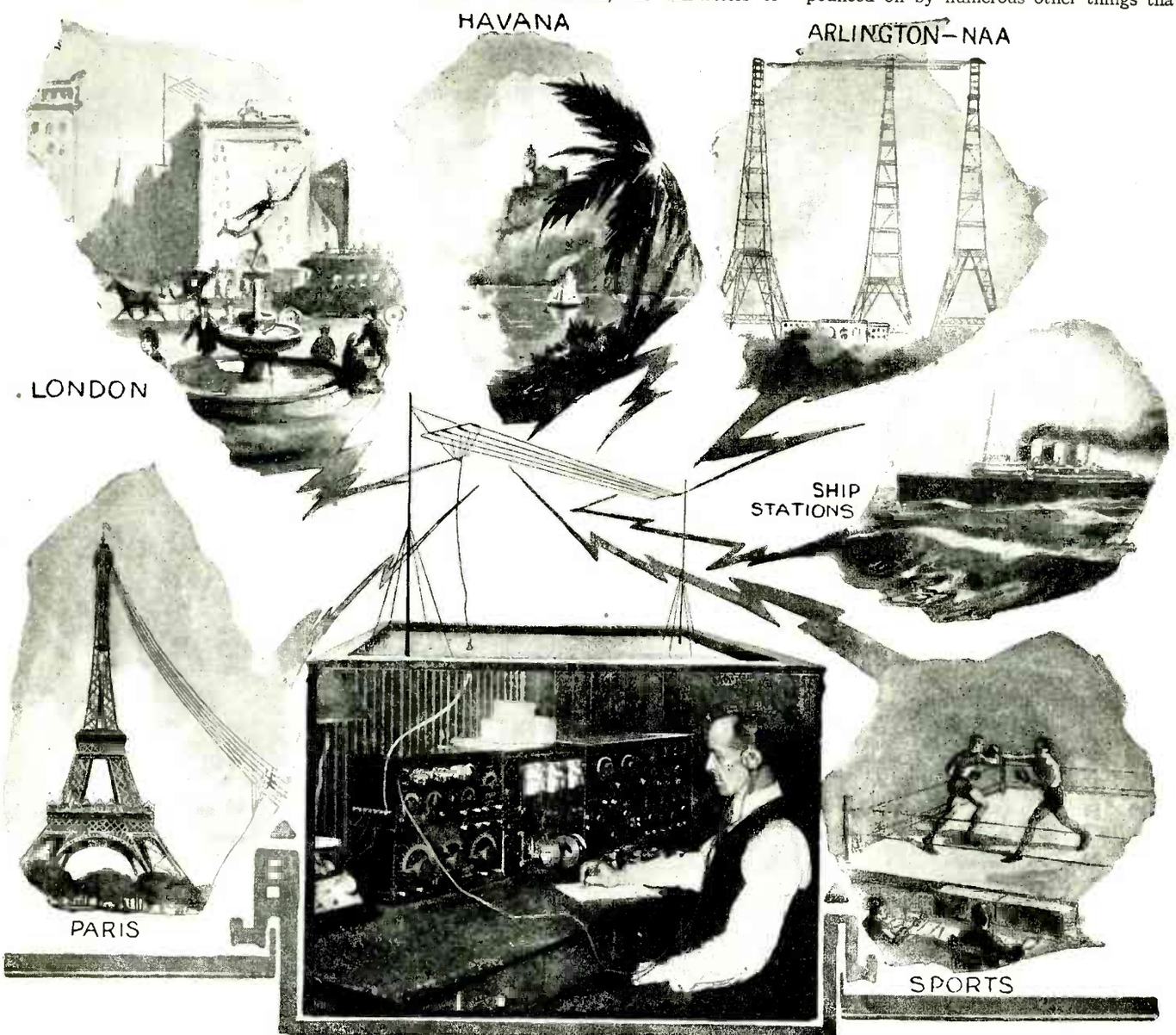
Radio for the Beginner

By ARMSTRONG PERRY

NO. 9—HOW TO FIND OUT WHAT IS IN THE AIR, AND WHEN

THOSE who use rural telephone lines have learned to distinguish the rapid series of clicks that show that the rest of the subscribers are taking down their receivers to listen in. In its lowest form, the desire to find out what is going on when it does not concern the listener may be obnoxious or even vicious, but the ether with an entirely legitimate purpose and in an inoffensive manner.

The beginner who interests himself only in listening to the price of eggs or the something-or-other blues has little exploring to do. He turns to the radio programs in the newspaper and selects what he wishes to hear. The location of the station, the call-letters or wise nearly always falls on deaf ears. Even people who play bridge and bet on horse races sometimes take no interest in sitting down to a radio receiver, starting at one hundred meters or less and prowling gradually up, pouncing on such game as is suspected to be hiding in the jungles of the air, and being pounced on by numerous other things that



To the Radio Enthusiast, Who Has a Fairly Good Receiving Set, and Who Learns How to Use It to the Best Advantage, There Is Practically No Limit to the Distance Over Which He May Hear Radiophone and Radio Telegraph Stations. It Is Not an Uncommon Performance for First Class Amateur Receiving Stations to Pick Up Signals from Foreign Shores. More and More Amateur Stations in the East Are Picking Up the Middle and Far West Radio Stations and Vice Versa.

fact that there exist colleges, research workers and explorers indicates that the longing to discover new information is fundamental even in the higher types of men. The reason that the high-brow has better standing than the eavesdropper is that he pries into the personal affairs of the ancient Abyssinians or the inhabitants of the polar regions instead of into those of the neighbor next door.

Governments, while they do not advertise the fact, listen in on each other's radio communications even in peace times. Some of them seek inside information by methods involving more of subterfuge. These facts are adduced not to encourage radio beginners to spend their time in picking up messages that are none of their business, but rather to stimulate interest in exploration of the name by which it may be identified, the hour at which it will transmit and the wave-length employed are all stated. He probably has a short-wave receiver, that being the type most employed for picking up radio telephone broadcasts. If so, his exploration is limited to the wave band between 150 and 600 meters probably. His two problems are to get his station and to avoid getting others at the same time. Having a definite objective and definite directions for reaching it, he loses all the real fun of exploration, which lies in venturing into unknown places and discovering unknown things.

Very early in the game I procured apparatus that would cover all the wave-lengths employed by the stations of the world. I learned the code. Advice to go and do likewere not known to exist. No doubt their sensitive natures cannot stand real excitement.

With my little old loose-coupler and crystal detector it is not difficult to cover its entire range. It has a circle of switch points on a panel at the front. By turning a knob I turn the switch tongue and add to or subtract from the inductance in the primary circuit, thereby adjusting it to receive longer or shorter waves. On the end of the secondary coil, which telescopes into the primary, is a circle of switch points similar, but fewer in number. The knob and tongue here adjust the secondary circuit to the primary.

I put the tongue of the secondary switch

(*Continued on page* 705)

Radio Oracle

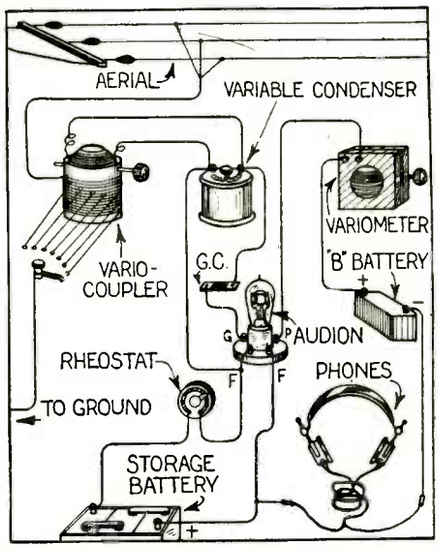
In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25c is made for all questions where a personal answer is desired.

REGENERATIVE CIRCUIT

(67) Harold Arnold, Unionville, Conn., requests:

Q. 1. A regenerative hook-up, using a vario-coupler and a variometer for tuning.

A. 1. The regenerative hook-up which you requested is given herewith.



A Simple Form of Short Wave Regenerative Tuner Is Shown Herewith, Employing a Single Variometer to Tune the Plate Circuit.

LONG DISTANCE RECEPTION

(68) Jose A. Perez de Lebrija, Mexico City, Mexico, asks:

Q. 1. What is the simplest kind of a receiving set that I can use to receive the music and concerts from New York, at my home in Mexico City?

A. 1. Since you are over 2,000 miles from New York City, it will take quite an elaborate receiving set to receive from there with any degree of consistency. We would suggest that you use a set such as was illustrated on page 156 of the June issue of SCIENCE AND INVENTION, and connect to this some type of power amplifier.

OSCILLATION TRANSFORMER

(69) Paul H. Montgomery, Albany, Mo., asks:

Q. 1. How should I wind the secondary of an oscillation transformer to be used in a transmitting circuit with a 1 K. W. transformer? The primary consists of one turn of copper ribbon 12 inches in diameter.

A. 1. The secondary of your oscillation transformer should be wound with eight turns of copper ribbon made up in a pancake shape. Use the same size ribbon as is on the primary. The outside diameter of this coil should be the same as that of the primary coil. Clips must be used for changing the inductance in order to tune your set to its highest efficiency.

ANTENNA HEIGHT

(70) J. Merriwether, Fort Wayne, Ind., wants to know:

Q. 1. If it is true that with a higher antenna the static becomes worse.

A. 1. It is true to a certain extent that the higher the antenna the greater the static, but the increase is so little that it would hardly be noticeable when compared with the increase in signal strength which would be obtained from a high aerial.

Q. 2. Would 150 feet be too high?

A. 2. We would say that 150 feet would be none too high, although aerials as low as 20 to 25 feet have given good results.

As a matter of fact, the efficient height of an antenna depends upon the nature of the surrounding country. If you are in a forest or in a city with high buildings, your antenna, for best results, should be higher than any of the surrounding objects. If, on the other hand, you are out on a level plain, a low antenna may very well be used.

CANNOT RECEIVE RADIOPHONE

(71) Lee R. Marks, Savannah, Ga., asks:

Q. 1. Can you tell me why I cannot receive radiophone broadcasts with my set which was constructed in accordance with the diagram on page 156 of the June issue of SCIENCE AND INVENTION? I can receive telegraph very plainly.

A. 1. Since you say that you are able to receive spark signals over your receiving set, all we can see is that you have not properly adjusted the tuning for any telephone station which may be within your range.

Q. 2. My radio-frequency transformers are rated to include wave-lengths of 5,000 meters. Must I change my short-wave set in any way to do this?

A. 2. In order to receive wave-lengths over 500 meters it will be necessary to load the circuits, but for average radiophone broadcasting this will not be necessary as most of the stations transmit on a wave-length of 360 and 485 meters.

STATIC AND CRYSTAL DETECTORS

(72) H. Mather, Chicago, Ill., asks:

Q. 1. What is static?

A. 1. Static is electricity present in the air.

Q. 2. Must the adjustment of a crystal detector be changed for every different station to be received from?

A. 2. No, unless you jar it out when tuning.

Q. 3. Would a stranded wire which would make contact with the crystal in several places, be better than a single wire?

A. 3. A stranded wire would not give better results on a crystal detector than a fine single wire in light contact with the crystal, providing you use galena, which is generally conceded to be the best all-around crystal. The cat-whisker wire should have a light spring tension.

Q. 4. Can a loop be used with a crystal detector to receive from a broadcasting station three miles away?

A. 4. If you use a large enough loop antenna, say about 4 feet square, wound with eight or ten turns of wire, you might possibly be able to hear the broadcast from a station three miles away, when using a crystal detector.

AMPLIFIER PLATE VOLTAGE

(73) H. A. Nicholson, Fowler, Mich., asks:

Q. 1. What plate voltage do UV-201's require for best results?

A. 1. UV-201 amplifying tubes generally operate on a plate voltage of anywhere from 45 to 100 volts. The exact voltage depends upon the characteristics of the tube, although generally the higher the voltage the greater the amplification.

Q. 2. Referring to the diagram, Fig. 4 in the article on Radio Amplification in the July issue of SCIENCE AND INVENTION, should the leads marked T. 1. be connected directly to the same place in the detector circuit where I now connect my phones?

A. 2. Yes.

NO RESULTS FROM RADIO-FREQUENCY AMPLIFIERS

(74) Ralph Blackman, Chattanooga, Tenn., says that he has had trouble in making radio frequency and audio frequency amplifiers work and asks:

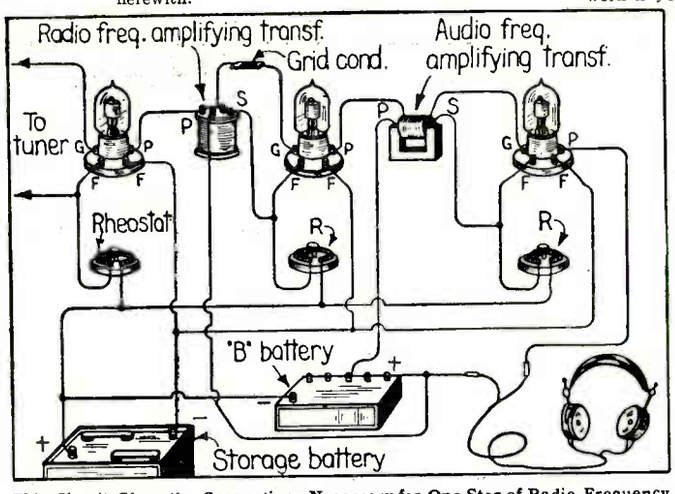
Q. 1. Please give me a little help in this line.

A. 1. Radio-frequency amplification for the amateur is a rather ticklish proposition, unless he is quite familiar with the operation of radio apparatus. We believe that you will get much better results, and learn a lot more about radio, if you proceed with the following method.

Hook up your vario-coupler with the detector bulb, and get this set working well. Learn how to operate it to its greatest efficiency, and also note any characteristics of the bulb and set which make themselves evident. Next, add one step of audio-frequency amplification, and proceed in the same manner. Then your radio-frequency may be added, and we are sure you will be able to obtain results.

Q. 2. Please give a diagram for one step of radio-frequency amplification, a detector, and one step of audio-frequency amplification.

A. 2. A circuit diagram as requested is given herewith.



This Circuit Gives the Connections Necessary for One Step of Radio-Frequency Amplification, a Detector and One Step of Audio-Frequency Amplification Using Common A and B Batteries. The B Battery Should Have a Voltage of 40 to 60 Volts With a Tap at 22½ Volts.

VARIOMETER CIRCUIT

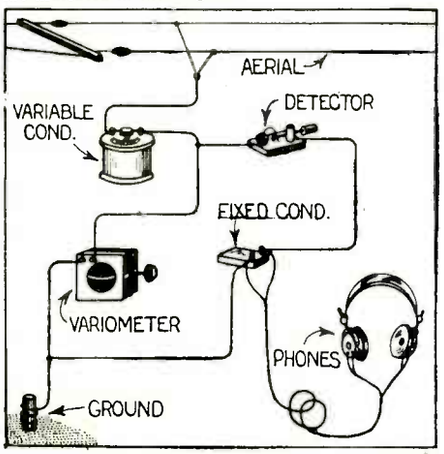
(75) Jas. Norwood, Upper Montclair, N. J., requests:

Q. 1. A circuit diagram for a variometer and crystal detector.

A. 1. We are giving herewith the hook-up requested by you.

Q. 2. Would a variable condenser improve this set?

A. 2. Yes. The variable condenser connections are indicated in the diagram.



A Simple Crystal Detector Circuit Using a Variometer and a Variable Condenser for Tuning, Is Given Above.

WHAT CONSTITUTES COUPLING?

(76) Elie Siegmeister, Brooklyn, N. Y., asks:

Q. 1. Why is it that my vario-coupler gives no coupling? I only hear signals when the rotor is horizontal, and when I turn it they gradually die out.

A. 1. If you hear signals when the rotor of your vario-coupler is horizontal and they gradually die out until, when the rotor is perpendicular to the stator, you hear nothing, this shows that you are getting coupling. The reason that the rotor is arranged so that it may rotate within the stator is to provide a variation in the inductive relation between the two.

Q. 2. I do not hear any amateurs' stations. Why? My aerial is 180 feet long by 30 feet high.

A. 2. The wave-length of your antenna is approximately 225 meters, and this is the reason that you do not get any amateur stations. We would advise you to cut it down to about 125 feet.

Q. 3. What is the wave-length of WVP, and how can I receive from them?

A. 3. The wave-length of WVP is 1,450 meters. To receive from them we would advise you to wind two coils, 4½ inches in diameter and 7 inches long with No. 24 wire, and use one in the primary circuit and one in the secondary. This is necessary in order to balance the circuits. They may be arranged in inductive relation to each other, or at right angles.

SET WON'T WORK

(77) Calvin H. Ling, Iowa City, Iowa, says:

I constructed a two-slide tuner, 12 inches long by 5 inches in diameter, and hooked it up according to a diagram in the May SCIENCE AND INVENTION, but did not get results. He asks:

Q. 1. Can you tell me how to make it work?

A. 1. There is no reason why your set should not work if you have constructed the set carefully and wired it correctly. Make sure that the positive side of the "B" battery is connected to the plate, and that all connections are either clamped tightly in binding posts or soldered.

Also be sure that your "B" battery is in good condition.

Are you sure your tube is in working order? If possible, obtain another tube that you have heard receive signals, and try it in place of the one you are now using.

We would advise you to use a tuner about 3 inches in diameter by 5 inches long, wound with No. 22 DCC wire. You should also try adjusting your grid leak.

RECEPTION WITHOUT TUNER?

(78) Willard Lolbers, Bethesda, Ohio, says:

I have a vacuum tube unit, a variable condenser, a pair of phones, and an aerial He asks:

Q. 1. Can I receive message with this set?

A. 1. You will need a tuner of some kind, preferably a vario-coupler for simplicity, in order to receive radiophone.

Q. 2. Will an A. C. line parallel to my aerial make any difference in reception?

A. 2. Running your aerial parallel to an A. C. line will induce a very bad and annoying hum in the receivers when the set is in operation.

LATEST PATENTS

Swimming Device

(No. 1,422,071, issued to George Gail Allenbaugh)

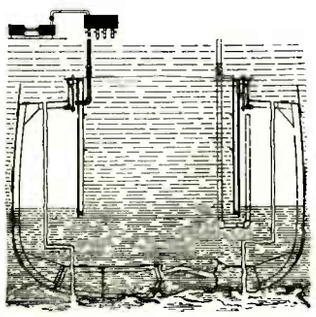
This swimming device is of the knock-down type, and may be readily

assembled or dissembled without the use of wrenches or other tools. It is adjustable to the sides of the individual using the same, and the buoyant floats may likewise be regulated to suit the particular requirements of the user. Essentially it consists of a frame on which is mounted a tail fin and a cross-bar to operate this tail fin. There are three buoyant members locked in place by means of wing nuts, and a pair of crank arms to be grasped by the user are connected by means of gears to the propeller. The buoyant members are inflated for use.

Apparatus for Raising Submerged Vessels

(No. 1,428,538, issued to Frederick W. Ebeling)

In raising vessels by this system the diver goes down to the submerged vessel and closes up the hatchway and other communications of the hold

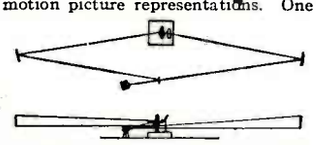


with the water outside. Pipes are then connected to the sunken vessel, and compressed air is pumped in from a vessel on the surface. This air thus forces the water out of the hold, reducing the water-level there, and gives buoyancy to the vessel, causing it to rise, but as the vessel rises, the hydrostatic pressure of water acting on the outside decreases, and the air pressure within naturally increases, so that the deck is subject to severe stresses. By means of automatic relief devices, the inventor proposes to relieve the air pressure in the hold, as the hydrostatic pressure decreases when the vessel rises to the surface. The water itself acts as the trap or valve, permitting the air to escape as its pressure is lessened.

Photographing Orchestra Conductor for Movies

(No. 1,422,909, issued to Eugene Wolff)

The movements of an orchestra conductor when thrown upon the screen are exhibited in two rows of motion picture representations. One

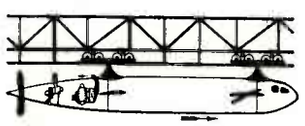


row shows the conductor being exhibited to the musicians, that is, his back is toward the musicians. The other shows the front representation of him exhibited to the audience. These are taken simultaneously on one film by means of three reflectors or mirrors; one being turned toward the conductor's back, another toward his face, and a third between the two, so as to reflect one series of representations into the camera, and permit the other to pass into the camera also. This mirror placed just in front of the camera is above the rays of light reflected from the mirror showing the front of the conductor as illustrated.

Suspended High-Speed Railway

(No. 1,422,394, issued to Rudolf Wagner)

In suspended railways heretofore constructed, speeds of forty or fifty miles per hour were the maximum attained. The inherent impediment to existing systems is the fact that a certain amount of adhesion, i. e., by wheel drive is necessary; otherwise, there would be no traction. Conse-

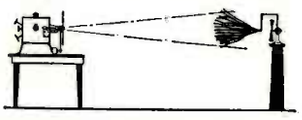


quently, with the increase of speed, the car had to be weighted so that it would stick to the track, which resulted in an expensive and heavy superstructure. In the present device, an airplane engine and propeller is to be employed for furnishing the power. Planes on the side of the body of the car will enable the car to rise slightly from the rails, minimizing friction and weight. The running wheels themselves may be made of ebonite, skin, cork, or may have pneumatic tires. In this way a steady run free from shock and extremely high speed is to be achieved and the load on the superstructure is relieved.

Method of Producing Color Effects

(No. 1,423,089, issued to Allerton S. Cushman)

Undoubtedly with this device the inventor can produce some very vivid and wonderful effects. He employs a color screen revolved in front of a projecting lantern, containing sectors of rainbow colors interposed with opaque sectors. If a bundle of white paper streamers, as shown in the illustration, is agitated by means of an electric fan and the colors are projected upon the same, the result is a display of unusual beauty. Each change of position, every whimsical



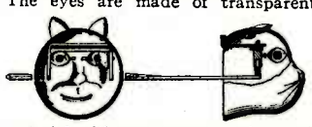
turn or twist of the different streamers, introduces a new color variation. A tumbler of water agitated in this projected stream of light appears to contain drops in varying colors. The speed of rotation of the disc as well as the speed of movement of the object, assist greatly in these color changes. The patent itself must be read to appreciate the full value of the invention.

The inventor, for instance, says: "Assume that the rate of rotation of the disc is such that the successive periods of light emission through each plane are too short to satisfy the law of persistency of vision, a stationary or very slow moving object will appear in the color of the mixed light composed of the different light beams or in a pure white color. Assume now that the rate of motion of the beam is greater than that of the object and that the relativity of motion is such that a plurality of differently colored light beams will pass through their zones of action while the object passes through the same zone, the object will appear in the colors much like those of the rainbow."

Sparking Toy

(No. 1,422,075, issued to Louis V. Aronson)

An animal's head, for instance, in the form of a cat, having eyes and ears, is mounted upon a spring wire handle. The eyes are made of transparent

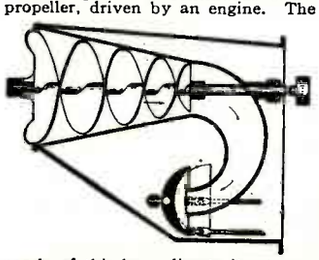


material with two opaque strips, and the ears are mounted on very simple hinges. A piece of pyrophoric metal bears upon a roughened file-like piece of metal, so that when the handle is pressed together rather quickly, friction upon the pyrophoric metal will produce sparks as in the ordinary gas lighters. The ears being mounted on simple hinges may be made to move by simply changing the position of the toy, which gives them a flapping action. The sparks produced by the pyrophoric metal give the device a lifelike appearance. This toy promises to be very successful.

Power Propulsion Device

(No. 1,422, 384, issued to Cassius M. Garrison)

We certainly would like to see this device work on an airplane, inasmuch as the inventor's claims for his system do not seem logical. In a curved horn there is placed a continuous screw propeller, driven by an engine. The

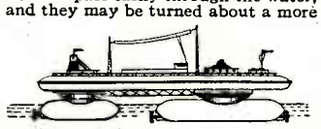


nozzle of this horn directs its stream of air against a cuplike disc, so that the air compressed by the continuous spiral propeller, is forcibly ejected against the interior of the cup, which by reaction is to assist the airplane in forward locomotion, or if the cup is tilted, the airplane should be, according to the inventor, more readily steered. The spiral propeller is to be used in addition to the regular propeller, and the device is to be driven by the ordinary airplane engine. Instead of increasing the power with this device, the inventor would add a useless resistance to his machine.

Multiple-Hull Boat

(No. 1,422,542, issued to Frederick George Creed)

Here is a vessel which is supposed to be easily manoeuvred, possesses greater ability, safety from sinking and greater facility for loading and unloading, and numerous other advantages over other craft. A ship comprising a deck and a frame, is mounted flexibly upon three or more floats. These floats are shaped so as to permit them to pass easily through the water, and they may be turned about a more



or less vertical axis for steering purposes, and about a horizontal axis for trimming the ship and checking rolling or pitching. The propellers are attached to the floats, and inclined planes are likewise secured to the floats. If desired, instead of water propellers, air propellers may be employed. The ship can turn in its own length. It possesses greater stability than the modern battleships, and cannot be as easily torpedoed. Access to the floats is at all times possible, the engine room and some of the crew's quarters being arranged there.

Power Torpedo

(No. 1,419,267, issued to Alexander T. Kasley)

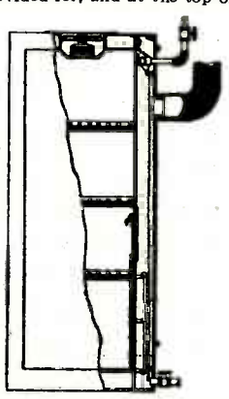
In the so-called automobile torpedoes now in use, the range at twenty-eight knots is about ten thousand yards. Inasmuch as the range in modern battles is approximately 15,000 to 20,000 yards, these torpedoes become ineffective. In order to increase this range, a method was designed, whereby the torpedo would receive a much greater supply of energy. When charged the torpedo could be kept indefinitely in an inoperative condition without the necessity

of recharging it just before use, as is now the case. The inventor has found that two chemical agents, such as metallic aluminum when acted upon by sodium hydroxide, liberates not only a great quantity of gas but also intense heat. This heat is employed to generate steam and the steam and gas evolved is used to propel the torpedo in the usual manner. A spraying appliance for the sodium hydroxide solution is also made use of, which permits the liquid to act upon the entire mass of aluminum.

Iceless Refrigerator

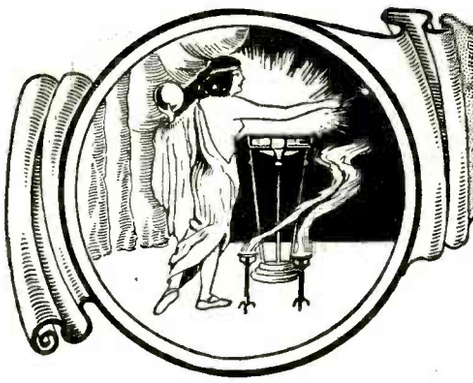
(No. 1,422,365, issued to Charles L. Kik)

In this device, the inventor employs what would seem to be an ordinary refrigerator, the walls of which are made in two divisions, between which are strips of porous material. Water is supplied to a pipe perforated with small holes, over which this porous material hangs, so that at all times it is completely saturated. At the bottom of the chamber a drip pan and drain are placed. Air circulation is provided for, and at the top of the



refrigerator is a fan which increases the supply of air. In order to permit this air to cool the interior of the refrigerator, it must first pass through the porous material sides, where due to the evaporation of the water, its temperature is sufficiently decreased to preserve the contents of said refrigerator.

It is evident that a refrigerator of this nature will keep the contents of the icebox cool, at practically no cost, the amount of water being very slight indeed, merely enough to permit completely saturating the dangling fabric. Of course, operating the fan is a greater expense, but this need not occur except on very warm days, the natural evaporation making its use unnecessary. Of course, beverages placed into a refrigerator of this nature, although cooled considerably below room temperature, would not be as cold as if they had been placed on a cake of ice.



THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. 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 written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this 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 considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

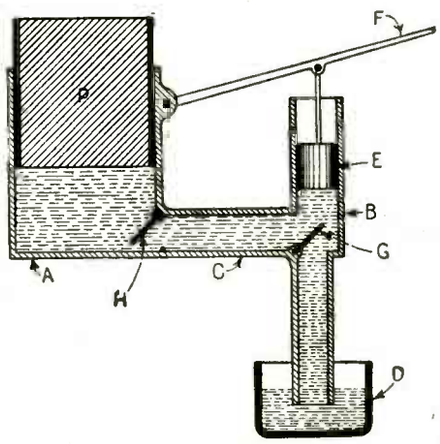
HYDRAULIC PRESS

(1325) Richard Hoyt, Jamaica, L. I., N. Y., wants to know:

Q. 1. What is the principle of the hydraulic press?

A. 1. The hydraulic press depends upon what is known as "Pascal's principle," which states that, "The pressure applied to an enclosed fluid is transmitted equally in all directions, and without diminution, to every part of the fluid and of the interior of the containing vessel."

Q. 2. Please give a diagram of a simple hydraulic



A Simplified Diagram Showing How a Hydraulic Press Operates Is Given Here. A Complete Description Is Given in the Text. If the Cross-Sectional Area of E Is 10 and That of P Is 100, the Piston P Will Move Only One-Tenth as Far as E.

press, showing how it works, and how the power is multiplied.

A. 2. We give herewith a diagram showing the principle of the hydraulic press in the simplest possible manner. In this we have a heavy piston or cylindrical block which fits into the larger cylinder "A" in such a manner as to be water tight. In the smaller cylinder "B" we have another piston "E," which also fits very snugly. Now, when we move the piston "E" up by means of the lever "F," it opens valve "G" and draws up water or oil from the reservoir "D." When we press down on "F," valve "G" closes, and the liquid is forced through the tube "C," opening the valve "H," and the liquid passes into the cylinder "A." Now when the handle "F" is drawn up again, the valve "H" closes and the same procedure is gone through again. When the cylinder "A" is pumped full of liquid—that is, to the bottom of piston "P"—a force will be applied to the bottom of the piston, which force is as many times the force applied to piston "E" as the area of the piston "P" is greater than the area of "E." If the cross-sectional area of the smaller piston is represented by "a," and that of the large one by "A," and the force applied to piston "P" is represented by "R," and that to piston "E" by "S," we have $\frac{R}{S} = \frac{A}{a}$.

For instance, take the area of "A" to be 100, and that of "a" to be 10; if we apply a force of one pound to piston "E," we have the following equation: $\frac{R}{1} = \frac{100}{10}$. Solving this, we find that "R" equals 10 pounds, or that 10 times the pressure is applied to piston "P" as is applied to piston "E."

REMOVING PAINT FROM CLOTH

(1326) Geo. E. Aubin, Woonsocket, R. I., requests:

Q. 1. A formula or a method for removing paint from cloth without injury to the same.

A. 1. When either paint or varnish has become dry, it is removed with difficulty. In such cases, soaking the article in strong ammonia water may answer. An emulsion formed by shaking two parts of ammonia water and one part of spirits of turpentine has been found very efficient. In fresh stains spirits of turpentine will often do the work.

The following may also answer, although we would advise that you first make a test upon an old piece of cloth to determine whether or not the cloth would be injured.

Acetone	16 parts
Wood alcohol	16 parts
Benzole	5 parts
Gasoline	3 parts

HEATING WATER CHEMICALLY

(1327) John G. Roman, Steubenville, Ohio, requests:

Q. 1. The name of a chemical and the quantity required, which, when added to four ozs. of water, will raise the temperature of the latter about 80° F.

A. 1. The best chemical to raise the temperature of water is concentrated sulphuric acid. Great care must be exercised in performing this experiment; to add the acid to the water, not the water to the acid; otherwise the liquid is liable to splash into the experimenter's face. About ½ oz. of the acid will be sufficient. About 1 oz. of calcium chloride will likewise do the trick.

GAS MANTLES

(1328) Walter C. Mitchell, Jersey City, N. J., wants to know:

Q. 1. Are broken gas mantles worth saving?

A. 1. It is a good idea to save gas mantles because of their radio-active properties and many experiments can be carried on with a box full of these mantles.

Q. 2. Could the small rings used to hold the mantles be ground up, mixed with a suitable binder, and molded into crucibles?

A. 2. Although the small rings in question are valuable when it comes to making small stands, etc., it is not advisable to even attempt to grind them up and make crucibles from them.

Q. 3. How can burned out mercury vapor lamp tubes be cleaned of the deposit left in them after burning for a considerable length of time?

A. 3. There are several methods of cleaning out mercury vapor lamp tubes, the best one of which is to place these tubes in an electric furnace, and heat them, while a stream of oxygen passes through the inside. This will, without a doubt, burn out the oxide of mercury now deposited upon the glass. Be careful not to heat the tubes to their melting point.

COUNTERACTING MAGNETISM

(1329) E. Mauke, Lancaster, Pa., asks:

Q. 1. Can magnetism be insulated?

A. 1. Up to the present time no insulator against magnetism has been discovered. The only thing that can be done with a magnetic force in order to decrease its effect, is to counteract it with a similar magnetic force of the same nature, and so disrupt the lines of force that they will have no effect in the vicinity of either magnet, or else place the body which you desire to insulate, at a sufficient distance away from the magnet so that the effect of the latter will not be felt. A magnetic field may also be shunted by an iron shield, as in watch protectors.

INKS

(1330) W. E. Rundle, of Toledo, Ohio, asks:

Q. 1. How may black ink be made to have a glossy finish when dry?

A. 1. A small quantity of sugar or a weak solution of shellac 15 gr., borax 30 gr., sugar 4 gr., and water 4 oz., added to the ink will give this effect.

Q. 2. What are two good substances to use in making black ink?

A. 2. Lamp black and aniline black are the ingredients which are found in many jet-black inks.

RESISTANCE OF AMMONIUM PHOSPHATE

(1331) John M. Ramsey, of Detroit, Mich., inquires of the Oracle:

Q. 1. What is the resistance of a standard solution of ammonium phosphate such as used in an electrolytic rectifier?

A. 1. The specific resistance of such a solution is so low that under ordinary circumstances it may be omitted entirely in the calculation of electrolytic rectifiers. For this reason, when using an electrolytic rectifier, it is necessary to insert some suitable form of resistance in series with the rectifier, as, otherwise, the circuit would be practically "shorted" and the fuses would blow out. A resistance of about 20 ohms is necessary in charging a six-volt storage battery at a rate of five amperes. About fourteen ohms should be employed for an eight-ampere charging rate, and eleven ohms for a ten-ampere charging rate.

PROBLEM IN LEVERS

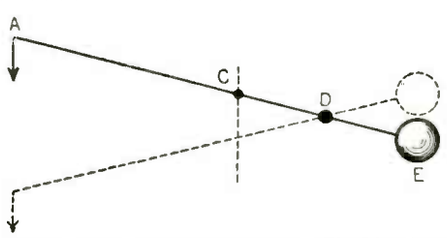
(1332) G. A. Frund, St. Louis, Mo., says:

In the accompanying illustration there is a lever balanced on, or running through the shaft D. The weight E at the end of this lever is made to balance the length AD. A certain weight is applied at A, and the lever is made to act upon the point C. Both A and C are acted upon in a downward direction. A roller bearing is used at D to minimize friction. He asks:

Q. 1. If AC is four times as long as CD, will not the force applied at point C be four times the force applied at A?

A. 1. No. The force supplied at C will be equal to five times the force applied at A. This may be determined by the simple formula which says that the weight arm, times the weight, is equal to the force arm, times the force. In other words, AD times the weight applied at A is equal to CD times the force applied at C. Taking AD as five units, CD as one unit, and the weight applied at A as five pounds, we have the equation: 5 x 5 equals 1 x X, X equaling the amount of force applied at C. Solving this, we find that X is equal to 25, or five times the weight applied at A.

We do not see that you gain anything by balancing the arm with the weight E, especially when the force is exerted in a downward direction, because it is necessary for you to also lift the weight E. However, if the weight were applied in the opposite or upward direction, you might possibly gain a slight advantage by the use of the weight E.



A Fallacy in Levers Is Shown Here. The Idea Is to Balance the Lever AD by the Weight E, So That More Power Will Be Applied to C When Work Is Performed on A. How This Lever Works and Why the Latter Is Not True, Is Set Forth in the Text.

SPEED OF LIGHT AND ELECTRICITY

(1333) Hollis S. Baird, N. B., Canada, wants to know:

If there were an electric light on the sun and a switch on the earth, to turn it off and on:

Q. 1. How long will it take before the persons on the earth will see the electric light on the sun after the switch is turned on?

A. 1. If it were possible to do this, it would take a long time because the wire would have to be charged before the light would receive a lighting current. However, it would not be possible to force enough current along wires of such tremendous length without great expenditure of power. Also, this calculation does not take into consideration the fact that there would be a considerable amount of lag in the wires due to self-induction and condenser effect, nor the fact that the lamp will not light up brilliantly instantaneously. We may assume the speed of light and electricity to be 186,000 miles per second, and the distance from the earth to the sun to be 92,900,000 miles.

POTASSIUM CHLORIDE FOR SEASONING FOOD

(1334) Walter F. Dantzschen, New York City, asks:

Q. 1. Can potassium chloride be used as seasoning for food the same as sodium chloride?

A. 1. There is no reason why you could not do this, but still there would be no advantage, nor for that matter, any serious disadvantages. However, sodium chloride is preferable to potassium chloride, in that the body of man contains more of the sodium element than it does of the potassium element, but it uses sodium salts more than potassium, and therefore needs more of the former to keep it in order.

AUTOMATIC TRAIN STOPPING

(1335) J. G. Davis, Eaton, Ohio, wants to know:

Q. 1. If we can give him some information as to what experiments and plans have been tried out on railroads to prevent trains passing signals set against them.

A. 1. In New York and many other cities, the railroads are provided with devices which will prevent engineers from passing signals set against them. This is a trip which is automatically raised when the danger signal is set, and which strikes an arm on the front of the locomotive, automatically throwing on the air brakes. In order to re-set the arm it is necessary that the engineer bring the train to a full stop, and get out of the cab to re-set it. Many train control systems are now being installed on railroads throughout the country, there being about a dozen concerns interested in this work.

HUMAN AURA

(1336) C. E. Curran, Tacoma, Wash., asks:

Q. 1. If the aura of a crippled person will be different from that of a normal one.

A. 1. There is no reason why the aura of a crippled person should be different from that of a normal person, and we do not believe it to be so. The distortion of the aura is generally caused by the person becoming affected with hysteria. Indirectly, the aura is within control of the person, because such feelings, as joy, pain and sorrow are immediately noted by a corresponding change in the etheric envelope which surrounds the body. It is claimed that the aura of a sick person differs considerably.

DISSOLVING GUTTA PERCHA AND INDIA RUBBER

(1337) Hardin P. Pedde, Kankakee, Ill., wants to know:

Q. 1. What chemical will dissolve gutta percha and India rubber.

A. 1. Gutta percha will dissolve in carbon disulphide, and India rubber in chloroform to the extent of 15 grains in two ounces of the liquid. The result approaches an emulsion rather than a true liquid solution.

AUTOMOBILE TRANSMISSIONS

(1338) J. C. Bell, Bridgeport, Conn., inquires:

Q. 1. Is there any positive infinitesimally variable speed transmission on the market?

A. 1. There are three types, one of which is the oil turbine transmission whereby the operator can change the speed as desired to the slightest fraction of a revolution more or less, and can immediately throw the car into reverse or stop the car by just using one lever. This transmission was described some time ago by Mr. Secor in this journal in an article on *The Motor Car of the Future*.

The other types spoken of are the magnetic drive, such as employed in the Owen magnetic cars and the friction drives in Kelcey and Metz cars.

RECTIFIER SOLUTIONS

(1339) Anthony Aymar, South Manchester, Conn., inquires:

Q. 1. What kind of salts or other substances may be used for the eletrolyte in a four-jar rectifier, and what proportions should be used?

A. 1. Ammonium phosphate, Rochelle salts, or sodium phosphate, may be used for this work in a saturated solution. Very dilute sulphuric acid also answers the purpose, also baking soda.

DISSOLVING PAPER AND COTTON

(1340) R. E. Chapman, Millburn, N. J., says: That he conducted some experiments for dissolving cotton and paper as described some time ago in SCIENCE AND INVENTION, but failed to get any results at all. The paper and cotton became soft in the same way as they would in ordinary water, but did not dissolve. He asks:

Q. 1. What could have been the matter inasmuch as I followed directions carefully?

A. 1. As was stated in the article you mention, an ammonical solution of copper sulphate is known to be a solvent of all cellulose. Cellulose would include paper or any product coming from the vegetable kingdom, such as cotton, linen and wood pulp. We can vouch for the authenticity of this formula, and are sure that if made up correctly, it will do the work mentioned.

AMPLIFYING PHONOGRAPH MUSIC

(1341) C. F. Whittaker, Coshocton, Ohio, wants to know:

Q. 1. How to amplify phonograph music by means of audions so it will be audible over a large area.

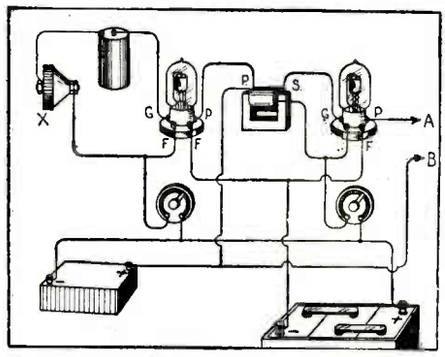
A. 1. We are giving herewith a circuit diagram showing how to amplify phonograph music by means of two audion bulbs.

The transmitter button is attached to the tone arm of a phonograph by means of a machine screw.

The amplifying transformer is of the audio frequency type.

If a low-resistance loud speaker is used, A and B are connected to the primary of a step-down transformer, and the secondary of the transformer is connected to the loud speaker. The primary of the transformer must be of fairly high resistance, say about 2,000 to 3,000 ohms, and the ratio should be about 50 to 1.

If a high-resistance loud speaker is used it may be connected directly to points A and B.



How to Amplify Phonograph Music by the Use of Two Audion Amplifiers and a Transmitter Button.

SUN MOTORS

(1342) J. H. Erickson, Venice, Cal., requests:

Q. 1. Can you give me some information in general on motors and apparatus which get their power from the sun?

A. 1. From time to time various types of sun motors have been described in our magazine. In one sun motor, now being used in Arizona, water is allowed to flow into a large tank, placed on top of a building. This water, of course, becomes heated, due to the action of the sun, and the heated water passes through pipes around a tank of liquified sulphur dioxide. This liquid gas, changing into the gaseous state, produces the pressure, which is used in a motor. The exhausted gas is again collected and after cooling, liquifies automatically, due to the pressure to which it is subjected by the already gasified liquid, sulphur dioxide.

In Egypt another type of machine is used, in which immense rows of mirrors reflect the radiant energy from the sun upon long pipes. The heat thus developed is sufficient to change the water into steam, whereupon the steam acts as a driving agent for a 10-horsepower vertical steam engine.

On an ostrich farm in South Pasadena, California, a sun motor is in constant use. This consists of a concave mirror made of single glass plates set together and is about 12 feet in diameter. The sun's rays are collected and focused on a water tank which is placed in such a position that it lies in the axis of the concave mirror. This axis also acts as a bearing for the mirror and is about 13 feet long. If the tank should for some reason or other become emptied, its walls will grow red hot in less than an hour. Four thousand quarts of water which it contains is brought to the boiling point in fifteen minutes and the steam thus developed drives a 10-horsepower motor, which in turn operates a pump raising 5,600 quarts of water per hour out of a well.

HYDROGEN PROPELLED AUTOMOBILE

(1343) Henry Goldberg, New York City, says: Some time ago a description appeared of a hydrogen propelled automobile. He asks:

Q. 1. Has this automobile ever become commercially practical?

A. 1. The hydrogen automobile has never been commercially practical for the simple reason that more power is consumed in forming hydrogen from water than could possibly be produced by a hydrogen motor and using the gas so generated.

It has recently come to our attention that the concern financed for this purpose is virtually bankrupt. They were claiming perpetual motion although very cleverly veiled, and you undoubtedly know that perpetual motion is practically an impossibility as far as we on this earth are concerned.

EVACUATING VACUUM TUBES

(1344) Frank Knipper, Rochester, New York, asks:

Q. 1. How is the vacuum in a vacuum tube obtained?

A. 1. Ordinary vacuum tubes are exhausted very easily. A mercury vacuum pump is used, capable of giving quite a high vacuum.

Q. 2. How are the different colors in the vacuum tubes used in radio obtained?

A. 2. These colors are obtained by the introduction of gases and more often by the use of various kinds of colored glass. Deposits of transparent colors upon the glass further color it.

BLOCK TINNING

(1345) R. Holzmeister, Salina, Kansas, wants to know:

Q. 1. How to tin small copper articles.

A. 1. The best way to tin small objects is by the electro-plating method. A fairly heavy deposit of tin may be obtained in this way, but if you desire a "block tinning" method, we would advise that you dip the articles which have been made chemically clean and polished, into molten tin. A very good permanent coating will be obtained. The articles can then be polished by tumbling them in a revolving barrel together with a quantity of bran.

WHIRLING MIRRORS

(1346) Percy E. Hulbert, Hockanum, Conn., asks:

Q. 1. Can there really be such a thing as a mercury reflector such as described in the article on *The Whirling Eye* in your magazine several months ago?

A. 1. Yes, there can be. Many experimenters have constructed mirrors from boiling hot pitch, which was whirled around on a concave disk at the desired speed until the pitch solidified, whereupon a parabolic mirror was the result. We believe that it is from such an experiment that the author of the article mentioned deduced his mercury mirror. Of course, the mercury would have to be perfectly clean in order to present a reflecting surface.

ELECTRIC HEATING UNITS

(1347) A. N. Hainer, Eastport, Maine, says: I have had great trouble in making the wire in home-made heating units stay where I want it to. He asks:

Q. 1. Can you tell me how to remedy this trouble?

A. 1. If your wire is fairly heavy you should have no difficulty in bending it so that it will stay where you place it. However, if you imbed the wires in asbestos cement, or wind them around a porcelain tube, after which they are coated with asbestos cement, we believe you will have no further trouble.

THE LIMIT OF TELESCOPE SIZES

(1348) Thos. R. Horner, Seattle, Wash., says: I have been told that the limit in the size of telescopes has been reached, owing to refraction; that is, if made any larger, an object viewed through the telescope would appear as though seen through a tank of clear running water, as one writer expresses it. He asks:

Q. 1. How is it expected to overcome this difficulty in the proposed 50-foot telescope which is to be set up in a Chilean mine shaft?

A. 1. Evidently your informer was more or less incorrect when he stated that the limit of telescopic design has been reached. The larger telescopes used at the present time are of the reflecting type and not of the refractive type. In other words, the image is reflected instead of passing through a lens. The great difficulty in telescopic construction has not been due to refraction, but to the impossibility of making the disc of glass for the refractory lens or reflecting mirror, which will be free from all bubbles and absolutely true when ground down.

TESLA COILS

(1349) Virgil House, Mishawaka, Ind., asks:

Q. 1. When did Tesla invent the famous high-frequency coil named after him?

A. 1. We believe that the Tesla coil was invented about 1884. At any rate, mention of this coil is made in articles appearing in scientific publications as early as 1886.

Q. 2. How large a propeller should be used with a 50-horsepower motor to propel an aerial sled?

A. 2. With a 50-horsepower motor we believe that an airplane propeller about 5½ feet in diameter will give the best results. The propeller pitch must be taken into consideration.

Q. 3. Where can I get a license for an aerial sled?

A. 3. We would advise that you write to the State Bureau of Licenses for a license for this type of vehicle, and unless they have a special rating, we believe that automobile rates will prevail.

AUTOMOBILE POLISH

(1350) Henry Stork, Columbus, Ohio, requests:

Q. 1. A formula for a good automobile polish.

A. 1. Many excellent automobile polishes may be purchased from firms advertising in the columns of this magazine. If you wish to try compounding a polish yourself, we would suggest that you try the following formula.

Yellow Wax	30 parts
Oil of Lavender	1 "
Ammonia Water	1 "
Alcohol	2 "
Benzine (deodorized)	200 "

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(*Continued from page* 651)

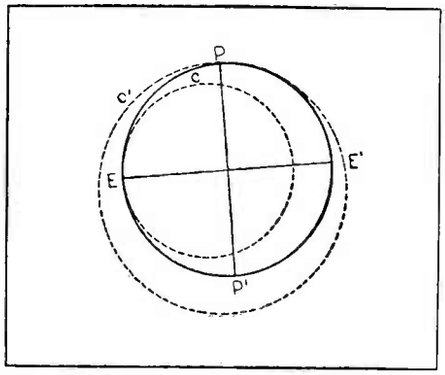
a degree of latitude is about seven-tenths of a mile shorter at the equator than it is at the poles. It can easily be shown that this would necessarily be so if the earth is flattened at the poles and the amount of the flattening is indicated by the difference in the length of degrees of latitudes in different parts of the world.

Pendulum experiments, which give the force of gravity in different parts of the world, have also been carried on extensively in many lands and the variation in the acceleration of gravity in different latitudes has been found to be such as would exist on a rotating globe having the same shape and flattened to the same amount as was found for the earth from measurements of arcs.

Here, then, are two independent methods for determining the shape of the earth that give results that are in excellent agreement, and it is an interesting fact that the value of the flattening of the earth at the poles found from these two methods agrees with the amount that is required by theory for a rotating spheroid of the size and density of the earth.

Aside from the direct proofs of the earth's sphericity obtained from measurements of arcs and from pendulum experiments in different parts of the world, one of the best proofs that the earth is round is obtained from a consideration of the phenomena of eclipses both of the sun and of the moon.

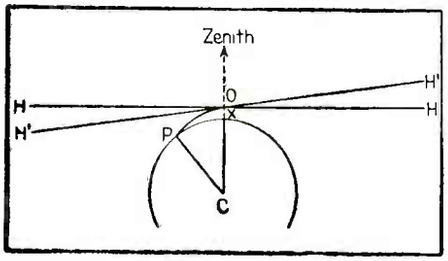
We are all familiar with the proof given in the text-books—namely, that the shadow of the earth that falls upon the surface of the moon at the time of an eclipse of the moon is circular in form and such as could be cast only by a body of circular section, in our case a spherical body. This is, indeed, an excellent argument for the sphericity of the earth but the phenomenon of a total *solar* eclipse furnishes one that is fully as good. In the prediction of a total eclipse of the sun, which occurs when the moon passes between the sun and earth and the cone of shadow formed by the moon sweeps over the earth's surface, the astronomer gives the exact times of the beginning and ending of all phases of the eclipse, the exact location of the path of total eclipse on the surface of the earth, the duration of the total phase of the eclipse and other circumstances of the eclipse, all of which are computed to a high degree of accuracy. These computations of all the elements and circumstances of total solar eclipses are based upon a number of assumptions as to the relative sizes and distances of the sun, moon and earth and their positions in the heavens, and also as to the relative speed of the earth and the shadow as the shadow darts over the earth's surface and the earth turns on its axis under the shadow.



Diagrams Illustrating Why a Degree of Latitude on the Earth Is Shorter at the Equator Than It Is at the Poles.

Let PEP^{1}E^1 Be a Plane Section of the Earth Through the Poles. The Curvature of the Earth's Surface at the Equator E,E^1 Is That of the Smaller Circle C. A Degree of Latitude at the Equator Equals, Then, a Degree of Angular Measurement With Radius OE, O Being the Center. The Curvature of the Earth's Surface at the Poles P,P^1 Is Equal to That of the Larger Circle C^1. A Degree of Latitude at the Poles Equals, Then, a Degree With a Larger Radius.

In making these computations, moreover, the astronomer makes use of the flattening of the earth found from geodetic surveys and pendulum experiments. In short, the computations of solar eclipses are based upon formulas and a theory that is completely in accord with the generally accepted theory that the earth is a flattened spheroid rotating upon its axis and revolving around the sun at a mean distance of 92,900,000 miles and that the moon is a sphere about 2,200 miles in diameter revolving about the earth in a period of 29.5 days at a mean distance of 240,000 miles. Now from computations based on such assumptions all the nautical almanac offices of the leading countries of the world publish several years in advance of the events the circumstances of all eclipses that are visible from year to year and publish, in addition, charts showing the exact location of that narrow strip of the earth's surface several thousand miles long and a hundred miles or so wide, within which the sun will appear totally eclipsed. If these computations were based upon erroneous assumptions the world would not be long in finding it out. If the earth were flat instead of round, the path of a total eclipse would be far different from the path computed on the basis of the assumptions of the shape of the earth, which the astronomer makes.



The Dip of the Sea Horizon: X Is the Height of the Observer, in Feet, Above Sea-Level. HH is the True Horizon of the Observer at O, Which Is at Right Angles to the Direction of the Plumb-Line. PO Is the Path of the Line of Sight to an Object, P, the Most Distant Point on the Earth's Surface Visible from O; the Line is Curved on Account of Refraction, Which Is Greatest at Sea-Level. The Observer at O Sees P in the Direction OH^1, Owing to the Effects of Refraction.

Many scientific expeditions have been sent out, since the days when accurate computations of eclipses were first undertaken, for the express purpose of locating the temporary observatory on the central line of eclipse, as predicted by the astronomers, and observing all the phenomena of a total eclipse of the sun. If the astronomers had made any mistakes in their computations or *if the world were flat instead of round* the path of totality would not be as predicted.

This year a number of eclipse expeditions from different lands, with implicit faith in the correctness of the astronomers' predictions, took up their stations within a narrow strip of the earth's surface in the Indian Ocean and Australia to observe the total solar eclipse of September 20. In some instances the members of these expeditions traveled halfway around the earth, months in advance, to have the advantage of making scientific observations on a certain day on a small island in the Indian Ocean, which the astronomers had told them several years before, would lie within the path of total eclipse of the sun. That the eclipse would occur at the appointed moment and would be visible at the place mentioned these scientists no more doubted than they would doubt that the sun will rise tomorrow morning.

(*Continued on page* 678)

Harriet Beecher Stowe

Have *You* the Power

that makes some men and women great?

Shakespeare

There is one great secret of success. Some people, naturally endowed with it, are unaware of their advantage. It is like a fine tool, given them at birth. Those who learn to use it most skillfully rise to heights that others do not attain.

Scores of men and women possess this tool—dull, perhaps, through lack of use, but needing only use to make it sharp; then the skill (which may be acquired) to carve out the career of which they are capable and about which they have dreamed, but toward which they have never yet advanced.

The Fundamental Secret of Success

IT is the force that solves most of life's problems; that builds great dams, factories and universities; that produces X-rays and radio; that writes masterpieces of literature.

You no doubt use it to some extent each day. It measures your success in everything you do. Age is no bar to its exercise.

The one requirement is that you be naturally endowed with it. Some are. Others are not. And many, richly endowed but unaware of it, miss their greatest opportunity.

Test Yourself —without cost or obligation

IF you wish to know about yourself, ask for the famous Palmer Test Questionnaire. It submits questions, the answers to which will almost unfailingly reveal whether or not you have this inherent ability.

Your answers are confidential. We tell you sincerely what your test shows and give complete reasons for our opinion.

You'll find this test intensely interesting and you may discover something in you that you little thought you had.

It's worth a two-cent stamp—costs nothing more in money or in obligation. So send the coupon for the Questionnaire.

This fine instrument is *Creative* Imagination. One of the wonders of it is that so few people who are endowed with it have learned how to use it in making their success in life more outstanding and more real.

The Channel through which it is developed

THE most fertile testing ground, where untrained people have fullest opportunity to prove creative imagination, is the moving picture industry.

Previous experience counts least in photoplay writing, so it is open to the novice who is willing to learn and develop.

Leading playwrights, novelists and short story writers have failed to write the most successful photoplays. The best have come from men and women unknown in the fiction world, but who developed creative imagination and learned the technique of photoplay construction.

We teach the writing of photodrama through an eminently successful home-study course; but hundreds of men and women students of all ages are not studying to make this kind of writing a profession.

Doctors, lawyers, educators, architects—men and women in all walks of life—are using this means of sharpening this tool — Creative Imagination, that invaluable power—to apply to other activities in which they are engaged.

The photoplay is the ideal field for proper instruction in this development for it furnishes both the necessary objective for study and a money-making field from which graduates are reaping, and thousands more can reap, rare cash rewards if they so desire.

We Offer $1000 and Royalties

THOSE who wish to enter this field professionally enjoy a new era of progress and improvement. The Palmer Photoplay Corporation for four years the largest clearing house for the sale of photoplays to producers, now becomes also a producer, and will bring out the better stories for the screen.

Under our new plan we are making better pictures from better stories for which a minimum of $1000 each, together with perpetual royalties from the profits of the picture, will be paid.

In addition one hundred sixty producing companies in Los Angeles alone are searching for better plays, paying from $500 to $2000 for acceptable stories.

Is It You?

BUT creative imagination is worth developing, if you are endowed, regardless of the use you wish to make of it. It returns immense profit in any line of work, art or profession.

Napoleon, Shakespeare, Edison, Stowe, Marconi, DeForrest—all accomplished their wonders through this tremendous power. You, too, can apply it, if naturally endowed, develop it, feel, use and profit by it, if you will.

Find out if you have this power in you. The Palmer Questionnaire will tell you. Mail the coupon now for this most interesting test—no cost or obligation—that may open to you new fields of endeavor and achievement.

Palmer Photoplay Corporation,
Department of Education, Sec. 2011,
Palmer Building,
Hollywood, Calif.

Please send me the Palmer Questionnaire, which I am to fill out and return to you for your personal and subsequent advice to me without charge.

NAME.....

STREET.....

CITY.....STATE.....

All correspondence strictly confidential.

Popular Astronomy

(*Continued from page 676*)

What better proof could be given of the truth of the theory that the earth is round? Let the flat-earth theorists compute all the elements and circumstances of the next total eclipse of the sun in accord with their theories and chart the position of the path of totality by which the truth of their contentions may be tested. No theory can be regarded as true until it satisfactorily explains *all* the facts required of it. There is no known fact or law that is contradictory to the Copernican theory. Our flat-earth theorists admittedly cannot explain the cause of eclipses and their theory leads them into a maze of contradictions and inconsistencies.

The day has passed when the majority of men believed the earth to be flat. To be sure we still have among us our flat-earth theorists with their geocentric ideas of the universe and their familiar adaptations of the "Word of God" to suit their own ends and purposes. Fortunately, however, like the perpetual motion cranks, they are few in number. The majority of men no longer have the attitude of the churchman who refused to look through the telescope of Galileo for fear he might be convinced of the truth of the Copernican theory.

Today we find that most men of all sects and creeds recognize the fact that there is nothing antagonistic to the true spirit of religion in the teachings of modern astronomy, which are far more uplifting and ennobling than the narrow, man-centered philosophy of the churchmen of mediaeval days who upheld the old Ptolemaic theory that the earth was the center of the universe because it catered to the vanity of man.

Both Galileo and Newton were deeply religious men as have been many other astronomers since their day, and in the ranks of the astronomers we now find many noted religious teachers who are deeply interested in, and who aid in furthering by their own endeavors, the advance of astronomical discovery. The old conflict between the theologians and the astronomers has practically ceased at last, for the churchmen have wisely come to a recognition of the fact that it is useless to fight against the truth or to attempt to delay its progress.

The Amateur Magician

By JOSEPH H. KRAUS

(*Continued from page 654*)

invisible. At first I thought that instead of a black slate, the Professor was using a sheet of glass. I mentioned this fact to him, stating that someone was probably in back of a black glass sheet, painting upon its surface. He explained that such a method could of course be employed, but in this instance it was not being done. He further informed me that should one of the methods of performing this trick be discovered, there were four other systems which could be employed. Sing then removed the slate and placing another one upon the easel, stood aside. Hargrave told me to ask several questions, the answers of which then appeared upon the slate. Before I could step forward to examine this piece of apparatus, Sing had replaced it with a third slate, which to all intents and purposes seemed absolutely solid when I examined it.

"You would like to know how that's done, eh?" queried Hargrave. "Well, it's simpler than you think. The slates which are placed upon the easel are made of black cardboard, in which the answers as well as the words which I desire to transmit to the audience, are cut. In other words, these letters are cut out in that black cardboard slate. Then in back of this black board and separated from it a distance of but one-half an inch, is another plate which has been painted white. This second plate may be removed in preparing the trick for its next exhibition. The letters which have been cut out of the black sheet are one-half inch wide, and as nearly continuous as it is possible to make them. Of course, small pieces of black material must be left to hold the center portions of the looped letters in place, but in words where these loop letters occur, such as the letter O or the letter D, I try to conceal these attachments by not closing the letters at the top. In back of these cut-out letters I then secure black electrician's adhesive tape, beginning to secure it at the end of the last letter and continuing until I have completely obscured the opening of the very first letter. The tape must be continuous. The end is then passed out through an opening in the center of the white sheet where it dangles from the rear of the slate. When I give the signal, Sing merely grasps this tape and pulls upon it, and in doing so the letters of the words are slowly and progressively unveiled, as the tape is removed. The white background gives the illusion of the letters appearing on the slate itself."

I interrupted Hargrave with, "But I went over there to examine that slate, and I didn't see any cut-out. It seems to me to be perfectly solid."

The magician chuckled, "And what did you think my trusty servant was doing while you were walking toward the easel? You saw him changing the slates, did you not, during which change he placed a dummy slate upon the easel for your most scrutinous inspection." Turning he continued, "Sing, bring out one of those white paper blocks, and get me a tennis ball and a large well of ink.—You had better put the ink in an evaporating dish instead of a well."

A moment later Sing returned with the ink and a tennis ball. He retreated almost immediately and coming into the room for the second time, placed a large paper pad,—such as artists are wont to draw upon when giving a stage exhibition—upon the easel. He then disappeared. Asking me to examine the tennis ball, Hargrave dipped it into the ink, unmindful of soiling his fingers. With the ink-soaked ball he walked toward the easel, and then with a word of command placed the ball in the center of the paper sheet, where much to my consternation it remained.

"You desire to ask any questions?" Hargrave queried.

For a moment I thought of a real tricky question, one which could not be answered by the words "yes" or "no." This was the question I placed. "What are the colors of the American flag?" The ball swung over to the left of the sheet, leaving a black ink mark as it rolled. Then it started to spell out the words, *red, white and blue*, all in one stroke. It stopped. Hargrave walked over to the easel, easily removed the ball from its position, tore off a sheet from the pad, and informed me that further questions were in order.

"What time is it?" was my second inquiry. Ten twenty-two, the ball wrote upon the slate, which I ascertained was absolutely correct. I could not help but voicing my praise for the trick. It was a truly remarkable demonstration. "How does it work?" I continued. "Magnetism?"

"Correct," Hargrave replied. "You see immediately in back of the paper pad is a strong iron magnet capable of operating on 110 volt D. C. supply. This magnet has a wrought iron or annealed mild steel round core, measuring 7 inches long by ½ inch in diameter. At either end of the core a fibre or other insulating disc is placed, each disc measuring about ¼ inch thick, and 2½ inches in diameter. The winding space between the discs should measure about 6 inches, and for 110 volts, D. C., with a current consumption of .1 ampere, the winding should comprise 3¼ pounds of No. 30 B. & S. gauge, single cotton covered magnet wire. This magnet will operate cool for long periods, and does not require any lamps or other resistance connected in series with it.

"If a battery electro-magnet is desired for the purpose, particularly where 100 volts direct current is not available, you will find the following magnet data very effective: The soft wrought iron or mild steel core should measure in this case 9 inches long by ⅝ inch in diameter and have two fibre or other insulating bobbin-discs placed at either end, and fitting tightly on the core. These discs may be ¼ to ⅜ inch thick, and measure about 1⅜ inches in diameter. The space between the two bobbin cheeks should be about 8 inches. In building either of these magnets, the iron core should be insulated with several layers of waxed paper, or better still, oiled linen, commonly called Empire cloth. After insulating the core, proceed to wind on 14 even layers of No. 22 B. & S. gauge single cotton covered magnet wire. This winding is designed for use on 8 to 10 dry cells, and when 15 volts from 10 such cells is applied, the current consumed is about 1 ampere, and a very powerful magnetic action results. In either case, one end of the iron core should be turned, filed or otherwise machined off, so as to resemble a small cone with a rounded nose. The iron ball which is dipped in ink may be a light hollow one, or even a pressed steel or a tin ball. If the ball is not too heavy, it may receive a thin felt covering which will hold the ink better for performing the trick. A small light rubber ball, similar to a tennis ball, may be covered with a ⅛ inch layer of iron filings, retained in place by a light felt covering. A small ball may be carefully covered with strips of soft sheet iron, or possibly also iron wire, retaining these in place around the ball with a felt covering, which will also act as the ink retainer. Of course this energy decreases as the thickness of the paper increases. This eye magnet, for that is exactly what it looks like, is suspended in back of the easel on a lazy tong bracket, the cord suspending it passing over a pulley and counterweighted at its opposite end so as to exactly balance the magnet. The pulleys are ball bearing, so that the magnet may be lifted up or drawn down easily. The lazy tong arrangement permits the magnet to be carried across the entire easel. I have found that this arrangement is better than a track attached to the easel because in stage productions this bracket may be placed behind the back drop and pushed out in back of the easel when operations are to commence. An extension in the form of a wooden rod is attached to the magnet, which permits the operator to manipulate the magnet, forming words or phrases. A switch, at his control, turns off the current when desired.

"If I use but a single sheet of paper instead of the pad, the lines are rather thin and cannot be read at a distance, but with the pad I am able to produce rather heavy lines. At first I presented you with a real tennis ball and as you handed it to me I seemingly changed it from the left hand to the right. In reality I had this hollow iron ball concealed within my right hand which I dipped into the ink."

Thrusting his hand into his pocket he produced the original tennis ball.

How Three-Hour Glides Are Made

By Prof. EDWARD P. WARNER

(*Continued from page* 634)

always into the wind, neither advancing nor receding, neither rising nor falling. When the record set up by Mr. Wright was finally broken, however, the most successful of the German pilots were quick to go a step farther and to maintain their flight in winds whose speed was less than the normal flying speed of their machines. If they had held a straight course, into the wind or in any other direction, under these circumstances they would quickly have passed beyond the limits of their favoring currents of air, and it was therefore necessary to turn, working back and forth along the aerial slope which the wind evolved in its blowing, and following a series of circles and figures of 8.

The existence of rising currents, combined with very efficient machines, exceedingly skilful piloting, and careful study of local conditions by the pilots, in order that they may find the places favorable for soaring and take advantage of the motions of the air there, account in general for the wonderful performances of Hentzen and his colleagues. It is probable that the larger part of the soaring of birds can also be explained in this way, although there is much that is not yet understood about bird flight, and some observers have credited the albatross and other birds with soaring powers, too great to be dependent on rising currents alone.

Since ascending currents exist only over very restricted regions it is necessary that some other method of soaring should be developed if the cherished dream of traveling across country without the expenditure of power is ever to be realized. The theory of such a method, requiring nothing but a series of horizontal gusts of varying speed, the internal work of the air, as it has been termed, was discovered long ago, and there remains only the very difficult step of reducing the theory to a matter of practical piloting. The practical use is difficult chiefly because of the inability of the pilot to detect the approaching gusts and plan, before they arrive, the manner in which he will make use of them. If man could be endowed with the ability to see all the motions of the air, it might be easy for him to soar, given such highly efficient gliders as have already been developed and used.

The procedure in soaring in variable winds is a little more complicated than that depending on rising air. It can best be understood if a wind be thought of as blowing first in one direction and then in the other, with momentary calms between. Under such conditions it would be sufficient for the pilot to travel in a series of circles or in an S-shaped curve, turning into the wind each time that it starts from a new direction. In this way it would be possible to maintain flight indefinitely. Suppose, for example, that the pilot is flying towards the north in a calm and that a north wind suddenly springs up. This wind blowing across the wings of the glider serves to lift it to a greater height. When the wind dies out, the pilot turns his machine through a half circle and heads towards the south to await the wind coming from the south a few seconds later, which will have the same lifting effect.

The same result can be obtained if, instead of blowing first in one direction and then in the other, the wind is unsteady, coming in a series of gusts, but it is necessary that the pilot should be forewarned of these gusts in order that he may head into the wind when it is about to increase in speed and turn downwind in preparation for a fall of wind speed. It is well known that nearly all winds are gusty in their nature, and soaring by this method would therefore be almost universally applicable. The next great step to be hoped for in sail-planing will be the utilization of the fluctuations in the wind to furnish the power required for flight.

It is not to be expected that it will ever be possible to go farther than that. Despite the enthusiastic prophecies and claims sometimes made, there is no reason to hope that it will ever be possible to fly without power in still air or air moving steadily in a horizontal line. That would be essentially perpetual motion and absolutely contrary to the known laws of mechanics.

Depth of Sea Learned by Dropping Body to Bottom

A new method for determining the depth of the sea has been devised by a German inventor named Hannemann, of Kiel. This new method depends on measuring the time taken by a body to fall from the surface to the bottom. According to the laws of gravitation the movement through the water should be an accelerated one, but in fact the acceleration is soon counteracted by the friction of the body in the water, so that from a certain point the speed of falling becomes regular. The bodies used contain a cartridge, which is automatically fired when the bottom is reached, and the sound of the explosion is picked up upon the ship by means of a submarine signaling listening apparatus. The time is determined by an ordinary stop watch.

The speed of the ship, which need not be reduced, has some influence upon the time taken by the sound to reach the navigator's ear, but this influence is small. With great depths and considerable ship's speed the error may be eliminated by means of tables, as the physical quantities involved are well known. The shape of the bodies may be varied, according to the presumptive depth, to give different times of falling, since a certain lapse of time is desirable for small depths in order to get accurate measurements, but with great depths, where a difference of a few feet is of no consequence, it is of some importance that the times for sounding should not be too long.

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

(*Continued from page 644*)

"I suppose so, but the reactions are very complex."

"Yes, in civilized men. In savages they are much more simple. Well, Silas, while experimenting with electrical waves of very high frequency I found that these waves could act as stimuli on human beings, and after a long series of observations I have succeeded in making an instrument which I call a 'tel-hypnotizer' for want of a better name. By properly tuning and directing the waves from this instrument I can compel anyone within a range of five or ten miles to perform practically any action I wish."

"Prove it to me, doctor, and I will believe you," said Silas Rockett with a grin.

"Very well. I will prove it on yourself. Sometime today I shall send you a hypnotic wave and compel you to perform my bidding. That there may be no mistake I shall write down and seal in this envelope the order I have given you. Open it at eleven o'clock tonight and you will find that you have carried out my orders. Will that convince you?"

"Perfectly, so long as the action is not one that I perform every day, such as 'eat my dinner,' or something of that kind."

"No, indeed. Take my word for it, the action is one you have never before performed in your life. By the way, how is Miss Gloria Mundy, the charming young lady you met during your summer vacation?"

"She is quite well, and more charming than usual."

"I suppose you have told her so, and asked her to marry you?"

"Well, no; I have never yet mustered up courage enough to do so. I am afraid my answer might be 'no,' and I prefer not to risk anything yet."

"You are wrong, Silas. Remember the old adage, 'Faint heart ne'er won fair lady!' Think over it. Well, good-by."

* * * * * * * *

After the reporter's departure, Doctor Hackensaw sat down before his tel-hypnotizing machine, while he consulted a rather long list he held in his hands. The fact was that the doctor, having perfected his apparatus for hypnotizing people at a distance, was not content unless he used that power for the good of the subjects themselves, as well as for the good of mankind in general.

"My power is limited," thought the doctor, "I cannot change a person's nature. But I can prevent him from committing a bad action and can force him to do a good one. Let me see, the first on my list is a lazy man who allows his wife to slave at the washboard while he sits with boon companions smoking his pipe. I will make him do one good day's work anyway!"

So saying, the doctor pressed the keys of his instrument for a few minutes, and then turned to the second case.

"No. 2," said he, "is a swindler who has robbed a poor widow of her savings. I will compel him to return the money to her." Again the keys worked, and the turn of the third case came. This happened to be a woman who was believed to possess vital information in a murder case, but who refused to make it known.

As Doctor Hackensaw believed the suspected murderer to be innocent, he worked the keys of his instrument and compelled the woman to come to him. She had been left at liberty by the police in the hope that her actions would afford them some clue to the real murderer. When the doctor had the woman before him he compelled

her to make a full statement of the affair, and with the knowledge obtained was able to secure the acquittal of an innocent man.

And so the doctor proceeded with his list. Brutal parents he forced to sign papers releasing all claim to their children; corrupt judges and other officials signed and sent in their resignations at his bidding. He forced politicians to appoint good men to office, and in a word he endeavored to use the boundless power he possessed for the welfare of his fellow men. True, he did indulge in one joke—he compelled Silas to put a dozen raw potatoes in a handsome box and send them to his lady love. The doctor chuckled as he thought of Gloria Mundy's face when she opened the box, but was recalled to himself by the unwelcome attentions of a fly who persisted in using the doctor's head and face as a walking track.

"I must really perfect my tel-hypnotizer," cried the doctor aloud. "If I could only hypnotize animals as well as people I could compel every fly and mosquito in the room to commit suicide by flying into the water pitcher! And barking dogs and yowling cats at night could be quieted in a jiffy!"

* * * * * * * *

"Come at once—urgent. Hackensaw."

Such was the message received by Silas Rockett several weeks after his last visit to the doctor's laboratory, and he hastened to obey the summons. He found the place in confusion; the assistants all excited, for the doctor had locked himself in his private office for a couple of days and refused to stir from it or see anyone, and received his food by means of a basket let down from a window.

When Silas's presence was announced, however, the door of the private office opened and the doctor's familiar voice bade him come in. Here he received a fresh surprise, for Doctor Hackensaw had barred himself inside a strong iron cage inside of which was a closely woven metallic netting which completely surrounded him.

Silas was tempted to laugh, but something in the doctor's expression restrained him.

"You think I'm crazy, don't you?" were the doctor's first words. "Well, I am not. If I stepped out of this cage for a minute my life wouldn't be worth a straw!"

"Why, what's the matter?"

"The matter is that my tel-hypnotizer has been stolen, and the villain now wants to murder me, so as to remain the sole possessor of the secret."

"Have you any idea who the fellow is?"

"Yes, it is Dope Peters, the man who ran off with my tel-automatic girl, and that you helped me to catch. I was a fool to let him go free. When he was in my employ here he must have pried around and learned of the existence of my tel-hypnotizer, and last Saturday night he broke in here and carried the instrument off in a high-powered automobile. Luckily for me he didn't quite understand how to work the machine or I should be a dead man by this time. As it is, I had time to enclose myself in this wire netting which protects me from the hypnotic electrical waves. As, however, he could hypnotize my assistants and make them break the netting. I have taken the further precaution of getting inside an iron-barred cage. There I am safe for a while. But my hypnotizer is so simple that the villain will soon be able to work it as well as I can."

"Simple!" exclaimed the reporter. "How can an instrument be simple that enables you to make people do any one of a million different things?"

"Easily enough," replied the doctor. "You see, the natural instincts that govern a man's actions are comparatively few. Our usual motives are fear, curiosity, envy, jealousy, hate, the sexual instinct, despair, sympathy, cupidity, etc. The list of important ones is not very long. My tel-hypnotizer must first induce the subject to walk in any desired direction and stop in any desired spot. To achieve this, after tuning up the instrument to accord with the position and mentality of the subject, the needle of the dial is turned in the direction you wish the person to take and the start or stop button is pressed. As soon as the subject has gone to the spot indicated you press the 'cupidity' button if you wish him to steal, the 'sympathy' button if you wish him to render assistance, and the 'jealousy' or 'despair' button if you wish him to commit murder or suicide. With the twenty-five keys of the apparatus, pressed down one at a time or two or more together, hundreds of thousands of combinations are possible.

"Now, Dope Peters has already mastered the most important of the combinations, and has been using his new power in a way that will soon make him *Master of the World* unless I can find some means of checking him. And yet I dare not leave this cage, where I am none too secure as it is, for he can, if he thinks of it, direct the captain of a company of soldiers to come here with his men and shoot me.

"Here are some of the things he has already done. First, in order to secure wealth, he orders a wealthy woman to bring her money and jewels to some specified spot where he can secure them. He also makes her steal the jewelry of her friends, and thus saves himself the trouble of tuning up the instrument several times, and also the danger of having several women to deal with.

"Then he has ordered the clerks in charge of his police records to destroy them and has compelled the witnesses of his crimes to commit suicide. In this way he hopes to secure immunity and be able to enjoy his new wealth in peace. Then he is designing to make a pretty girl he has seen fall in love with him. Luckily, however, he has not yet found the love combination on the machine, for she is a beautiful girl, belonging to one of our best families, and it would be a shame to have her life ruined.

"Then, too, the fellow seems to be getting ambitious. I can see that he wants to secure power, and it will be easy for him to secure any position he desires, and become either President or a power that is even greater than President—a political boss! With his hypnotizer and his money there is no goal he cannot reach!"

"But suppose a foreign nation should step in and try to stop him."

"Pooh! He would simply hypnotize their generals and have the armies surrendered or turned back. He would hypnotize the admirals and obtain mastery of the fleets. And the same for the airplanes. Nothing can stop him once he has thoroughly learned how to use the machine!"

"Then what is it you expect me to do, doctor?" asked Silas. "How am I to get at him if he has power to make me do anything he pleases? How can I accomplish more than an army of a hundred thousand men?"

"Remember, Silas, that a flea can get in where a lion can't go."

"Thanks for the comparison. But what am I to do?"

"Listen, Silas. Here is the address of the place where Peters in staying tonight. Take a good look at the place in my *television* apparatus so you can find the spot without trouble. Take this small box with you and place it in Peters' room in the top drawer of his bureau. I'll keep an eye on him. He's not at home now. Telephone me just before entering the house and I'll let you know if the coast is clear."

"But, doctor——"

"Not another word. Go! And remember that the lives and happiness of all the rest of the world depend on your doing your part well!"

* * * * * * * *

From the day Dope Peters had stolen the doctor's machine for hypnotizing persons at a distance, New York City had been startled

by a series of the most sensational robberies that had ever been perpetrated. In the most select gatherings jewels and other valuables disappeared when there was no one present to whom any suspicion could be attached. Private detectives were set to work and were astounded to find that the thieves were persons of rank and wealth for whom money had no temptation whatever. Evidently there was an epidemic of KLEPTOMANIA raging.

Women who tried to save their jewels by placing them in safe-deposit vaults and wearing imitations were no more fortunate. They came back a day or two later, took out the valuables again and lost them. And they told strange tales of the fierce temptation that assailed them to get the real gems again, and then the wild desire to go to lonely spots and there throw away necklaces and bracelets that had cost thousands of dollars. And in every case, when the obsession left them and they returned to the spot, it was only to find that the jewels had disappeared.

In another case over a million dollars' worth of jewels were stolen in one night from one of the best patronized of the safe-deposit vaults. The precautions taken by the firm were so great that the collusion of over twenty different trusted employees was necessary, men who had held their positions for years and whose integrity was above suspicion. Yet the jewels or other valuables had vanished, and the tales told by the guilty guardians were passing strange—tales of irresistible temptation coming suddenly to them and overcoming all their principles. Yet none of the employees had received a reward of any kind for his assistance in performing the theft!

Dope Peters was jubilant when he returned home that night. He was literally rolling in wealth. As yet he had not tried to dispose of any of the jewels or securities—the amount of cash he had secured was far more than sufficient for his present needs. He feared no detectives. If any got on his track he would simply hypnotize them and send them off on the wrong scent. Only two things worried him—the first was that he could not find the love combination of the machine, and the second was his fear of Doctor Hackensaw. He knew the doctor's wonderful powers of invention, and he felt that his only safety lay in the physician's death. But the doctor, in his wire-meshed cage, was proof against the electrical hypnotizing waves. Still, Doctor Hackensaw was mortal!

"It's got to be done!" cried Peters aloud. "And the sooner the better! I'll hypnotize the man who prepares his food and have it poisoned!" So saying, he sat down in front of the tel-hypnotizer and pressed down one of the keys. But at the first touch of the instrument there was a tremendous explosion. Peters himself was blown to atoms, and nothing remained of the tel-hypnotizer but a mass of shapeless bits of iron. Dope Peters had been master of the world—but his reign had been a short one!

* * * * * * * *

"You did your work well, Silas," said Doctor Hackensaw. "Yes, it was an explosive that I had in the can I gave you. It was arranged so as to go off the first time the tel-hypnotizer keys started the electrical waves going. It had to be done, and the world is better off without Dope Peters."

"But how about your apparatus?"

"Well, the world is better off without that, too! I should have had to destroy it, anyway. No man is fit to be trusted with the power of hypnotizing his fellow-beings at will."

"How about the stolen valuables?"

"They are all safe except the few dollars Peters spent. I watched the fellow through my television apparatus and I know all his hiding places. The jewels can be easily recovered."

"You're a wonder, doctor!" cried Silas in admiration. "And I am sorry you lost your instrument."

"I am not," said the doctor, quietly. "I was often tempted to use my power for questionable ends. I might some day have succumbed to the temptation, if, for example, I had fallen in love with a girl who loved another. I might have hypnotized her and commanded her to love me, instead."

"I should have given a great deal yesterday for such a power," said Silas, "but today I shouldn't care a fig for it."

"Ah, then Gloria accepted you, did she?"

Silas Rockett looked at the doctor in amazement. "Are you a mind-reader, doctor?" he cried.

"Not quite, but I know you proposed to her today, because I hypnotized you and ordered you to do so. If you will look at the sealed memorandum I gave you you will find my order written out. I saw you were hesitating to propose, and I felt sure Gloria Mundy would accept you, so I thought I would hasten matters a little. No thanks, please, Silas. Don't thank me until you have been married ten years. Then you will know whether you will want to thank me or murder me!"

A World-Time Clock for Radio Stations

By Dr. ALFRED GRADENWITZ

(*Continued from page* 663)

Berlin and London, corresponds to a 15 degrees difference on the globe, while the hour-hand of Berlin coincides with that of its antipode.

Now, the spiral path of the feet of all hour-hands affords a simple means of ascertaining whether there happens to be day or night time at a given place. All that is required to this effect, is, starting from the point of origin or end of the spiral (Fig. 2) to follow this out until the foot of the hour-hand in question is reached. Whenever, in doing this, the figure 6 of the dial is crossed, there has been a change between day and night time. In Fig. 3, the clock, e.g., records as Berlin time 9 h 24′ a. m.; New Zealand time then is 7 h 54′. In order to ascertain whether this is day or night, the spiral path, starting from Berlin, is followed on the shortest way. Inasmuch as the figure 6, in doing so, is actually passed, there is in New Zealand the opposite time to Berlin, i.e., night time. In British India, however, there is then still day time, for the foot on the India hour-hand is, on the shortest way, reached without crossing the figure 6. If, on the other hand, there is in Berlin, 9h 20′ p. m., there is, as seen from a glance at the spiral, 6 h 24′ a. m. at Sydney. In a similar way, it is possible by means of the World-Time Clock or Watch to ascertain for what places there has been a change of date.

The minute-hand, of course, belongs to the local hour-hand, both hands being preferably marked off by special painting.

Spiral hands destined for watches can, if desired, be punched in any numbers out of one piece, and can be readily fitted to any watch, the proper combination of cities being chosen in accordance with actual needs.

HEALTH BELT CALLED FAKE

The Post Office Department has issued an order refusing use of the mails to a New York genius(?) who, it is alleged, has been selling a so-called "electric belt with miraculous curative powers," through advertisements. Post office inspectors were unable to discover merit in the belt.

"Perpetual Motion" Contest Awards

(*Continued from page 653*)

amount of energy to raise it from the bottom reservoir to the point B, as it will give up in falling from B back to the reservoir. So unless we use every fraction of head that the water has at B our machine will not even be in balance. Now look at the losses:—from B until it gets into the bucket at L, from the bottom bucket until it gets to the surface of the water in the reservoir M, then from the outlet of the turbine to the surface of the bucket reservoir. To say nothing of the fact that there has never been a turbine invented that is anything near 100% efficient.

SECOND PROBLEM (PRIZE $50.00)

Many errors were made in this explanation; some readers calculating the moments of forces and obtaining figures which would tend to show that the machine ran backward rather than forward. Of course, explanations of this nature are worthless, inasmuch as the machine even if accurately designed will balance perfectly on both sides and will run in neither direction. Mr. J. F. O'Beirne, of 301 N. Main St., Tipton, Ind., decreases our bankroll by an additional $50.00, and a check for this amount is now en route.

Let us take one pair of cylinders and weights to see just how they operate. One weight is at its highest point and the other is nearly at its lowest point. We will call the higher one A, and the lower one, B. A falls a short distance in forcing the mercury to its own side of the machine, but does not revolve the machine during that fall. The heavier cylinder of mercury causes the machine to revolve until A reaches its lowest point. B, however, is still a short distance from the highest point, and the small amount of mercury is not heavy enough to raise it without the help of A. Any vacuum formed by A is compensated for by an equal drag on the machine. It will be found that the effort necessary to raise B to its highest point is exactly equal to the turning effort gained by the fall of the cylinder of mercury, because the distance A fell to raise the mercury is equal to the distance B must be raised. Thus, one set is incapable of producing power, or even of moving itself, consequently no power is produced by several sets, and the machine is useless.

FIRST HONORABLE MENTION

Mr. Peter Patchis, 29 Spring St., Everett, Mass., explains this from his own angle; his explanation is given below.

The machine Fig. 2 will not operate as claimed by its inventors, because it is impossible to have continuously more weight or greater turning moment on one side than on the other.

Since the left hand cylinders are supposed to be always filled with mercury while those on the opposite are empty, it might appear, at first sight, that the machine ought to turn to the left, and continue doing so indefinitely; but as a matter of fact, all it could do, if left in position indicated by Fig. 2, would be to execute a turn of about 25-30 degrees, and then stop—for then the five weights on the right hand side would just counterbalance the three weights and the mercury in cylinders on the opposite side.

This can be proved by making a diagram of the machine to scale, assuming any size and weight of different parts, and multiplying every weight, and the weight of mercury in cylinders, by the distance from their respective centers of movement to, and at right angles with, the line drawn perpendicularly through the center of the machine. The

positions of weights on the ends of the levers will depend on the relation they bear to the quantity or weight, of mercury in cylinders, as well as the size of pistons. As shown in Fig. 2, the weight of mercury contained in one cylinder must be very small, when compared with a weight on the end of any lever; hence the top cylinder and three others on the left are full of mercury, the bottom one and three on the right are empty. Therefore, the sum of moments on the left is greater than on the right, and the machine will turn in anti-clockwise direction till moments equalize, when all motion will cease.

SECOND HONORABLE MENTION

A letter from John G. Merne, of Drumsna, Co. Leitrim, Ireland, with an admixture of poetry, enters as follows. It may be added here that there were one hundred and twelve foreign entries in this contest.

Dear Mr. Editor: You will agree "The State of Denmark" must be rotten
When everyone excepting you and me is trying to get something out of nothin'.
In SCIENCE AND INVENTION, there I find
Friend Howard Brown has finally decided
To eight sides your machine shall be confined,
While on the blueprint it appears six-sided.
The fellow sitting down seems quite upset;
he thinks the old machine is void of gumption
Because it will not go; and your best bet is that his hopes were based on pure assumption.
The chap standing up with his thumbs in his vest is waiting to see the fine notion;
For he surely has plenty of cash to invest, if the engine would start into motion.
But, "Alack and Alas," the machine won't go round, and is causing them both consternation.
The reason it won't in one word can be found, and that word is just Gravitation.
Why it never will move till the great Judgment Day
I'll now try to prove in my own simple way,
As you've offered a prize, a solution to find.
Fifty dollars is sure a nice sum to my mind.
So here is the reason, as far as I know,
Why the blessed contraption refuses to go.
If I don't win a prize, "Alas and Alack,"
It is "Something for Nothing" to Mr. Gernsback,
And when someone more lucky receives Dollar Bills,
The paper I write on will go for pipe-spills.
The solution is easy, as everyone knows,
But I think I had better just put it in prose.
So here is the reason the thing will not turn.
With best of respects, I am

Yours,

JOHN G. MERNE.

Referring to the Diagram 1 we find that the two cylinders D and X are connected together by a pipe. As these two cylinders with plungers, levers and fulcrum are equal in weight on each side of the center axle, they balance one another and are in a state of equilibrium. Both long levers are of the same length and weight and the weights at end M and N are equal in amount. We introduce mercury into cylinder X and connect up as in the diagram herewith. When this is done we find that weight N acting through lever displaces from cylinder D the mercury to fill X and both levers take up the relative position shown in Diagram 1. We next draw a horizontal line to represent the cylinders and balance the same on a fulcrum O, Diagram 2. As gravity acts through center of mass, we next project lines vertically downward from both M and N, and find where they cut the horizontal line. If we measure the distance from A to B we find that it is longer than from B to C. This is due to mass N having moved towards the fulcrum O more than the mass M has moved. In this condition we would have unstable equilibrium, except that we have not yet

taken X into account. Project X vertically downward on a horizontal line and we find that it extends outside N in this case and acts as a counterbalance with mass N to equalize the action of mass M, therefore bringing about a state of equilibrium.

No matter how many arrangements like this are fixed on a center axle and no matter in what position they may be arranged in relation to each other, the weights M and N bring about stable equilibrium, and the amount of mercury displaced in the cylinder D, by the mass M will be counterbalanced by the mass N + X and vice versa. Hence there can be no motion of any kind to make the machine revolve continuously.

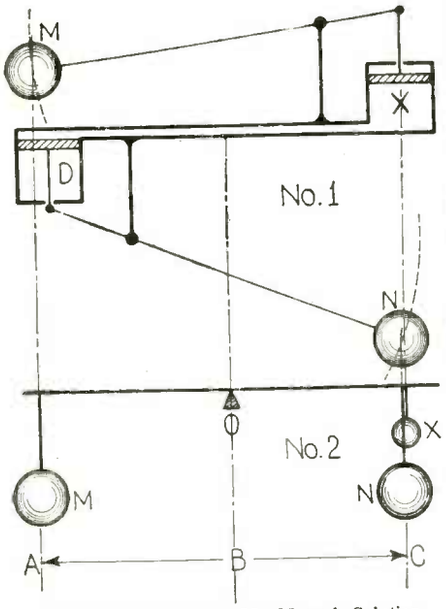


Diagram to Accompany Mr. Merne's Solution.

THIRD PROBLEM (PRIZE $50.00)

The first prize for the third problem, the last of the $150 (two-thirds being already awarded), in which many contestants assumed that the length of the descending track is five times the length of the ascending track, which is not necessarily the case, as the ascending track could be almost vertical and the descending track extremely long, proper gearing being employed for raising the cars, goes to Mr. Leroy J. Miller, of 823 Flatbush Ave., Brooklyn, N. Y. He is the only man from greater New York whose explanations were considered worthy of a prize award. When called up on the phone, Mr. Miller informed us that he has an M.E. degree from Stevens Institute, and that he is but twenty-five years old. No favoritism is shown to Mr. Miller because he is a New Yorker, but his answers were considered the best. They follow.

The reason, the inventor claims, that this machine will work, is that the weight of the five cars moving on a downward course is greater than the weight of one car ascending.

The fallacy of this scheme lies in the fact, that only the force acting on the cars, which is the same as the weight of the cars, has been taken into consideration, whereas the distance traveled (in the direction in which the weight is acting) has to be taken into account also. In other words, to find out if the five cars descending will raise the ascending one, the "work" done by the descending cars and the "work" done by the ascending car must be determined.

"Work" as used in this explanation is defined as the product of the force acting on the car (which is its weight) and the distance through which this force acts. (The distance being measured in the same direction as the force is acting.) In this case the distance is measured vertically because the weight acts vertically downwards.

There are three possible cases to be dealt with here. They are:

1. If the work done by the five descending cars is greater than the work done by the ascending car then the machine will work.

2. If the work done by the five descending cars is equal to the work done by the one ascending car there will be equilibrium or no motion; hence the machine will not work.

3. If the work done by the five descending cars is less than the work done by the ascending car the machine will work backwards, that is, the one car on the steep incline will descend and the five cars will ascend. This would mean that the machine would work backwards.

It now remains to determine under which of the above headings this machine comes.

In the following explanation the five cars are considered as descending and the one car ascending. Also all cars are considered to be of the same weight and friction throughout is neglected.

The work done by the one car in ascending is the product of the weight of the car and the total distance (measured vertically) that it is lifted.

The work done by the five cars in descending is equal to the sum of the work done by each of the five cars. The work done by one descending car is the product of its weight and the distance (measured vertically) that it travels downward while the one car is ascending. Now as there is to be only one car ascending while five cars are descending each one of the five cars will move down one-fifth of the distance that the one car ascends (all distances measured vertically). Therefore the work done, by each of the five cars in descending while the one car ascends, is one-fifth of the work done by the one car in ascending and the work done by the five cars in descending is five-fifths or equal to the work done by the one car in ascending.

Hence this machine comes under heading No. 2 and will not operate without power being applied.

FIRST HONORABLE MENTION

The first honorable mention is given to Mr. Kenneth Wolfskill, of 37 Front St., San Francisco, Calif., whose explanation follows:

Let us assume, for convenience' sake, that there are five cars on the long spiral incline pulling the remaining car up the steep slope. The amount of work required to pull the car up the incline (regardless of the speed) is equal in units of work (foot-pounds or gram-meters) to the product of the weight of the car by the height of the incline at the top, pulling the car up the incline requiring the same amount of work as lifting that weight up the same distance (the height of the incline). Now let us see about the energy of the cars going down hill on the spiral slope. By the same principle of physics the energy of anyone of them equals the weight times the vertical distance of descent. But, since there are five of them, any one car transverses a distance equal, not to the height of the incline, but to one-fifth of the height. Thus it is that the energy of any one of them at any time is equal to one-fifth the weight of the car times the height of the incline. Since there are five cars, this energy in units of work is five-fifths of the energy required to pull up the single car, or, in other words, the two are equal. Hence we get a balance.

SECOND HONORABLE MENTION

The second honorable mention in the third problem is issued to Mr. Geo. W. Webster, Jr., of 1658 W. 1st Ave., Columbus, Ohio. His explanation is given below.

The driving power of No. 3 is gravity, which acts perpendicularly only.

As there are always five cars descending while only one is ascending, each of the five cars therefore descends but one-fifth of the perpendicular distance from the top to the

bottom, while the one car is ascending the total distance.

The work performed in raising the single car from the bottom to the top is the product of the weight of the car times the perpendicular distance between the bottom and top planes.

The work performed by the five cars as they descend, each one-fifth the perpendicular distance between the top and bottom planes, is the product of the weight of the five cars times the perpendicular distance each descends, which is one-fifth the distance between the top and bottom planes.

If the weight of each car is one, and the distance between the top and bottom planes is one, the work performed by the five cars descending one-fifth of the distance between planes is $5 \times 1/5 = 1$.

The work performed by raising the single car (weight one) the total distance between planes (one) is therefore $1 \times 1 = 1$.

Therefore the work performed by the five cars descending is equal to the work required to raise the one car, and, as they are opposing each other, there can be no motion.

The number of cars descending while one car is ascending is immaterial, as only one car can ascend at a time, while each of the other cars is descending a proportionate distance in an inverse ratio to the number of cars descending.

In closing, we would state that unless the men put a little more action behind their explanations, the girls are going to walk off with all of the first prizes. Even girls fourteen and fifteen years old submitted truly remarkable reasons why the various contraptions here listed would not work. Perhaps when a girl takes the first prize in one of these contests, the men will sit up and take notice. Let us inform the various gentlemen that have designed the machines shown here that their devices will not work, and let us further caution each inventor working upon perpetual motion systems that none of their devices would stand scientific explanation or proof. Although not from Missouri, we believe as the Missourians do—"we want to be shown," and to any inventor who claims that he has a perpetual motion machine which actually operates we say "show me." We would advise that any inventor can secure a patent upon such a machine on condition that he submits a working model to the Patent Office at Washington, which office up to the present day has never received such a working model.

X-RAY ALTERS SEX OF UNBORN INSECTS

Announcement that he had succeeded in changing the sex of unborn banana flies and otherwise altering their hereditary characteristics by use of the X-ray was made by Dr. James W. Mavor, professor of zoology at Union College, at Schenectady, N. Y., recently.

While he did not predict any practical application of his discoveries in the direction of efforts to alter the transmission of hereditary characteristics in animals and plants, Professor Mavor said he did anticipate they would be of great help in making "a sound foundation for the therapeutic use of X-rays."

"It is of more than academic interest to prove that the mechanism of heredity can be modified by external agents such as X-rays," he said. "Although the whole animal was exposed to the rays while the eggs were in the mother, this striking and far-reaching effect on the inheritance of the offspring was produced without apparently affecting the body of the mother herself in any way."

The banana fly was selected for the experiments, he explained, because the great mass of data concerning its hereditary characteristics already massed made it possible to check accurately any alterations effected by the X-ray.

1,000 H. P. AIRPLANE A SUCCESS

The satisfactory trial flight of a 1,000 horsepower "Leviathan," the success of which marks an important step in airplane construction, was announced recently.

The feature of the giant plane, which is constructed entirely of metal, is an arrangement by which the motors may be operated independently and by which any one motor developing trouble is automatically thrown out of gear without disturbing the functioning of the others. The machine contains an engine room where the mechanics during flights can superintend the functioning of the four 250 horsepower motors, which are in the front of the plane.

HOW TO KILL DANDELIONS

The University of Wisconsin lists as among its greatest achievements the discovery of an effective "death to dandelions" treatment.

Twenty-four hours after announcement of the discovery by the university horticultural experts, thousands of letters were received, inquiring for the details.

The basis of the university's new discovery is iron sulphate, commonly known as green vitriol. Full investigation has shown its efficacy, it is said. The spray is made by dissolving iron sulphate, which is obtainable at any drug store, in water in the ratio of two pounds to a gallon of water. One gallon of this solution will spray 860 square feet of lawn. Three sprays are necessary every year, one in May, one in June and the third in the fall.

PROCESS FOUND FOR THE PRESERVATION OF NEWSPAPERS

How to so pickle newspapers that they can be preserved indefinitely in the public libraries is a problem which has apparently been solved, according to the American Paper and Pulp Association.

Eight years of experimenting, participated in by three big New York newspapers at a cost of $5,000 a year each, under the supervision of the New York Public Library, has taught librarians how to preserve for posterity newspaper files. The solution seems simple, being the mounting of each newspaper sheet between two sheets of thin Japanese tissue, shutting the air from the original sheets, reducing its legibility but slightly, and strengthening the page. Bound volumes of the mounted pages are now in constant daily use, and are free from the wear and tear which destroyed the untreated newspapers.

In the New York experiments silk was first used, but the Japanese tissue was found the best for the purpose, as it hermetically sealed the newspaper pages from the air. Shellacs, varnishes and other substances were tried, with little success. Under the method now in use, the operator wets a glass or steel-covered table, lays down a sheet of tissue with the pasting machine, rice paper is put on, then in turn the newspaper page, paste and tissue, when the page is dried and pressed under a gas-heated mangle.

WHY AUTO RUNS FASTER ON CERTAIN ROADS

Motor cars of all kinds have long been known to gather speed in some unaccountable manner when passing over smooth asphalt or bituminous macadam roads. It is now held to be due to the abnormal profusion of vegetation found along many of these roads.

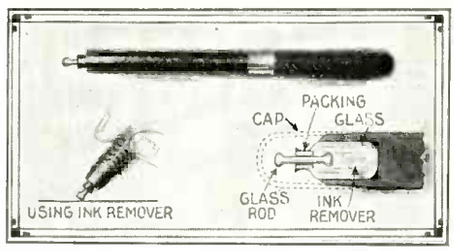
Trees and plants exude oxygen. Motors run more smoothly when there is plenty of oxygen in the air. The increased amount of oxygen diffused in the localities where vegetation is profuse makes the motor "pick up." Scientists have recently conducted experiments in several localities and along roads bordered by heavy vegetation.

Ink Eradicator in Fountain Pen

In view of the success of the rubber-tipped pencil it seems surprising that an ink eradicator in fountain pens was not invented before this, but there were difficulties that seemed insuperable. In the first place the ordinary eradicators would not do in this case, they call for two fluids, whereas such a device evidently presupposes a single fluid eraser and until recently, no single fluid was known that would eradicate ink with neatness and despatch. Secondly, when the present writer discovered such a compound, it was only to find that no ordinary material, such as is used in fountain pens, would hold it.

No metals or alloys, not even platinum, would resist it, thus eliminating metal springs and valves from the device, and complicating the problem.

There was nothing for it, therefore, but to place the erasing fluid in a neat glass tube, closed with a small rubber cork, through which passes a smaller glass tube with a glass rod plunger which works loosely through it. This rod acts by displacement and when pushed into the bottle an equal volume of fluid flows down the sides of the rod upon the word or figure to be erased. By removing the small cap that covers the eraser, the plunger is drawn out and is ready for operation.



Clever Idea in Combination Fountain Pen and Ink Eradicator. The Latter Is the First Single Solution Eradicator That the Editors Have Tried. It Removes Practically Any Ink and Contains no Free Acid. It Can Be Used on the Hands.

So much for the mechanical details of the first invention, the pen. With regard to the second, which is a chemical process and product, the principal features of note are: The fluid eradicator acts in one operation, instead of requiring three operations as do other devices of the kind.

Unlike others, it contains no free acid, it is non-corrosive, and may, for example, be used with perfect safety to remove ink stains from the fingers. It is effective also in removing stains from cloth, paper, wood, and even stone. A curious illustration of its power in this respect was seen recently in its rapid action on a deeply-stained hewn limestone covered with supposed indelible stains.

There are a number of companies—some very large ones—engaged in the manufacture of ink eradicators. All these eradicators are of the two fluid type, all copies of the same original, in which it is necessary to use No. 1 fluid first, then blot, and apply No. 2 and then frequently have recourse to No. 1 again.

With the present invention, however, all that is needed is a slight excess of the eraser to convert the standard inks into a fluid which is almost water white as may be proved by pouring a few drops of ink into the bottom of a test tube and treating it with the single solution.—THOMAS W. CAPPON.

PHONOGRAPHIC GAS FLAME

Utilization of an ordinary gas flame is the latest novelty offered to put a larger volume of tone and beauty into phonographic reproduction. News of the latest device comes from England, where some inventor has devised a small sound horn that employs the pulsation of a gas flame combined with a reflector.

NEW MACHINE TRANSMITS HIGH-PRESSURE DIRECT CURRENT

Great interest has been aroused in England by experiments now in progress with a method of transmission by high-pressure direct current instead of by high-pressure alternating current. The machine employed, which is the invention of Highfield and Calverley, is known as a "transverter," and consists of a transformer for stepping up the pressure of the three-phase current generated by the turbo-alternators and of several rotating commutators for converting the alternating current into direct current.

By connecting these commutators in series, the direct-current pressure of each is added to that of the one behind it. In the experimental transverters which have been working for the last sixteen months the pressure is 100,000 volts, but it is thought that this might possibly be doubled.

Assuming, however, that direct-current transmission is limited to 100,000 volts, this would more than double the economic railway distribution radius, and it is possible that if higher pressures can be used the distribution radius for railway purposes can be raised to 100 miles. As the machine is reversible, transverters are employed at the receiving end to convert the direct current into three-phase or single-phase, or to reduce the direct-current pressure to that required for traction purposes.

DE-INKING PROCESS FOUND TO SALVAGE NEWSPRINT PAPER

A process to remove ink from old newspapers so the paper can be used for printing purposes has been developed by the United States Forest Products Laboratory in Madison, Wis.

One mill under commercial conditions has de-inked 1,500 tons of old newspapers and has remade the paper into newspaper stock of desired strength and color which was accepted by publishers as standard, says the laboratory announcement.

Bentonite, a clay-like substance formed from volcanic ash and found largely in Wyoming, is used in the de-inking process. Because of the cheapness of the new process laboratory officials believe much of the 2,200,000 tons of newsprint annually used can be salvaged.

SAILORS DREAD SUGAR CARGO MORE THAN DYNAMITE

At first thought it would seem that dynamite was a cargo to be carefully avoided, but from a sailor's point of view there are far more dangerous cargoes. He dreads, for instance, a cargo of sugar. Put hundreds of tons of cane sugar in casks in the hold of a vessel and let the ship steam through a spell of hot weather. The odor is sickening. The sailors cannot get the sweet taste out of their mouths and crave vinegar or lemon juice—anything sour. They lose their appetites and are always glad when a voyage on which the cargo was sugar is over. Coffee is as disagreeable as sugar, in addition to being dangerous.

Cotton is a really dangerous cargo. If a little oil happens to touch raw cotton the result may be spontaneous combustion. A single bale of cotton saturated with such an oil as boiled linseed and lying at the bottom of the hold can be compared only to a slow match attached to a bomb.

Acids and other chemicals form dangerous cargoes. Carbide of calcium, for example, is more dangerous than dynamite. Acetylene gas is made from this chemical and the gas is constantly given off if the product is exposed to moist air.

—and now harmony replaces discord!

MUSIC clear as a bell; speech so that every word is marvelously distinct; jazz in uninterrupted syncopation; opera with that transcending, full-toned quality which brings its remarkable beauty into strong relief.

This sort of radio reception *is* a matter of *batteries*. Elimination of most *noises* is a matter of batteries, rather than static or other interference.

These noises are caused by the *irregular* voltage output, natural in ordinary "B" batteries. Where the current output becomes unvarying, these noises cease and this marvelously clear and life-like reception results.

And it is because RADIOBATS "A" and "B" are the only batteries which act as radio batteries *should*, that we urge you to listen to a demonstration at your dealer's.

Until you have actually heard reception through RADIOBATS "A" and "B" you cannot imagine how wonderful radio *can* be—and there *is no* way to hear it, till these epoch-making, new-principle batteries are hooked in.

RADIOBATS "B"—as well as "A"—are *leak-proof because they have the only solid electrolyte*; and they are more economical, because, like "A" Batteries, they are indefinitely *rechargeable at home*.

Send now for the intensely instructive booklet "The permanent Power Unit for Radio" and send your dealer's name and address so that we may arrange an immediate demonstration. There is absolutely no obligation.

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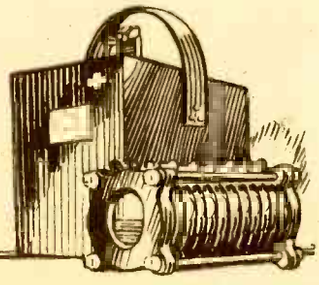
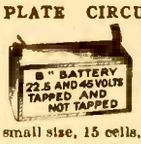
"A" and "B" RADIOBATS
The Permanent Radio Power-UNIT



BUILD YOUR SET WITH BARAWIK STANDARD

PLATE CIRCUIT "B" BATTERIES



You can make real savings on these batteries. Don't pay more. We guarantee them to equal any on the market regardless of price. Absolutely uniform. Extra long life.

K180 Signal Corps type, small size, 15 cells, 22½ volts. Each 95c

K182 Large Navy size, 6½x4x3, 15 cells, 22½ volts. Each $1.75

K184 Variable Large Navy size, 5 taps, giving range from 16½ to 22½ volts in 1½ volt steps. Each $1.80

K186 Double Navy size 6½x4x6, 30 cells, 45 volts. Suitable for amplifier circuits and power tube use. Two or more of these units in series may be used in C. W. and radiophone circuits. Each $3.40

K188 Combination Tapped 45 volts, 30 cell, 6½x4x6 battery. Tapped to give 45, 22½, 21, 19½, 18, and 16½ volts. Handles both detector and amplifier tubes. Each $3.58

4½ VOLT "C" BATTERY UNIT

For use in grid circuit. Also can be used to make up "B" batteries.

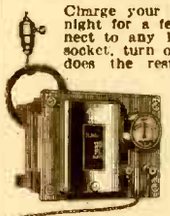
K189 Each 39c

WILLARD "B" STORAGE BATTERY

Better results. No battery noises. Cheaper in the long run. Easily recharged by our Battery Charging Rectifier. Leak proof glass jars. Will last for years.

K205 Price $9.00

BATTERY CHARGING RECTIFIER



Charge your battery at home over night for a few cents. Simply connect to any 110 volt 60 cycle light socket, turn on current and rectifier does the rest automatically. Will work for years without attention. Simple connections. Gives a tapering charge which batteries should have. You can make it pay a profit charging your friends' auto batteries. Long connecting cords with pair of battery clips.

Prices are Transportation Paid

K201 For 6 volt battery $13.95
K203 For 12 volt battery 13.95

STORAGE BATTERY

A very high grade battery made especially for radio service. Guaranteed. Properly cared for will give years of service for filament lighting.

K194 6 volt, 40 ampere size. Each $10.00
K196 6 volt, 80 ampere size. Each $12.50

Prices are Transportation Paid

BATTERY CLIPS

K198 Two for 28c

Clip onto storage battery terminals. Make positive non-corrosive contact at all times.

WIRE CONNECTING CLIPS

K199 Per dozen 30c

Small connecting clips for fastening leads onto binding posts, etc. Handy and useful. Every experimenter should have at least a dozen.

PORCELAIN BASE SWITCHES

Fine white porcelain bases. Copper contacts and blades. Can be used as antenna switches.

K385 Single Pole Single Throw. Each 20c
K387 Single Pole Double Throw. Each. 32c
K384 Double Pole Double Throw. Each. 50c

FILAMENT CONTROL RHEOSTATS

Crosley—Wound on vulcanized fiber. Adjustable to any panel. Complete with knob.

K130 Each 54c

Best grade. High heat resisting base. Diam. 2¼ in. cap. 1½ amp. Resist. 6 ohms. 1½ in. Knob with pointer.

K132 Each 60c

POTENTIOMETER

Same style as above rheostat. Gives fine "B" battery adjustment. Resistance 100 ohms.

K133 Each $1.18

VERNIER RHEOSTAT

Gives exceedingly fine control of a battery current. A necessity for best receiving results.

K136 Each $1.19

QUICK ACTING VERNIER RHEOSTAT

Gives very fine control of current and can be switched on or off instantly at any desired point.

K124 Each $1.27

Porcelain Base Rheostat for table mounting. Resist. 10 ohms.

K136 Each 78c

WE PAY TRANSPORTATION CHARGES EAST OF THE ROCKIES

THE PRICES QUOTED DELIVER THE GOODS TO YOUR DOOR
FAST SERVICE—TRY US AND BE CONVINCED

THIS GUARANTEE PROTECTS YOU—Examine the goods we ship you. They must suit you in every respect. If you are not satisfied with your purchase return the goods at once and we will refund the price you paid.

SPECIAL OFFER ON TWO HIGH GRADE RECEIVING INSTRUMENTS

Regenerative Tuner and Detector—Two Step Amplifier

K220 The two for $67.50

This is a combination unequalled for clear long distance radiophone receiving. With a good aerial the range is only limited by the power of the transmitting set. Send for complete descriptive circular.

REGENERATIVE TUNER

K224—Price $37.50

This is a standard make Armstrong licensed set. Range from 180 to 600 meters. Will tune sharply and bring in signals strong even under difficult conditions. Fine Mahogany finished large size cabinet. Satin finished Formica Panel. Two high grade variometers, with variocoupler for closest tuning. Engraved dials, knobs, switches, binding posts for all necessary connections, etc. A high grade outfit worth much more than we ask.

DETECTOR-TWO-STEP AMPLIFIER

K222—Price $35.00

A very sensitive high grade instrument. Signals that cannot be heard with detector alone, will be brought in strong. Has one detector and two amplifying circuits. Standard tube sockets, grid condenser in detector circuit two amplifying transformers, 3 jacks and a plug. Satin finished Formica Panel. Fine Mahogany finish large size cabinet. Hinged top. Interior easily accessible. Binding posts for all necessary connections.

VACUUM TUBES

Standard Brands—Cunningham Radiotron. Every one guaranteed new and perfect. We will ship brand in stock unless you specify otherwise.

K105 Detector. Each $5.00
K110 Amplifier. Each 6.80
K115 5 Watt Transmitter 8.00

MYERS TUBES

These tubes have many desirable characteristics that have made them great favorites. No critical adjustments. Low battery consumption. Clear signals. Great sensitiveness on long distance reception. Small size. Rigid construction. No tube noises due to mechanical vibration. Perfect oscillator. Excellent as audio or radio frequency amplifier. Especially satisfactory on Armstrong super-regenerative circuits. Can be used in Myers receptacle or in any standard socket with adapter listed.

K113 High-Mu Audion. Has 5 times amplification of ordinary tubes. Oscillates anywhere from 2 to 300 volts on plate. Each $5.00

K116 Receptacle for above. Each $1.00
K117 Adapter to adapt Myers tubes for use in any standard socket. Each $1.00

MYERS CHOKE COIL

Designed to work with Myers tubes. Brings in loudest possible signals. Flexible over a broad band of wave lengths. Free from amplifier noise. Free from distortion. Mounts in Myers special receptacle.

K119 For Audio Frequency Amplification. Each $3.50
K118 For Radio Frequency Amplification. Each $3.50

VACUUM TUBE SOCKETS

Our Special Socket. A wonderful value. Moulded entirely of bakelite. Four binding post connections. Right angled contact springs.

K140 Each 39c

PORCELAIN BASE AND TUBE

K144 Crosley for either panel or table mounting 42c

High Grade combination type for panel or table mounting. Metal tube. High insulation base.

K146 Each 45c

Paragon combination type for panel or table mounting. One of the best designed and best made sockets on the market. Metal tube bakelite base.

K148 Each $1.10

TWO AND THREE GANG SOCKETS

These sockets make it easy to build detector and amplifier units and make a neat, compact, workman-like job. Perfectly made of high grade materials. Metal tubes mounted on fiber base. Quickly mounted on panel or base.

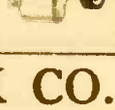
K147 Two gang socket $1.20
K149 Three gang socket $1.65

FIXED CONDENSERS

Moulded cases, nickeled binding posts.

K802 .005 Mfd. Each .49c
K804 .01 Mfd. Each 59c

CARBON PRESSURE DISC VERNIER RHEOSTAT



Current regulation is obtained by changing of pressure on carbon discs. This permits of infinitely fine variation of current. Very durable. Resistance 15 ohms. Capacity 2½ amperes

K131 Each $1.48

VARIABLE GRID LEAK

Pencil mark type. Resistance may be varied exactly as needed.

K160 Each 24c

GRID CONDENSER

K162 Mounting holes spaced to fit lugs of above leak. Cap. .00025 MF. 19c

K163 Same as 162 but higher grade. Enclosed in metal case 39c

PHONE AND GRID CONDENSERS

A compact, inexpensive style of condenser that is very satisfactory and durable. Conducting sheets and dielectric are wound on fiber strip with eyelets for mounting and connections.

Price, each

K170 Phone Condenser .001 Mfd. 12c
K172 Phone Bridging Condenser .0005 Mfd.
K174 Grid Condenser .00025 Mfd.

K176 Grid Condenser .00025 with pencil mark leak. Each 24c

TUBULAR GRID LEAKS AND CONDENSERS—MOUNTED STYLE

Very convenient. Permits quick change of leaks or condensers of varying capacities.

Grid Leaks. Price, Each 57c

	Resistance		Resistance
K850	.5 Meg.	K858	2. Meg.
K851	1. Meg.	K857	3. Meg.
K853	1.5 Meg.	K859	5. Meg.

Grid and Plate Condensers. Price, each ... 55c

K830 .000025 Mfd. Correct for Myers Tubes.
K832 .0001 Mfd. For special circuits.
K834 .00026 Mfd. For U. V. 201 and Cun. 301.
K836 .0005 Mfd. For U. V. 200 and Cun. 300.

Mountings. Bakelite base. Spring clip contact.

K840 Single mounting. Each 32c
K842 Double mounting. Each 57c
K844 Triple mounting. Each 78c

INDUCTANCE "HONEY COMB" COILS

Carefully made—fine looking coils. Highest efficiency. Low distributed capacity effect, low resistance—high self inductance. Very firm enamel impregnation. Range given is in meters when varied with .001 variable condenser.

Mounted coils have standard plug mountings.

Turns	Range	Price Art. No.	Mntd.	Art. No.	Price Mntd.
25	120- 250	K301	$0.39	K320	$0.97
35	175- 450	K302	.42	K322	1.00
50	240- 720	K303	.49	K323	1.07
75	390- 910	K304	.54	K324	1.12
100	500- 1450	K305	.58	K325	1.16
150	600- 2000	K306	.63	K326	1.21
200	900- 2500	K307	.72	K327	1.30
250	1200- 3500	K308	.78	K328	1.36
300	1500- 4500	K309	.82	K329	1.40
400	2000- 5000	K310	.97	K330	1.55
500	2800- 6100	K311	1.12	K331	1.70
600	4000-10000	K312	1.27	K332	1.85
750	5000-12000	K313	1.43	K333	2.00
1000	7900-15000	K314	1.70	K334	2.38
1250	9750-19500	K315	1.92	K335	2.60
1500	14500-26500	K316	2.18	K336	2.76

COIL MOUNTINGS

K340 Three coil mounting $2.95

High grade fine looking mountings. Polished black composition. Center receptacle stationary, two outer ones adjusted by knobs. Takes any standard mounted coil.

COIL PLUGS

Made of moulded bakelite. Fits any standard plug. Mounts any standard honeycomb coil.

K344 Each 50c

RADIO FREQUENCY AMPLIFYING TRANSFORMER

K995 Each $3.95

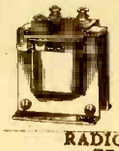
This transformer will get the long distance stations loud and clear. Permits of easy sharp tuning. Helps cut out static and interference. Makes your set sensitive enough to use a loop aerial. Enclosed in metal case affording perfect shielding. Suitable for panel or base mounting. Because of its special design can be mounted in any V. T. socket. Works with any make of tube. Wave ranges 150 to 550 meters. Wiring diagrams included.

OUR SPECIAL AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

We believe these transformers to be the best on the market. We offer them with two winding ratios—the 10 to 1 for Radiotrons and Cunninghams—the 3 to 1 for A. P. Moorehead. These two types of tubes have entirely different characteristics and therefore require transformers of different winding ratios. As high as three stages can be used without howling due to proper impedence ratio, minimum distributed capacity, low core losses and proper insulation. Mounted style has bakelite panel with binding post connections. Unmounted has core and coils assembled with two holes in core for fastening to apparatus.

K234 10 to 1 Mounted. Each $3.95
K235 10 to 1 Unmounted. Each 3.20
K236 3 to 1 Mounted. Each 3.90
K237 3 to 1 Unmounted. Each 3.10

THORDARSON AUDIO FREQUENCY AMPLIFYING TRANSFORMER



An especially high grade transformer with correct characteristics for Cunningham, Radiotron or A. P. Tubes. Wonderful results without distortion on one, two or three steps. Low distributed capacity. Fully mounted bakelite panel.

K232 Each $4.00

RADIO CORPORATION TRANSFORMERS

Audio Frequency Amplifying Transformer. Especially designed for Radiotron tubes. 9 to 1 winding ratio.

K712 Each $6.40

RADIO FREQUENCY AMPLIFYING TRANSFORMER

Range 200 to 5000 meters. For long distance reception.

K714 Each $5.95

OUR COMPETITOR AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

While these are very low priced transformers, nevertheless they will give excellent results. They are carefully designed and carefully made. Quantity production and small profits make the low price possible. They will equal in results many transformers selling at much higher prices.

K238 Unmounted, with wire leads $2.00
K239 Mounted, with binding post connections $2.75

BARAWIK SPECIAL PANEL MOUNTING VARIABLE CONDENSERS

K812—43 plate .001 Mfd. $2.75
K813—21 plate .0005 Mfd. 2.45
K814—11 plate .00025 Mfd. 1.95
K815—3 plate Vernier 1.20

These are especially high grade condensers and we guarantee them to be mechanically and electrically perfect. Fine polished end plates of high dielectric and great mechanical strength. Sturdy aluminum alloy plates perfectly spaced to insure smooth, even reliable capacity. Our low prices save you money. These condensers are of the very best make and are not to be compared with many inferior cheap condensers offered. We guarantee them to please you or your money back.

COMBINATION VERNIER VARIABLE CONDENSERS

K824—23 plate .0005 Mfd. Price $3.79
K826—43 plate .001 Mfd. Price $4.48

The latest improvement in condensers consists of regular variable condenser controlled by large knob and dial. Separate small knob mounted above dial controls a single vernier plate. This arrangement permits of very fine tuning. High grade design and construction.

ENCLOSED VARIABLE CONDENSER

One of the best made condensers. Rigid, accurately spaced aluminum plates. Formica ends. Engraved scale. Knob and pointer. Clear transparent case.

K806—43 plate .001 Mfd. $3.95
K808—21 plate .0005 Mfd $3.25

KNOCKED DOWN VARIABLE CONDENSERS

You can save money by assembling your own condensers. Formica top and base. Complete with all parts not assembled. Go together easily and perfectly. Panel mounting type.

K820—41 Plate .001 Mfd $2.18
K821—21 Plate .0005 Mfd 1.88

THE BARAWIK CO. 102 South Canal Street CHICAGO, ILL.

RADIO GOODS—BEST QUALITY—REDUCED PRICES

EVERYTHING FOR THE COMPLETE SET

PRESERVE THESE PAGES
ORDER FROM THEM AND SAVE MONEY
FAST SERVICE—TRY US AND BE CONVINCED
THE PRICES QUOTED DELIVER THE GOODS TO YOUR DOOR

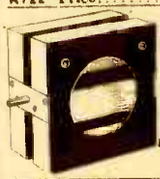
ARLINGTON RECEIVING TRANSFORMER

Will tune in all stations up to 3,500 meters. Very efficient on short waves and for radiophone reception. Used with our Detector Two Step Amplifier it produces very excellent results. Also does good work with crystal detector. Silk covered windings on formica tubes. Very fine mahogany finish wood work. Base size 6x18 inches. Slider controls primary. 12 point switch on secondary. Can be tuned very close. A wonderful value at our price.
K720 Price $6.95

TUNING COIL

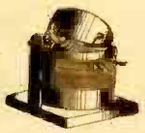
Range up to 950 meters. Wound with bare copper wire, machine spaced. Ends of mahogany finished hard wood. Two easy sliding contacts on polished brass rods, four binding posts. Substantial, efficient, attractive. Length, 8¼ in.
K722 Price $2.45

VARIOMETER



K410—Completely assembled, price $2.97
K411 Not assembled but all parts complete, including winding form, $1.90
Perfect in design and construction. Accurate wood forms. Correct inductive ratios. Solid baked windings. Positive contacts. Highest efficiency.

VARIO-COUPLER



With this loose coupler and two variometers, together with the necessary other parts, a highly efficient tuning set can be made. Easily mounted on panel. Primary winding on formica tube. Inductively coupled for 180 to 600 meters. Multiple taps permit fine tuning.
K415 Price, completely assembled $2.85
K416 Not assembled but all parts complete. Price $1.35
K417 Rotor ball only. Each 20c

MOULDED VARIOMETER

Polished black moulded rotor and stator forms. Maximum inductance with greatest efficiency and minimum distributed capacity. A high grade durable instrument that will make up into a set you will be proud of and will get the best results. Wave length 180 to 600 meters. 4¼" square. 1¾" thick. Shaft threaded 8–32.
K412 Price $4.35
K413 Brackets for panel mounting, pair .. 20c
K912—3" Dial and knob to fit 65c

MOULDED VARIO-COUPLER

This coupler is designed to work with the above variometer. The stator and rotor forms are of polished black moulded composition. Primary has seven taps to enable finest tuning. Wave length range 180 to 650 meters. Fitted with panel mounting bracket. Shaft threaded 8–32.
K418 Price $4.25
K910 Moulded dial with 90° scale to fit .. 65c

180° VARIO-COUPLER

K416 Price $3.80
The most efficient type of coupler. Insures sharper tuning and louder signals. Primary and secondary wound on genuine bakelite tubes. Secondary connections through soldered flexible cables eliminates contact noises. Primary has 7 taps. Can be panel or table mounted. Range 180 to 650 meters.

BRASS ROD

Supplied only in 12 inch lengths.
K981 Threaded 6–32, per length 8c
K983 Threaded 8–32, per length 10c
K985 Solid 3–16 inch, per length 10c
K987 Solid ¼ inch, per length 12c

SPAGHETTI

For covering connecting wires in sets. For size 12 and 14 wires.
K955 Finest quality braided and saturated with best baked lustrous transparent insulating varnish, 3 feet for 29c
K956 Best quality braid and covered with good grade insulating compound, 3 feet for 12c

PARTS FOR ARMSTRONG SUPER REGENERATIVE CIRCUIT

K355 100 Millihenrie Iron core choke coil. Each $1.20
K354 10 Millihenrie Open core choke coil. Each 92c
K357 12,000 ohm Non-Inductive wire wound resistance. Each $1.58
K356 12,000 ohm Moulded resistance. Each 48c
K358 5 Millihenrie Open core choke coil. Each 82c
K359 1 Henrie Iron core, choke coil. Each $1.20

FIBER TUBES

Fiber tubes for winding coils. Strong solid material.
K950 Diameter 3 inches, per foot 20c
K951 Diameter 3½ inches, per foot 25c
K952 Diameter 4 inches, per foot 30c

BARAWIK QUALITY HEADSETS

These headsets have proven on rigid tests to be one of the very best on the market. The tone quality is excellent with an unusual volume. Skilled workmen make them from only the best selected materials. The receiver cases are brass in fine polished nickel finish. Polished black ear pieces. Fabric covered head band comfortably and quickly fitted to the head. Supplied with 5-foot cord. These sets were designed to sell for $8.00 and $9.00 each and at our price are a wonderful bargain. We guarantee that you will be pleased with them and agree that they are the best value by far yet offered. If they don't suit you we will cheerfully return your money.
K770—2000 ohm .... $4.00 K772—3000 ohm $5.00

OTHER STANDARD BRAND HEADSETS

K751	Murdock 56, 2000 ohm $4.45	K754	Baldwin Type C with universal jack plug $16.00
K752	Murdock 56, 3000 ohm 5.40	K755	Baldwin Type C unit with attaching cord $7.75
K764	Frost, 2000 ohm 4.45	K766	Brandes, 2000 ohm 7.20
K765	Frost, 3000 ohm 5.40	K769	Holzer-Cabot, 2200 ohm 7.20
K758	Red Head, 3000 ohm 8.85		
K768	Western Electric, 2200 ohm 10.80		
K771	Kellogg, 2400 ohm 6.75		

ENCLOSED DETECTOR

One of the finest crystal detectors on the market. Supersensitive galena crystal enclosed in heavy glass shield. Quick, positive adjustment. Brass parts polished nickel finish.
K730 Each $1.45

GALENA DETECTOR

Easy fine adjustment. Crystal mounted in cup. Moulded base and knob. Brass parts polished nickel finish.
K732 Each 80c

DETECTOR CRYSTALS CAREFULLY TESTED

K736 Galena, Arlington tested, per piece .. 10c
K738 Silicon, Arlington tested, per piece .. 10c
K735 Buzzer tested, Galena, per piece 12c
K737 Buzzer tested, Silicon, per piece 12c

DETECTOR PARTS

K729 Price set .. 32c
All metal parts for crystal detector. No base included. Easily assembled. Polished nickel finish.
K727 Detector Crystal Cup. Each 6c
K728 Cat Whisker Wire, 5 feet for 5c

BAKELITE DIAL AND KNOB

Neat, clean cut design. Clear, plain engraved scale, with enameled white letters contrasting with polished black finish of dial. Fluted knob. Diameter three inches.
K902—For 3–16 inch shaft. Each 61c Dozen $7.20
K903—For ¼ inch shaft. Each 61c Dozen $7.20

Same as Dial and Knob but made of polished black composition. Looks just as well as the bakelite when new but does not retain finish as well and is more fragile.
K908—Three inch 3–16" shaft. } Each 30c
K909—Three inch ¼" shaft. } Dozen $3.00

ONE PIECE DIAL AND KNOB

A fine looking knob and dial moulded in one piece. Neat clean cut design. Polished black finish. Clear plain engraved scale with numbers and lines in contrasting white enamel. Ribbed knob that fits the hand. The three sizes used on the same panel can be arranged to produce a very attractive effect. Three and four inch sizes are marked 0 to 100 over 180° of the scale. 2¼ inch size is marked 0 to 9 over 270° of scale.
K900—2¼ in. Diam. for 3–16in. shaft. Each, 45c
K901—2¼in. Diam. for ¼in. shaft. Each, 45c
K904—3in. Diam. for 3–16in. shaft. Each, 58c
K905—3in. Diam. for ¼in. shaft. Each, 58c
K906—4in. Diam. for 3–16in. shaft. Each, 75c
K907—4in. Diam. for ¼in. shaft. Each, 75c

ELECTRIC SOLDERING IRON

K957 Price $5.75
Especially adapted to radio work. Will enable you to do neat clean work quickly. Simply attach to any light socket 100-120 volts. Complete with six foot cord and attaching plug. Renewable solder point. Will last a lifetime for ordinary home or light shop work. A wonderful value at the price.

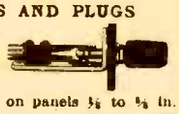
ROSIN CORE SOLDER

K958 Per Coil 22c
Self fluxing. Especially designed for soldering electrical connections. Fine for use with above electric iron. Coil will last a long time.

TINOL

K959 Per tube 22c
With this preparation you can solder your connections with the heat of a match. Works fast. Makes a perfect electrical and mechanical joint. Self fluxing.

RADIO JACKS AND PLUGS



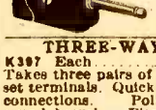
Finest grade jacks. Improved design. Best materials. Phosphor bronze springs. Silver contact points. Nickel finish. Mount on panels ⅛ to ⅝ in. thick.

Jacks Only
K390 Open circuit. Each 45c
K391 Closed circuit. Each 52c
K392 Two circuit. Each 53c
K393 Single cir. fila. control 70c
K394 Two cir. fila. control 88c
K395 Plug. Large space with set screws for attaching cord. Each 54c

COMPETITOR JACK AND PLUG

Well made, durable, smooth working. Interchangeable with any standard Jacks and Plugs. Solder connections. Nickel finished metal parts. Fiber barrel on Plug.
K388 Two Circuit Jack. Each 48c
K389 Standard Plug. Each 48c

STANDARD FLAT PLUG



K396 Each 74c
Black polished case with polished nickel insert. Fits any standard jack. Quick solid connections.

THREE-WAY ROUND PLUG

K397 Each 98c
Takes three pairs of head set terminals. Quick easy connections. Polished round barrel. Fits any standard jack.

BINDING POSTS

Brass, polished nickel finish. Washer and 6–32" screw extending ¾".
K370 Large size—barrel and knob ¾" long, dozen 96c
K372 Smaller size—barrel and knob 9–16" long, dozen 84c
K374 Large size with composition knob, dozen 50c
K378 Large size with hole for phone tip or wire, dozen 95c
K376 Small size with hole for phone tip or wire, dozen 38c

SWITCH CONTACT POINTS

Brass, polished nickel finish. All have ¾" long size 6–32 screws. All prices the same.
Dozen 20c Hundred $1.40
Order by Article Number.
K360 Head, ¼" Diam., ¼" High
K362 Head, 3–16" Diam., ¼" High
K363 Head, 3–16" Diam., 1–16" High
Solder Lugs to Fit Contact Points
K386 Dozen 12c—Hundred 80c

SWITCH LEVERS

Moulded composition knob. Exposed metal parts polished nickel finish. Fitted with panel bushing, spring and two set nuts. A high grade switch.
K380—1" Radius. } Each
K381—1¼" Radius. } 22c
K382—1¾" Radius. }

SWITCH LEVER STOP

Brass, polished nickel finish.
K386—Dozen 20c. Hundred $1.40

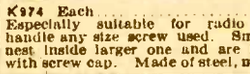
LONG NOSE PLIERS

K970 Price $1.25
The handiest pliers for radio work. Made of fine hardened steel. Length 5 inches. Fine clean finish.

DIAGONAL JAW NIPPERS

K972 Price $1.25
For fine electrical work. Made of hardened steel. Length 5 inches. Fine clean finish.

FOUR-IN-ONE SCREW DRIVER



K974 Each 55c
Especially suitable for radio work. Will handle any size screw used. Smaller drivers nest inside larger one and are held in place with screw cap. Made of steel, nickel finished.

CABINETS

Fine looking cabinets solidly built. Made of genuine solid mahogany in elegant hand rubbed finish. You will be proud of your set mounted in one of these cabinets. Hinged tops. Front rabbeted to take panels. Panels not included. Prices are transportation paid.

Panel Size	Inside Dimensions High	Wide	Deep	Art. No.	Price Each
6x 7"	5⅛"	6⅛"	7"	K420	$2.48
6x10½"	5⅛"	10"	7"	K422	2.75
6x14"	5⅛"	13⅜"	7"	K424	3.30
7x14"	6⅛"	13⅜"	7"	K423	3.60
7x18"	6⅛"	17⅛"	7"	K428	3.90
6x21"	5⅛"	20⅛"	7"	K425	3.90
9x14"	8⅛"	13⅜"	10"	K428	3.70
12x14"	11⅛"	13⅜"	10"	K430	4.40
12x21"	11⅛"	20⅛"	10"	K432	5.25

SOLID GENUINE CONDENSITE CELORON PANELS

Notice our very low prices on this fine quality grade 10 genuine solid sheet Condensite Celeron (a product with mechanical, chemical and electrical properties like formica and bakelite). Machines well without chipping. Won't warp. Waterproof. Highest mechanical and di-electric strength. Attractive natural polished. Black finish which can be sanded and oiled for extra fine work.

Panel Size Inches	¼" thick Art. No.	Price	3–16" thick Art. No.	Price	⅛" thick Art. No.	Price
6x 7	K450	$0.80	K460	$0.75	K470	$0.98
6x10½	K451	.75	K461	1.15	K470	1.47
6x14	K452	1.05	K462	1.55	K472	2.05
7x14	K458	1.20	K468	2.00	K478	2.40
7x18	K453	1.55	K463	2.30	K473	3.10
7x21	K457	1.78	K467	2.65	K477	3.50
9x14	K454	1.80	K464	2.30	K474	3.10
12x14	K455	2.10	K465	3.10	K475	4.15
12x21	K456	3.15	K466	4.65	K476	6.20

TRANSFER PANEL MARKERS

K501 Per set 27c
A complete set of decalcomonia transfer markers that can be quickly and easily applied to any part of any panel to mark binding posts, dials, knobs, etc. Very attractively lettered words on neat gold background. Following captions included.

Aerial	Coupling	B Battery
Pri. Condenser	Detector	Loading coil
Sec. Condenser	1st Step	On ... Off
Ground	2nd Step	(3) Increase
Primary	3rd Step	(2) + (2) −
Secondary	Input	A G
Plate Var.	Output	A Battery
Grid Var.	Phones	Tickler

ETCHED METAL NAME PLATES

Made of brass. Silver plated characters and border on black background. All plates are 1 inch long and ⅜ inch wide, except "INCREASE CURRENT" which are quarter circle 1⅜ inch over all, and "ON" "OFF" which are ⅝ inch long. Attaching holes pierced.
K503 Per Dozen 35c
Not less than one dozen assorted sold. Specify marking wanted as follows:—

Plate Variometer	Secondary	Aerial
Grid Variometer	Primary	Ground
Vacuum Tube	Tickler	Phones
Primary Condenser	Load'g Coil	Input
Secondary Condenser	Coupling	Output
Increase Current (to right)	Parallel	On
	Series	Off
Increase Current (to left)	Detector	1st Step
	A Battery	2nd Step
	B Battery	3rd Step

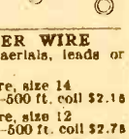
(Blank—takes pencil or pen marks.)

MAGNET WIRE

Insulated copper wire. Best quality even drawn wire, one piece to a spool.

Double Cotton Covered Insulation		Single Green Silk		Enameled Insulation	
Number	K990	Number	K991	Number	K992
Gauge	Price 8 oz.	Gauge	Price 4 oz.	Gauge	Price 8 oz.
18	50c	20	45c	20	45c
20	50c	22	55c	22	55c
22	75c	24	61c	24	61c
24	85c	26	68c	26	68c
26	95c	30	70c	30	70c
28	$1.15	32	78c	32	78c
30	1.85	36	98c	36	98c

OUTDOOR LIGHTNING ARRESTER



K980 Price $1.68
Protect your instruments with this lightning arrester You cannot afford not to. Weatherproof porcelain case. Air gap type. Permanent. Durable. The most practical quality arrester obtainable. Underwriters approved.

ANTENNA INSULATORS

K260 Size 1 x3½.
Two for 18c
K262 Size 2½x3¾.
Two for 55c
K264 Size 1½ x 4.
Two for 80c
K266 Size 1½x10½.
Two for $1.35

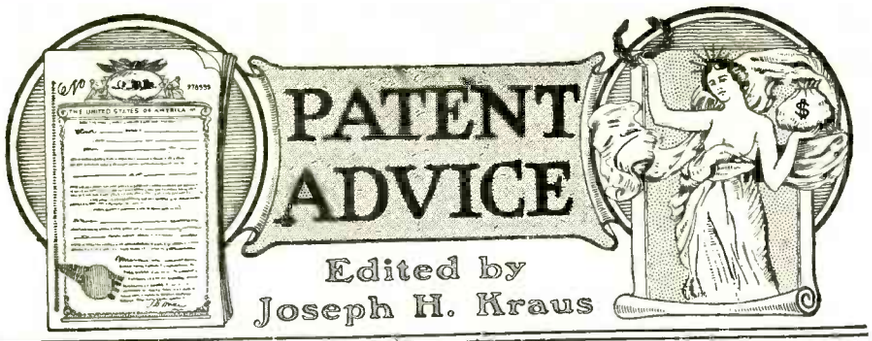
SOLID BARE COPPER WIRE

Solid bare copper wire for aerials, leads or wiring instruments.
Solid Bare Copper Wire, size 14
K240—100 ft. coil 45c K242—500 ft. coil $2.15
Solid Bare Copper Wire, size 12
K244—100 ft. coil 61c K249—500 ft. coil $2.75

STRANDED ANTENNA WIRE

Cabled of fine copper strands. Very flexible. High tensile strength. Best for aerials.
K248—100 ft. coil 85c K249—500 ft. coil $2.95

THE BARAWIK CO. 102 South Canal Street, CHICAGO, ILL.



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

RECEIVING SET

(651) Arthur Benedict, So. Boston, Mass., submits a sketch of a midget radio receiving set secured to a receiver. He desires patent advice on the same.

A. We can find nothing unique or novel in your radio receiver, except its small size. We think you can get a design patent upon the same, and at the present time if manufactured cheaply, the device could sell. You must get busy, however, as this boom in radio will not continue forever, as manufacturers are now building sets at a rate sufficiently great to supply the demand. We would advise immediate action; but none at all, unless you can manufacture the instrument yourself.

OVERHEAD OILER

(652) Edward Bayer, Jersey City, N. J., requests our opinion on an overhead oiler operated from the ground doing away with "step ladder oiling."

A. There is something very similar to your idea upon the market which is being widely used today. It is simply an oil can fitted with a long spout, almost identical to the type you describe, the can itself being fitted with a plunger. This plunger is a piston pump arrangement which forces air into the oil can, causing the oil to flow out of the top. The idea is easier to construct than yours, and few repairs whatever are necessary. On the contrary, in your device repairs would always be needed. We would not advise application for a patent.

SLOW ACTING FUSE

(653) Gerald W. Babbitt, New Brunswick, Canada, asks whether he could obtain a patent on a fuse which will not melt and open the overloaded circuit immediately but lag for several minutes. He also asks whether the device is patentable.

A. One of the Underwriter's rules is that fuses shall be placed in the circuit, so that if there is a momentary overload or short circuit on the lines, the fuses will blow. This is not to protect the power supplying company, as they can supply current over and above the maximum demand required by any concern, but the law is so enacted because of the fact that ordinary house wiring size No. 14 will not take any more than 11 amperes without heating. In this manner, defects in the wire are fully protected, and if current is forced through the wires so as to heat them, the fuse inserted in the circuit blows, thus cutting off the current. For this reason placing resistances in the circuit will not help matters any, but will tend to increase the fire hazard. Although the idea may be patentable, it is not practical, nor would the patent, if granted, be of any value.

ROAD CONSTRUCTION

(654) George C. Amaden, Buffalo, N. Y., asks: "I have motored over natural roads of lava formed by volcanic eruptions. Why cannot this system be employed in the making of artificial roads?

A. The cost of making the road of liquid rock (lava) will be so great, and the road so poor, because of its relative thinness, in comparison with modern concrete or asphalt roads that we would not advise patenting such an idea. The heat required in laying down a road of this kind is so great that houses adjoining the road would be placed in a hazardous position and passersby would suffer greatly from the heat.

COMBINATION TOOL

(655) Joe Bradberg, Atascadero, Calif., submits a sketch of a combination tool and pliers of ingenious design and requests our opinion.

A. We believe that the system (combination wrench and plier) which you have submitted is patentable, but we would not advise that you try to patent it, unless you are in such a position that you can manufacture the tool yourself, or have it manufactured and sold through agents. The hardware concerns are not favorably disposed toward new tools, consequently you will find it quite difficult to place the same upon the market unless the tool is of exceptional merit.

RENEWABLE TIRE TREADS

(656) John Bain, Ladysmith, B. C., submits two sketches, Fig. 1 being an attachable tread for auto tires to be secured in place by means of rubber cement, and Fig. 2 being similar, except that nails are to be secured to the tread, the same being simply placed around the old tire and hammered into place; the nails thus secure a hold on the old casing.

A. We do not think very much of your suggestion of an "Ada tread" tire attachment for divers reasons. Years ago an attachable tread for bicycle tires which had a self vulcanizing cement underneath it requiring the tire to be merely cleansed and the tread attached, appeared on the market. This when placed over the worn tread of a bicycle tire secured itself to the outer casing very rigidly. The idea is identical with your sketch No. 1.

The sketch No. 2 differs from these to the extent of putting small nails into the tire. In view of the fact that the tire must have a certain amount of resiliency and elasticity, it is quite possible that when the automobile strikes a rut in the road or bounces over a stone, some of these nails will be driven through the tire casing and into the inner tube. This may sound absurd to you now, but the writer would suggest that you equip your shoes with a pair of good rubber heels, and have the shoemaker drive nails into the heels in such a manner that they will barely come through the inside of the shoe. If you will then attempt to leap upon a pavement with these rubber heels on your shoes from a height of about six feet and strike the pavement smartly, you will find that the sensation of two or three nails trying to imbed themselves in the heel of your foot is not very pleasant. We, therefore, would not advise application for a patent on either of your two suggestions.

CHECK PROTECTION

(657) J. G. Bain, Ladysmith, B. C., Canada, asks whether he can obtain a patent on a check in which numbers appear in boxed off spaces. The check reads "Not over largest amount given." A portion of this check is to be torn off before delivery, making the paper similar to a post office money order. He requests our advice.

A. We have recently advised a correspondent of this department that a check protector similar to yours could not be patented, as the idea is a very old one, it being used on all postal money order blanks. In addition to that, it is a decided nuisance. Modern check protectors, costing from $1.50 to $25.00 will protect a check as well as your system. Not only that, but checks to the value of 999,999 million dollars can be made out with the figures and words perforating the paper, making it forgery-proof, and not making the check large and bulky as would naturally be the case should you have to number your stubs up to that total. We do not believe that the idea is either patentable or worth patenting or developing in any form.

ELECTRIC AIRPLANE

(658) William LeRoy Baker, Philadelphia, Pa., suggests driving airplanes by means of electric motors, current to be drawn from the air.

A. How are you going to draw free electricity from the atmosphere? Many attempts at doing this have utterly failed. If you can design an apparatus that will do this work your fortune is made. Forget, for the present all about the airplane. The other device is needed to a greater extent. You will not succeed, however.

SKILLET

(659) H. Barnes, Chattanooga, Tenn., submits a sketch of a skillet which is made up in compartment form.

A. Some 15 years go, the writer saw in a crockery store a skillet designed exactly like the one outlined in your sketch. At that time the same was purchased. Because of the fact that it was made of agate-ware, it lasted admirably.

Should you not be convinced, the writer will be very glad to send you his used skillet. Consequently we do not think that you can secure a patent upon the idea.

AMPLIFIER

(660) Hyman Biegeleisen, New York City, suggests a loud-talker for talking movies. Current from a source of power modulated by a selenium cell is to act on a receiver which in turn will control via carbon granules a heavier current for the loud-talker, (a microphone amplifier).

A. It seems as though we are again going to throw a wrench into the cog-wheels of your machinery. The amplifier which you describe is not efficient. Not only is it inefficient, but we doubt if it will work. It requires quite a strong signal to cause the diaphragm of a receiver to move sufficiently to agitate carbon granules packed between it, and the base of a cup adjacent thereto, in order that these carbon granules give a clear indication of sounds or music, in other words, amplifying the current signals.

Consequently, with your device, which is so delicate, that practically no current is sent through the telephone receiver, it would be impossible to vibrate the diaphragm thereof to such an extent that carbon granules will become compressed and released, thus supplying a varying current of a heavier voltage to the loud-talking device.

Up to the present time the only system which could be successfully employed is the vacuum tube.

SNOW MELTER

(661) F. E. Bernhardt, Richmond, Mo., asks our opinion of a snow melter for use on roofs and streets, a convoluted steam pipe is to act as the melter.

A. We would advise against the attempt to patent any snow melting device, particularly of a nature similar to the one described in your communication. There have been some 40 snow melters designed and patented. Of these, none are in use today.

We would suggest that you examine the *Latest Patents* page of the June issue of SCIENCE AND INVENTION magazine, where a snow melter is described, the design of which recalls your device.

AIRPLANE PROPELLER

(662) I. M. Boroughs, Pittsburgh, Pa., enters a diagram of a feathering type of propelier on the paddle wheel principle for aircraft which he says originated with him.

A. The sketch of the airplane propeller made by you, is neither unusually clever nor novel. The idea is original as far as you yourself are concerned, but nevertheless, it has been advanced for use in vertical rising airplanes years ago, where it has not as yet been thoroughly tested. In our opinion it is worthless.

SOAP BOWL

(663) E. J. Browne, Los Angeles, Calif., enters a diagram of a unique soap bowl for bath tub use which is instantly adjustable to any position or location. He also submits a sketch of a switch for radio purposes and requests our advice.

A. It is quite possible that a patent on your soap dish would be of value. We would advise a search on this suggestion.

The device should be redesigned so as to be simplified; the vacuum cups themselves being inserted into the dish proper instead of extending therefrom, as shown in your illustration. We do not think much of the switch, and doubt if a patent upon the same would be of any commercial value.

How Safe-Breakers Work

By A. P. PECK

(*Continued from page 637*)

diameter, to a depth of about two inches. This is drilled at a slight angle. Using ordinary yellow soap, a small cup-shaped depression is formed at the entrance to this hole, after which a quantity of *soup* is poured into the latter. A fuse is inserted, and the end of the hole plugged up with soap. With larger safes, holes are generally drilled in the opposite sides and sometimes on the top and bottom of the door. In these cases the charges are fired by electricity, using a detonator, and either a flashlight battery or the regular lighting current. Now the safe-cracker obtains several rugs or other heavy cloth articles such as large bags, and places them over the safe and in front of it.

The charges are now set off, and, if successful, the door is blown off completely.

Another clever little arrangement which has been used is a bell of the same type as is used in trolley cars for signals between the conductor and motorman, which is placed on the window-sill, and a rope which is attached to it, hangs down the side of the building. Now while the safe-cracker is at work his *lookout* is outside watching for police or other intruders. If he sees anything of a suspicious nature he gives a certain signal to his pal, which signal means to watch out. If he sees something which convinces him that it is time to depart, he gives another signal, and the man in the building makes his get-away as best he can.

Of course, the up-to-date crook does not rely on such an old-fashioned method as this, but uses an electric bell or buzzer actuated by one or two dry cells. The wires are led down the side of the building, and at their end there dangles a push button. All the lookout has to do is to press this button in accordance with prearranged signals, instead of pulling the bell rope as in the former method.

Several years ago an ambitious and industrious gang of crooks, somewhat misguided in the ways of safes, conceived an idea for smashing in the front of a safe, and proceeded to attempt to put it into execution. They had several specially made castings, which were arranged so that when put together they resembled an immense "C" clamp. This is graphically illustrated on the first page. The method of using it was as follows: The parts of the "C" clamp were bolted together, and the adjustable bolt at one end screwed into the hole tapped for it. The entire clamp was then placed around the safe, and adjusted so that the block on the end of the screw rested on the combination dial. A large wrench, made to fit the opposite end of the threaded rod, was placed thereon, and by turning, enormous pressure was exerted on the dial, eventually smashing in the face of the safe.

The venture, however, failed completely, and the entire apparatus, weighing over 300 pounds, was found on the scene by the police after the yeggs had fled. It may be readily seen from this that many crimes are committed by ignorant people, who in most cases are abnormal or feeble-minded. Another noticeable feature in criminology is that about 95 to 96 per cent of crimes are committed by the foreign born.

Still a different type of apparatus which is designed to make its attack on the combination dial is shown in the illustration. This consists of a piece of hardened steel about one foot square, in one side of which is cut a V-shaped notch several inches deep. The steel is about ⅜ inch thick. In the four corners of the square are drilled holes which are tapped to receive heavy machine screws, each about 4 inches long. To use this device the knob of the dial is jammed into the notch, the four bolts are inserted into the holes, and tightened up against the face of the safe. A wrench is now

used and the bolts tightened gradually, one at a time, until the combination dial is ripped off.

Science has been applied to safe-cracking in numerous ways, the most noticeable case being that in which thermit is used. This is composed of a mixture of iron oxide and aluminum dust, which when ignited by means of a magnesium fuse, produces an intense heat, sufficient to burn through an ordinary steel safe. The method for using thermit is generally to build, on the top of the safe, a ring of putty or soap, about 10 inches in diameter. In the center of this is placed the mixture of iron oxide and aluminum dust and a piece of magnesium ribbon, the end of which extends out over the ring. This ribbon may either be ignited by electricity or by a match. When the magnesium burns down to the mixture a violent reaction between the iron oxide and aluminum takes place and intense heat results which melts the top of the safe and the entire molten mass falls into the interior.

One of the ways most successfully employed to enter a building is by means of rope ladders from the roof, inasmuch as sidewalk entrances are generally very well protected by burglar alarms, while windows, to which there is seemingly no access, frequently are not. Of course, the way a building owner can fight this trouble, is to have all his windows protected by burglar alarms which can be of the very simplest type. The added expense of this would, of course, make up for its cost if it prevented one single burglary.

Sometimes a yegg will be able to hide in a building during office hours and start his work after everyone leaves. He can be foiled by any one of the many interior burglar alarms, which employ such devices as selenium cells, etc.

It is seldom that a burglary is performed successfully and the marauders escape. The police are generally very watchful and detect almost at once any unusual happening in buildings in their vicinity. It is said that a criminal who was carrying his tools in a violin case, as mentioned before in this article, was detected by a policeman, who noticed that he seemed to be exerting considerable muscular strength, whereas a violin could be carried very easily.

Several other interesting exhibits were shown at the conference, and included such criminal accessories as bombs and drugs.

In the bomb division was shown one known as the *shattering bomb*. This seldom, if ever, kills the person to whom it is sent. It is composed of cardboard and gunpowder, and merely serves to frighten the victim into a state in which he will yield to the demands of blackmailers. If this bomb does not frighten the prospective victim, a real bomb is sent. This is generally made of an iron pipe, closed at both ends, containing an explosive, bits of broken iron and a method for setting it off.

By looking at the exhibit of bombs, it was very easy to see that most of them were prepared by fanatics who were by no means in their right minds. One shining example of this was a cigar box filled with gun powder and having several matches stuck to its cover. The maker evidently expected the matches to ignite as the box was opened and set off the powder, thereby killing the recipient of the package.

Another one which was sent to a prominent society woman in New York City, consisted of a candy box filled with a miscellaneous assortment of matches, absorbent cotton and short pieces of dynamite. How the perpetrator of this *bomb* expected the concoction to explode is beyond the imagination of the writer.

The bomb squad is always alive and on the alert for the persons who persist in this sort of work, and one example of their work was shown in the bomb outrage in a subway in New York in 1916. All the clue that they had was a piece of the fuse. The detectives found that this fuse was manufactured by the Aetna Explosive Co., and from them found the purchaser. Eventually he was captured, together with several members of the gang.

The narcotic squad has been particularly active and has unearthed drugs and dope in most unexpected places. For instance, one criminal who was sent to jail, had several ounces of opium concealed in the lining of his shoes but, nevertheless, he was caught. Other places where dope was hidden were an embossed valentine with the concave side full of morphine; a book on chemistry which was found to have a cubic inch cut out of the pages and filled with drugs, and what the police considered to be one of the most ingenious hiding places yet discovered. This was a two by four piece of lumber which was used to bar the door in a "hop joint." The police raided this place in search of five pounds of opium. They knew that it had been delivered there and were sure that it was on the premises. However, after a long search they found nothing until one of them picked up the wooden bar and dropped it accidentally. It struck him that it gave out a peculiar sound for a solid wooden bar and upon investigation the long sought for drug was found.

The greatest instrument in the hands of the police is that of finger-printing. This has done more to locate criminals than any other single method alone. When finger prints are found on articles on the scene of a crime, they are at once developed by means of special powders which bring them up so that they are visible, and are then photographed. From the photograph the different parts of the print are analyzed, and the entire print classified, after which it is subdivided into the many different types. With this method of classification it is very easy to check through the records at headquarters and see whether or not the prints correspond to any of those on record. When a suspect of the crime is rounded up, his finger prints are at once taken, and if they are the same as those found on the scene, he is, of course, held for trial.

The method of taking a person's finger-prints is as follows: On a glass plate ink is spread by means of a roller, and the fingers are placed one at a time on this, after which they are placed on a sheet of paper. The print thus made is then dusted over with white powder, which brings it out sharply. It is then classified and filed in a card index.

Motor Hints

(*Continued on page 649*)

oil pan, in the bottom of the engine. A plug or pet-cock is screwed in the bottom of the tee for emptying the crank case in the usual manner.

The float member is of cork fastened to a piece of ⅛-inch brass rod, which changes with the oil level at the top of which is a multiple contact member, having four or more downwardly depending points. These make contact with a brass washer placed on the top of the fiber or hard rubber plug mounted in the top of the auxiliary oil chamber, as the drawing clearly indicates. A substantial bracket formed of ⅛-inch brass, may be soldered or screwed fast to the auxiliary oil chamber, and this bracket is secured to the engine bed by means of one of the bolts which holds the oil pan in place. Due to the relation shown between the two oil chambers, the oil level in the auxiliary chamber containing the cork float, corresponds with that in the engine crank case, and when the oil drops to the level where more oil should be added, which point must be determined and calibrated for each installation, the lamp or buzzer will indicate this fact.

Contributed by E. F. ESSARY.

AUTO AND RADIO BATTERY TESTER

Car owners or radiophone owners will be interested in this novel and exceedingly simple battery tester recently placed on the market.

The new tester is only six and one-half inches long, and consists of a bulb, a filling nozzle of rubber and a glass tube. Inside the tube are three colored balls, red, white and green, made of materials whose specific gravities differ.

The inscription on its container tells how to use the device and is clever. This reads:

"Floats all three, battery is charged fully,
Sinks the white, charge still right
Sinks the green, charge is lean,
Sinks the red, charge is dead."

Simplest battery test in the form of a hydrometer having three colored balls of differing specific gravities, as each ball sinks a different state of charge is indicated.

A DOUBLE DUTY SPARK PLUG.

Here is a new type, combination double spark-plug and intensifier in the form of one spark plug unit.

This device consists of nothing more nor less than a double ended spark plug, the one end firing in the air as the other fires in the motor. This automatically acts as a spark intensifier, as well as thoroughly cleaning the exposed plug end, through sparking and strong air circulation from the fan.

Another good feature is that a glance at your plug tops shows exactly the sort of ignition being delivered through coils, timer, battery or magneto.

If there is any trouble with one end the plug can be unscrewed from the cylinder, turned about, and screwed in with the other end in the cylinder.

Something novel—a double-ended spark plug—you always have a reserve plug with you.

Scientific Problems and Puzzles

By ERNEST K. CHAPIN

(*Continued from page* 648)

AN EXPERIMENT WITH A MILK BOTTLE

Fill a pie or cake plate half full of water and place it over a burner. Invert a milk bottle in the dish, see Fig. 5, and raise the water to the boiling point. If the heat is then properly adjusted, the water will alternately rise and fall in the neck of the bottle. Can you account for all that happens? There are a number of distinct physical principles illustrated.

ANSWERS

THE DOUBLE SLIDE PROBLEM

As stated in the problem, the beginning and end of each slide are equidistant from a common point situated directly below the top of the hill. From this it is evident that it is possible, using the common point as a center, to draw a pair of equal circles through the beginning and end points of each slide. For simplicity we may suppose that these circles coincide and that the situation is as represented in Fig. 1.

Let (g) (the acceleration due to gravity) be represented by the line (AB). This is the acceleration with which the boy and sled would fall if unhindered by the hill. Their true acceleration (a) down the hill is the component (AC). Now if the length of this particular slide is (s), and the diameter of the circle is (d), by similar triangles we see that $\frac{a}{g}=\frac{s}{d}$, or $a=\frac{gs}{d}$. The time (t) for the boy to slide the distance (s) with an acceleration (a) is given by the formula $s=\frac{1}{2}at^2$ or $t=\sqrt{\frac{2s}{a}}$. Substituting the value $\frac{gs}{d}$ in place of its equivalent (a) in this formula we see that the factor (s) disappears and leaves $t=\sqrt{\frac{2d}{g}}$. Now, since by the conditions of this problem $\frac{2d}{g}$ is a constant, it is apparent that if friction is neglected the two slides will take place in equal times.

HOT AND COLD OBJECTS

Metal objects are good conductors of heat. They conduct the heat to or from the hand much more rapidly than do non-metallic objects, such as furniture and clothing, which are poor conductors. Hence, it is that while all objects in a room may be at the same temperature yet some of them feel distinctly colder than others. The above is on the assumption that the room temperature is lower than that of the human body. For the same reason metal objects withdrawn from hot water feel much hotter than wooden ones.

ROPE AND PULLEY PROBLEM

When the children are putting their full weight on the ropes, it is evident that forces of 60, 80 and 100 lbs. are acting outward from the point (A), where the ropes connect. In Fig. 2-A, these forces are represented by the arrows AB, AD, and AE, respectively. Now when these three forces are in equilibrium or balanced, the upward lift of AB and AD must equal the downward pull of AE; or, in other words, AC must equal 100 lbs. After having completed the parallelogram, ABCD, we at once see that the triangles ABC and ADC are right-angle triangles; for, the sum of the squares of 60 and 80 exactly equals the square of 100. It follows also that AB and AD must be at an angle of 90 degrees; and that if the distance (FH) between the pulleys is 25 ft., AF must be 20 ft., AH 15 ft., and AG 12 ft.

So, pull as hard as they may, Mildred and John can never bring Joe closer than 12 feet from the beam.

ATMOSPHERIC ENGINE

The atmospheric engine of the tourists will not work for the reason that the weight of the air in the pipe exactly counterbalances the pressure of the atmosphere at its base.

ELECTRIC MOTOR PROBLEM

It is true, as was stated in this problem last month, that the magnetic field of a direct current tends to turn the N-pole of a nearby magnet in one direction and the S-pole in the opposite direction around the conductor. However, a plate or disk bearing a magnet will have no tendency to rotate about a conductor passing perpendicularly through the axis of the plate; for the reason that, while the force exerted by the magnetic field of the current is greater on the pole nearer the conductor, the other pole, because of its position is favored with a correspondingly greater opposing leverage.

MILK BOTTLE EXPERIMENT

In this problem a milk bottle is inverted in a shallow pan of water which is then heated to the boiling point over a small burner. As the apparatus heats up, the expansion of the air inside soon forces bubbles of it out around the mouth of the bottle. The bubbling soon ceases, however, for the heat is never sufficient to drive all the air out. Steam now forms in the bottle, creating a temporary pressure as it forms, but eventually materially reducing the pressure as it condenses in the upper portion of the bottle. Air pressure from without then forces water into the bottle until a balance of pressures is reached. Again the water heats up; and, as soon as steam is generated faster than it condenses, its pressure clears the bottle of water and permits the cycle to start all over again.

RADIO FOR SOUTH AFRICA

Sir Thomas Watt, the South African Minister of Public Works and Posts and Telegraphs, states that the government intends to acquire a wireless station for the purpose of establishing an adequate service with other countries of the world, and is at present considering several propositions in this connection.

Arrangements have been made by the Postmaster-General to enable telephone subscribers to *book trunk calls in advance*. The calls, which are effected at or about a specified hour, as desired by the subscriber, are known as "fixed time" calls, and the booking may be either for a single call or for a daily call for a minimum period of a week, including or excluding Saturdays and Sundays. The calls are number to number, not person to person, calls. A single "fixed time" call should, if possible, be booked at least three hours before the time at which it is required, such as stock exchanges, corn exchanges, etc.

"HYDROTURF," NEW FUEL

The hydroturf process of drying turf from the swamps of Finland to relieve the serious fuel shortage has received considerable attention recently. The most advanced development has been made in preparing turf in large quantity and economically for a great central power station. The raw turf from the swamps is changed into a thin mud by means of high pressure water pumps that inject enormous quantities of water into the bogs. This thin mud is drawn out of the swamps by reversing the same pumps and spread in thin layers over the drying fields, where it is allowed to solidify and when it has partly dried out, steam rollers or tractors with special small cutting wheels are driven over the thin mass and the cut-up pieces are shoveled up and used the same as coal.

Contributed by FRANK H. JONES.

Radio for the Beginner

By ARMSTRONG PERRY

(*Continued from page 670*)

on the first switch point. On the primary panel I slowly move the switch tongue around the circle and back. The probabilities favor my hearing something while the tongue is in a position corresponding to that on the secondary, if at all, but sometimes stations come in when the positions of the two vary widely. Of course I have to find out with a test buzzer, or by tuning in a strong station that is known to be operating at the moment, whether my cat-whisker is on a tickle spot on the crystal or not. Also I have to work the secondary coil in and out to test all degrees of coupling.

Having thoroughly explored one area, I move up the tongue of the secondary switch, try the primary and the sliding coil in all possible positions and thus explore another area. By working rapidly I can try out the entire range of the tuner in a few minutes. By working slowly I can increase my chances of hearing the weaker signals.

When I hear a station I try to identify it by catching its call letters. The station that calls, transmits the call letters of the station it is calling three times, then the French word *de*, which means *from* and is used because it takes only one quarter as long to send as the English word. After *de* come the call letters of the station that I am hearing. When I was learning code I found it difficult to get the call letters of the transmitting station. I would concentrate on the first call letters heard and in the excitement of getting or missing them I lost the others, which were of much greater interest to me. If I can identify the station heard, I write down its call, the hour and date when I heard it, and the adjustment of the receiver at the time. The time and the adjustment I record whether I identify the station or not, for that gives me a chance to pick up the same station again some other time and try to find out where it is.

When I have finished listening in, I look in the call book for the names and locations of the stations whose calls I have heard. If the calls begin with K (excepting calls KAA to KCZ), N or W, I know they are United States ship or shore stations and will be found in the Government list of stations, which I bought for fifteen cents from the Superintendent of Documents, Government Printing Office, Washington, D. C. If they begin with other letters I know I must look in a call book that includes foreign stations, such as the Consolidated Radio Call Book that I purchased from a dealer for $1.50. Calls beginning with figures from 1 to 9 belong to amateur stations as a rule, but I have heard some that apparently were being used by airplanes. The list of amateur stations of the United States I purchased from the Superintendent of Documents for fifteen cents. They are also listed in the Consolidated Radio Call Book.

Comparison of my daily records reveals the fact that certain stations work at the same time every day. This can be tested by tuning for them again and again at about the time they have been heard previously. Gradually I built up a list of stations that I could depend upon hearing at stated times. Commercial and Government stations almost invariably work on schedule. There is a lesson in this. Haphazard work wastes time and leads with uncertain steps, if at all, toward real accomplishment. Persons who call or listen when and as the spirit moves them are about as apt to fulfill a definite purpose as Mrs. Brown and Mrs. Smith are to get together if they agree to meet in a big department store but set no time or spot. Plan and system are the distinguishing marks of the successful man or enterprise. Schedules of broadcasts transmitted from Government stations for the benefit of the public are printed from time

to time in the Radio Service Bulletin, which can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for five cents a copy or twenty-five cents a year.

When I added to my station an electron tube receiver having a tuning range of 500 to 24,000 meters it was like leaving the farm and starting a tour around the world. I used the same system of exploration, setting the secondary circuit so as to start with the lowest wave and working up to the highest or starting high and coming down, but with the coupler, antenna condenser, antenna inductance, short-wave section, filament rheostat, secondary inductance, by-pass condenser, tickler and secondary condenser to adjust, the complexity of the process compared with the operation of the simpler set as threshing with an up-to-date machine compares with the old flail method. The knobs had to be turned slowly and carefully or I missed something. A fraction of a degree on a condenser dial or a single turn of wire on the rheostat brought in or tuned out stations.

The increased range was startling. Where once I was thrilled at hearing a single ship at sea, a turn of a knob would now bring fifty of them about my ears like a swarm of bees. Then I had to coax one of them up and discourage the rest in order to copy even call letters through the interference. Phone stations heard but faintly through the crystal spoke out with startling distinctness. Voices floated across scores of miles of land and ocean. Working up through the hum of traffic around 600 meters I passed the Government and commercial higher powered transmitters at 1500 to 2500 meters, then discovered myself in a quieter atmosphere where the transatlantic arc stations whistled their tuneful greetings to the lands beyond the sea.

Certain characteristics of the traffic identify the wave bands that I tap, and I could recognize the type of a station heard, even though I did not know the wave length on which I was listening. Down at the bottom, around 200 meters, are the amateurs scrabbling around. Now and again the steady hand of the old-timer sending a message of importance cuts through the jam but most of the traffic consists of the kind of things that high-school boys say to each other about their apparatus. Few of the words are spelled. They use a jargon of abbreviations that add to the other interests of the game of semi-secrecy that puts the fraternity almost in a class with a secret order. Outsiders may learn it if they can, there are no restrictions and everybody is welcome, but the number who do is comparatively small in these days.

The radio telephone broadcasts are in a class by themselves. Most of them come on wave lengths of 360 and 425 meters. The ship-to-shore and shore-to-ship traffic on 600 meters is flung through the ether in a volume and at a rate that reveal the pressure of the workaday world, yet there is sentiment a-plenty, and hundreds of little human interest stories. The operator on an ocean liner has to send and receive the word "love" so many times in the course of a day's work that it is no wonder the companies have to make rules concerning his contacts with the fair, romantic young passengers. Even the increased ship tax on radio messages has not driven this word of words from its position at the end of the usual greeting or good-by.

When I hear formal and dignified phrases passing through the ether at a leisurely rate, with punctuation marks spelled out and unusual names repeated, I know that I am listening to a Government station on a wave length that probably measures between one thousand and three thousand meters. A clear, steady tone; a stately, unhurried rhythm; code words that are meaningless to the casual listener; these mean the high-power station handling big business. Sometimes they use plain English even when transmitting messages of tremendous importance. When the letters fly so fast that it is evident that no human being could catch and record them with ear and pencil, that

shows the automatic transmitter and receiver are on the job. A hundred words—five hundred letters—per minute is a moderate speed for them.

Even with all the known schedules before me, there is never any danger of finding the game unexciting. One night Bermuda hops out of the silence and tells a story in dots and dashes. Porto Rico came up-stage one evening in a location that had theretofore been blank on the tuning dials. A Boy Scout declared to me in camp that he could get European stations, the big fellows that talk back to our high-power stations—and he did it.

A world traveler who had never heard anything by radio came to me for his first experience. I fished the ether. Somewhere in the lower register a well-trained voice began reciting the Declaration of Independence. There followed "The Launching of the Ship" and other selections. He paused and a Frenchman made some comments in his native language. Only the habit of exploration enabled me to give my guest so satisfactory a demonstration.

The practical value of radio exploration to the average man was illustrated to me a few weeks ago. I was arranging for a reunion of my high-school class. We graduated twenty-nine years ago, and the members were coming from distant points to the old home town, some of them with large families. An unexpected acceptance swelled the number beyond the anticipated maximum. The question of weather took on a new importance. Rain would necessitate considerable changes in the local transportation, the sports for the children and the preparations for the dinner. The gathering was two days away, but wet weather precautions could not be left until the last moment. To prepare needlessly for rain would mean unnecessary trouble and expense. The weather forecast in the papers did not cover our date.

At the moment when a decision became necessary I thought of the morning broadcast from NAA, the Navy station at Arlington, which includes state weather forecasts. I had encountered this in my explorations. It was time for it then. I made a dash for my radio receiver. Turning to my records I quickly set the controls in the proper positions and switched the juice into the electron tube. The broadcast was already under way. The first thing I copied was the name of our state. I listened hard for what was to follow.

"Fair and warmer Wednesday and Thursday."

Grand and glorious feeling! As the Good Book says, a word in season is like apples of gold in pictures of silver. We made the arrangements on a sunshine basis. The forecast was one hundred per cent correct, too.

REQUIREMENTS FOR ELECTRICAL MICA

Requirements for mica for electrical purposes relate to dielectric strength, heat resistance and flexibility, states the Bureau of Mines in Serial 2357. All good electrical mica is sufficiently resistant to heat for ordinary electrical equipment and this quality is, therefore, rarely specified. Specifications for dielectric strength vary for different uses and with different consumers for similar uses. Navy Department specifications call for a dielectric strength of not less than 25,000 volts for each 1/64-inch thickness. Mica has such a high dielectric strength that failures most commonly occur in defective spots. It is very important, therefore, in selecting material where high dielectric strength is required that the mica be given a careful visual examination so that all defective sheets may be rejected.

Book Review

DIE SELBSTHERSTELLUNG EINES SPIEGELTELESKOPS. By Prof. Dr. A. Miethe.

CHEMISCHE TECHNOLOGIE DER NATURVOLKER. By Dr. Karl Meule.

DAS LEBEN IM ACKERBODEN. By R. H. France. Hard covers; size, 5¼"x8". Published by the House of "Kosmos," Stuttgart, Germany.

The Germans possess the art of getting up wonderfully attractive little text books with illustrations of a type which add at once to their value and appearance. The first of these three tells how to make a reflecting telescope at home, giving the fullest details for the young or household astronomer. The materials used are very simple and all details and processes are to be carried out by the amateur himself.

The second of these books is devoted to the chemistry of aboriginal races; the drying of meat; the smoking of fish; the drying of fish, and the preparation of pemmican and other processes are described first. The artificial light and lamps of different savage races are most interestingly treated. Then comes fermentation and distillation, for these happy beings have no eighteenth amendment. The smelting of iron by the aborigines of Africa is treated, and very instructive, though perhaps too few illustrations are given.

The third book is devoted to the life in the crust of the earth; it includes the lower forms of animals, worms, infusoria, insects, and this time with adequate illustrations. Is to be highly commended.

The three books are directly or indirectly to be attributed to the well-known popular German paper, Kosmos, so we have accredited them to it as publisher.

MODERN PLUMBING ILLUSTRATED. By R. M. Starbuck. Hard covers, size 7"x10". Published by The Norman W. Henley Publishing Co., of New York City.

This very exhaustive treatise deserves high commendation. As regards chapters, it is distributed principally by plates. Of these, fifty-eight illustrate each a section or chapter, and at the end of the book a number of special plates are grouped together. There is considerably interesting literature in the subject, and some of the moot points get good and clear discussion. Two things are to be particularly commended in the book as regards makeup. One of these is the great clearness of the cuts. These are all in strong lines, liberally lettered and captioned, and are so clearly drawn that there is no possibility of a misunderstanding. The other point which we note is the clearness of the large type, somewhat leaded or on oversize body, make the reading a pleasure. The book is quite an impressive production, and really gives a good suggestion for other books of a technical nature.

LICHTTECHINIK (in German). By Dr. Ing. L. Bloch. Hard covers, size 6½"x 9½". Publisher, R. Oldenbourg, of Munich and Berlin.

Dr. Bloch figures as the editor of this very impressive work. It is too long to be susceptible of anything like an adequate review. The subjects, treated with liberal illustrations, half-tone and line cuts, cover the subjects of artificial lighting to the widest extent. The subject of artificial lighting has received great development in the last few years, and the opening sections of the book are devoted to the general theory. Then comes photometry, with the Lummer-Brodhum photometric prism as the central figure; little or nothing is said of the old-fashioned Bunsen photometer, and the Leeson disc receives no attention. The integrating sphere is very nicely treated, and then comes the hygiene of the subject, and after this illumination, beginning with electric lighting, going through gas lighting, and solid and liquid-burning materials, such as oil and sperm-wax. Lighting of streets, indirect illumination, private-house lighting, the lighting of offices and theaters, are all included, and a very interesting exposition of theater lighting comes in. Photography and photographic reproduction and moving-picture projecting receive a modicum of treatment. The book is liberally illustrated with over three hundred and fifty very attractive illustrations. What we have said above is a very incomplete description.

HEUSCHRECKEN UND LIBELLEN (in German). By Dr. Kurt Floeicke. Hard covers, size 5"x8". Published by Kosmos, Stuttgart, Germany.

This nice little treatise on grasshoppers and locusts is due to the German magazine "Kosmos,"

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Book Review

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and forms one of a good many similar treatises which have emanated from its press. It is printed in the very attractive way which distinguishes the monographs produced by the "Kosmos" writers. The proprietor of the magazine issues four of these books annually, and this forms the third book for the year 1922. It is fully illustrated by very clear illustrations, with an adequate index, and it is worthy of all commendation.

SPACE—TIME—MATTER. By Hermann Weyl. Hard covers, size 5¾"x8¾". Published by E. P. Dutton & Co., New York City.

We have just reviewed a couple of German language books, and the present work is a translation from the German. It is devoted to decidedly high mathematical discussions of its titular subjects. Relativity takes up, in one form or another, nearly half the book. A bibliography, in fine type, takes up six pages. An adequate index closes the book. It hardly lends itself to review, it is so very full and uses so much mathematical demonstration.

WORLD METRIC STANDARDIZATION. Compiled by Aubrey Drury. Hard covers, size 6"x9½". Published by World Metric Standardization Council, New York City.

For many years the subject of the metric system has agitated the mechanical world. It has excited in some cases considerable asperity, and rather absurd claims are made to the effect that it is not as good as the English system of units. But when we consider that all physics are based upon it, that no chemist uses anything but metric weights in his analysis, and that no difficulty is found with its use in Continental Europe, it seems absurd for anyone to object to its introduction into this country. In electricity, the ohm, ampere, volt, and all the other units are based on the centimeter, gram, and second. The present work amounts to a very impressive presentation of the advantages to be derived from the adoption of the said metric system of weights and measures. Those who traveled in Europe before the war found great convenience in the equivalency of the coins of the Latin countries. It will be a wonderful improvement if the English-speaking races would unify their weighings and measurements with the Latin world, and with Germany.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION. Hard covers, size 5¾"x9½". Published by Government Printing Office, Washington, D. C.

This report is far more than what would seem to be indicated by its title page. The report proper ends on page 139, and then there follows an appendix of over five hundred pages of most interesting reports and treatises on various subjects, with quantities of illustrations. Anthropology is treated at considerable length, with many reproductions from the wonderful groups in the National Museum. Fine art also appears in reproduction of some of the treasures of the Ralph Cross Johnson collection of paintings in the National Gallery in Washington. A number of presentations of these paintings fill up the last portion of the book, whose range reaches from chemistry, meteorology and natural history up to the fine arts. The book is a small library in itself.

PRACTICAL COLOR PHOTOGRAPHY. By E. J. Wall, F.C.S. Hard covers, size 5½"x8". Published by American Photographic Publishing Co., Boston, Mass.

All that can be said of this book is that in nearly two hundred and fifty pages the various ways of producing colored photographs are given in considerable detail, and evidently by one who has thoroughly studied out and worked up the subject. It begins with the theory of color, then treats of photographic plates and color filters; then tells of the photographer's work, his darkroom, his camera and exposure factors. After this introductory portion, carbon printing, the imbibition process, different three-color effects and methods, screen plates and many other topics indicate a very complete covering of the subject. One chapter is devoted to the producing of moving pictures in colors, something yet to be carried out in a fully practical and successful way. The book has an excellent, if short, bibliography; tells possible sources where various dyes can be procured, and has an excellent index.

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Book Review

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THE TELESCOPE. By Louis Bell, Ph.D. Hard covers, size 6"x9¼". Published by McGraw-Hill Book Co., Inc., New York City.

This liberally illustrated book is good reading. It tells how telescopes are made; all about optical glass and its working; describes not only the modern telescope, but in a most interesting way goes back to old times, to the days of Galileo, and even earlier. It is very interesting to read about the Herschels—father, son and daughter. Some of the really remarkable results obtained by them testify to the excellence of what we now consider the old-time reflectors. He was pretty well wedded to the reflecting telescope, but difficulties with the specula brought it into disfavor up to a comparatively recent time, but now the finest work is being done by it again. The biographical portions give a human touch to the book, which with its numerous illustrations and popular statements make it excellent reading for anyone at all interested in the world we live in.

SCHALTUNGSBUCH (in German). By Max Linder and W. Knobloch. Hard covers, size 5"x7". Published by Hachmeister & Thal, Leipzig, Germany.

This is an elementary treatise on electric circuits very clearly expressed, each plate having a numbered description, so that, as in another book which we have recently reviewed, each plate indicates a little chapter. All sorts of circuits are described, such as those used for the bell-ringing system in hotels and residences; telephone connections are given in considerable detail, with the clearest possible diagrams; and telegraph systems, fire alarm circuits for villages or for single buildings are included. One testimony to the excellence of the book is that the copy which we are reviewing is an example of the thirty-first edition. This seems to tell the story better than any words of commendation from us could do.

SELF MASTERY THROUGH CONSCIOUS AUTOSUGGESTION. By Emile Coué. Size 5"x7", paper covers, 94 pages, with frontispiece of the author. Published by American Library Service. New York City.

This little book by Dr. Coué, the famous French exponent of autosuggestion, gives a great deal of food for thought. While the reviewer does not quite agree with all of the philosophies set forth by the author, there is no doubt that there is a grain of truth in all that he says. This work is based on the idea that it is our imagination and not our will that dictates whether or not we are sick, or whether we drive an auto into a telephone pole, etc. To prove, at least in part, the author's assertion that our will is subservient to our imagination, he cites this experiment: One may walk a plank one foot wide and thirty feet long, if placed on the ground. But if this plank is placed one hundred feet in the air and the subject was asked to walk it he could not do so once in a thousand times, no matter how strong he willed that he would. Why is this so? says the author; simply because his unconscious self, or his imagination in other words, has pictured before the mind the scene of falling from such a height, and the more he willed the stronger the imagination becomes, and he will surely fall if he tries to execute this experiment at such a height above the ground.

Dr. Coué's work is based partly on a religious faith, we should say, and also on the phenomenon of hypnotic autosuggestion, or rather the effects to be obtained from it. In other words, the author's work is founded on the idea that if you have strong faith that you can do a certain thing, you can. Science today does not know a great deal about the human mind and how it works, nor its relation to our physical body in health and disease, but our medical men today are gradually coming to realize that there is every difference in the world, at least in many patients, whether they have faith, or permit their mind to have faith, that they are going to improve in health; or whether they give up all hope and have no faith at all. Some very interesting and indeed remarkable experiences are given in this book, and one thing is certain, whether we believe the author's arguments or not, the reading of this work cannot harm but only improve our minds.

LANDS PLANE IN CANYON

The first airplane landing in the Grand Canyon of Arizona was made recently by Lieut. R. B. Thomas, Officers' Reserve Corps of Kansas, at Turtle Head, Ponto Plateau, near El Tovar. The landing place was 3,000 feet below the rim of the canyon.

The Thought Wave Detector

By THOMAS WILLING HICKS

(*Continued from page 642*)

Such a wave can be measured and recorded when the disturbance is properly amplified by the new scientific instrument known as a Multiple-Electrode-Vacuum-Tube-Amplifier, an instrument now known to a select few of the inner circle of America's foremost scientists and physicists. Marconi is trying to call up the planet Mars with it. Edison is trying to communicate with the dead through it. Pershing's experts, using it in France, could easily detect the presence of a human body crawling along in the inky darkness of No-Man's land—by the dial registering the body heat rays of the German raiders at a distance of 600 feet.

With it, Admiral Sims drove his flagship "blind" through fog banks, at top speed, knowing the way was clear.

With it, Einstein says his theory of Relativity can be proven and that it visualizes the Fourth Dimension.

And now the young American scientist, Norman Mortonby, proposes to—but you don't know Mortonby, do you?

Jerked away from his studies at Mass. Tech., early in his third year, to take charge of the Coffee Importing business, suddenly thrust upon him the morning after a scrubwoman had found the senior Mortonby limp in his office chair with a revolver in his rigid right hand, young Mortonby had found Lower Water Street and the Coffee Trade skeptical of his ability to rehabilitate his father's business. But he was just as skeptical of the ethics of any person or firm who transacted business through the medium of any "board" or exchange—a feeling aided and abetted by the fact that only a cursory peep into things proved that the parental fortune had been lost through the elder Mortonby's penchant for holding to the bear side of a bull market.

Finding himself practically alone in the world, young Mortonby rented out the two lower floors and with his books and instruments retired to the third floor loft of No. 36½ Lower Water Street, New York, and was known only to a few of the regulars that frequented the Coffee House at the corner of Lower Water Street and Old Slip, and was regarded by even these denizens as "queer."

When Lee de Forest publicly admitted that he could not explain exactly what took place in the Audion bulb which he, himself, had invented. Mortonby stiffened into tense interest. When eight-year-old Samuel Rzeszewski walked into the rooms of the New York Chess Club and in three minutes solved a half-dozen chess problems which had been carefully rigged up for him in advance by the highest experts—and Mortonby had read where his old "Mass. Tech." tutor had suspected the young prodigy of being mentally equipped with a "receiver" which caught the collective thought of those assembled in the room and solved their chess problems with their own minds, and not his own—after that information Mortonby was known not to have eaten a meal or slept a wink for seven days and nights.

A fortnight later, Pete, the shipping-room foreman of a Camden, New Jersey, laboratory supply house, was vainly quizzing his helper, Jerry, as to what in blazes one man could want with six hundred and sixty-six of those Multiple-Electrode-Vacuum-Amplifying-Audion bulbs, when two or three were a big order for even a State University. Jerry was hanged if he knew, and cared less, as he put the finishing flourishes of the address, No. 36½ Lower Water Street (third floor), New York City, N. Y., on the shipping case.

As a janitor in the New York Stock Exchange Building, young Mortonby was not a howling success. But help is help these days, and the building superintendent noted that the serious-faced young man, while not a star as a janitor, was always on the job early and often stayed late, sometimes very late; in fact, once he remained in the big exchange room all of one night—though without the knowledge of his overseers. And the head janitor was genuinely sorry when assistant-janitor Mortonby suddenly chucked his job and no longer mopped up the floor of the trading room or polished up the handle of the big front door of the New York Stock Exchange.

Two nights later as The-Richest-Man-in-the-World sat alone in his study, the butler quietly entered and said, "'es 'ere again, Sir; it makes the seventh time: 'e looks respectable, Sir."

"Very well," said the Croesus, "place Vardon there, handy, and show the party in."

Eight hours later, as the ashes grayed on the hearth and the fingers of the dawn tapped hard on the window pane, Mortonby left the palatial home up on the Avenue with a firm step, chin up, and eyes bright. He had won.

Shortly before 10 o'clock the same morning The-Richest-Man-in-the-World entered the third floor back, of scientist Mortonby at 36½ Lower Water Street. If he had lost some of the look of conviction at the time of parting in the early morning hours, there was, nevertheless, much of the mingled air of credulity, curiosity and hope left. Briskly the Croesus plunged into the work.

"Now Mortonby," he said, "the stock market is about opening. Set things going and show me your contrivance in actual operation."

The young scientist quickly crossed the room and closed a big bright electric switch. There was a blinding flash, a whirling roar, and then silence, as the room was flooded with a dense violet light. Opening a heavy iron door, the two entered a circular steel room.

"This," said the young scientist, "was originally used by my father as a storage bin for green coffee. It's made of ¼-inch steel plates riveted together. I use it to completely insulate my apparatus from all outside electrical currents, static interference and stray magnetic waves. Here in the center of this steel chamber I have mounted, and connected in series, 666 Multiple-Electrode-Vacuum-Audion-Amplifying bulbs. The anodes of these audion bulbs or tubes draw their high-tension direct-current supply through this mammoth choke-wound coil. Electro-magnetic waves picked up by aerial antennae affect this smallest and most sensitive audion mounted over here, alone, which acts as the micro-valve. When no waves are being received, the chief audion, or micro-valve is quiescent, and the output and general behavior of the powerful mass of several hundred audions is nil. When, however, electro-magnetic waves of dense frequency are caught up by the dangling feeler wires of the antenna and sent pouring into the micro-valve oscillator, then large surges are set up in the mass and at nth speed frequency, a current approximate to the high-tension direct current potential sweeps the output from zero to many times its normal constant. The ebb and flow of such a current is of course readily indicated on the dial of the galvanometer. So far, the equipment is ordinary. But, in our case, instead of having a towering aerial antenna of feeler wires erected in the open, our highly sensitized antenna, composed of extremely fine platinum-alloy wires, is secreted in various parts of the trading floor of the New York Stock Exchange. Every trading post, every light fixture, every hinge on every door, all carry a veritable spider web of antenna wires, which in turn are connected to a

size .004 German silver wire, completely insulated, and running from the ceiling of the exchange trading room into this set of instruments. You already know the natural function of antenna wires is to pick up and convey the faintest ether waves to these audion amplifiers. Through these, a potential too delicate to be detected even by the sensitive nerves of the tongue, can be amplified or magnified into a hundred million volts, if desired. Hence nothing in the way of even the most minute of such waves escapes. All such disturbances are gathered and transmitted to us here over the feed-wire and the audions amplify them, while the galvanometer records them."

Noting by his watch that it was now well after ten o'clock, the young scientist turned eagerly to The-Richest-Man-in-the-World, and said, "Trading is now well under way. See, the needle of the galvanometer has swung to a point at the extreme right of the dial. From past observations I know this indicates that the strongest thought-action on the brains of a majority of the men now present on the floor of the exchange is *the buying thought.* This mass-thought or cumulative state of mind, actuates the electrons of the atoms that compose the matter-substance of these multiple brains, and this action produces a series of electro-magnetic waves which are caught up by my secret antenna, distributed about the Exchange floor, and these waves are carried here, magnified into a powerful electrical current by the audion amplifiers, and are then indicated on the galvanometer, as you see." Stepping to a phone and calling up a well-known brokerage house, the young man handed the receiver to the Croesus and said, "Ask the state of the market." Turning from the phone, the Croesus said, "The general list is up from five to eight points, and still going strong."

For hours the two sat within the narrow confines of the steel-walled room, with their eyes fixed on the needle of the indicator. Steadily it held, and through frequent phone calls, they knew the market was climbing—climbing—climbing. Suddenly, with but a scant half-hour of the trading period left, the needle was seen to falter; slowly at first, then rapidly, it began to swing to the left.

The scientist met the inquiring look of the Croesus, and said, "The mass state of mind of the personnel of the floor traders now present in the exchange room is undergoing a change. This change in thought is, of course, changing the previous state, or position of the separate electrons contained in the atoms that go to make up the material or flesh-muscle-like mass of matter lying beneath the skull bone of each, and which we call the brain. The very act of rearranging these electrons in the brain of these men, throws out an electro-magnetic wave and my delicate antenna, secreted about the room, is picking up these waves exactly the same as an aerial antenna picks wireless waves out of the air. These thought waves are transmitted to this room over the insulated wire and are being amplified by these audion amplifying bulbs to the point where they can be calibrated, measured and read; and the result is shown by the swing of the needle on the galvanometer. From experience and past observation, I know the waves now being registered are generated by thoughts of fear, doubt, suspicion and distrust—such always portend a slump in prices." Hastily the Croesus called a prominent broker. Turning from the phone, he said, "The keenest trader in the street just reported to me that after an all day climb, profit taking and short selling, through fear of an adverse legal decision in pending litigation affecting a leading stock, caused a sharp break of several points during the last half-hour."

As trading ceased and the Exchange floor became deserted, the needle slowly swung

back to zero; the young scientist shut off the current and the two strolled silently through Battery Park until dusk; thinking, thinking, thinking.

For a fortnight more, day after day in succession, The-Richest-Man-in-the-World and the young scientist followed the course of the tell-tale needle. Never did it fail to indicate, well in advance, a change in the trend of thought of the traders and just as certainly did a change in the trend of prices follow. Rather early one morning, a good half hour before trading started, the needle was depressed. Later investigation disclosed that the Biggest-Bear-Of-Them-All was early present in person, surrounded by a numerous staff, packed around the "Sugar" post, impatient for trading to start. Grim, with jaws set and dark visaged, plainly he was out to make a raid—a raid that carried the price of Amalgamated Sugar down 25 points. The pulsing brain and throbbing temples of this super-bear and the mass thought of his horde of assistants, all in the same state of mind, sent out a veritable flood of electro-magnetic waves of the same length, density and frequency—all writing an unmistakable message on the instruments tuned to receive them.

Late one evening, long after all trading had ceased, while the young scientist was engaged in making some adjustments for the next day's run, he was startled by a violent agitation of the needle, which trembled on the balance, and then swung sharply to the extreme right, and back again to the extreme left. What was happening? What world event was known on the floor of the Stock Exchange? Whose brain was there at this strange hour to receive the news and generate such monumental thought waves that threatened to wreck the delicate instrument? Had war come again? Was a panic impending? Mortonby must know. Using his acquaintanceship and former employment on the janitor staff as a means of gaining entrance to the building, he quickly passed to the trading floor and there in the shadow of the "Steel" post where Mortonby had planted his strongest antenna, stood "Bolsheviki Joe" and "Christian Science John," two former fellow workers of his janitor days. Scrubber Joe and sweeper John stood with verbal horns locked, in one of their famous socialistic arguments. At the moment of Mortonby's arrival, "Bolsheviki Joe" was accusing civilization, humanity and Christianity of every crime named on even his lengthy calendar. Hissing his song of hate, vindictiveness, fear, malice, envy and suspicion through a shoe-brush beard with all the strength and ardor of his huge Slavic hulk, he engendered mountain-high electro-magnetic, rough sea, thought-waves that made Mortonby fear for the safety of the delicate instruments in his steel-enclosed laboratory. Patiently, "Christian Science John" heard him through and then with quietness and firmness that completely baffled the Russian, he said, "Joe, my brother, you, yourself, say that there is but one God and that He is good and that He made all. It naturally follows that everything real, is good; in spite of any temporary sense-testimony to the contrary. All-powerful good will ultimately overcome and destroy all sense of evil and when it does, universal harmony, peace, happiness and contentment will be a realizable and permanent condition."

When Mortonby returned to his loft to close up for the night, he smiled as he noted the needle on the dial stood firm, and with a wide margin to the right. "Christian Science John" was winning the argument with "Bolsheviki Joe."

At the end of a heavy trading day when the thought waves had come in clear and strong and the needle had indicated, far in advance, every change in the trend of thought, and every change in the trend of thought had been followed by a change in

the trend of prices, The-Richest-Man-in-the-World suddenly turned to the scientist and said, "I'm convinced; what's your proposition?"

Mortonby was ready. Again the two talked until far into the night. They were in full accord. A definite plan was agreed to, and a bargain made.

And so it is to be, that, early in the new year of 1924, a plan will be put into operation that will result in the New York Stock Exchange being quickly and permanently closed. A speculative market with wide price fluctuations and operations by the "professional" type of trader, or the "scalper," will be an impossibility. The bulls will find that "a mysterious somebody" has invariably acquired most of the floating supply of stocks ahead of them. If they suddenly turn bears and try to rend the thing that dogs their every step and is sucking their very life blood, they will be chagrined to discover, all too late, that this stealthy, colossal something has turned *first*. Although never taking the initiative itself, it is, nevertheless, always just ahead of every price movement, large or small—raking into an apparently insatiable maw the bulk of uncountable profits. Bulls and Bears, alike, can make no headway in any speculative venture. Quiet, orderly and natural sales of stocks and bonds resulting from bona fide transfers of the actual securities for permanent investment purposes, progress as usual; but the volume is not sufficient to require the labor of one in a thousand, of the employees, brokers, and many dependents of the present Stock Exchange.

In the meantime, a quiet-mannered, serious-faced, old-young man spends long hours supervising a corps of 100,000 employees, working in three 8-hour shifts, 24 hours a day, checking up and searching out the record and history of every real simon-pure, bona fide case where anyone, at any time, has lost his or her home, position or fortune through a speculative transaction in any stock listed on the Exchange. As each case is proven, full restitution, as far as money can restore the loss, is made; if not to the party direct, then to the most interested or to the nearest remaining relative or friend. All losses for all time, are paid back in full. When payments become heavy, the supply of profit is easily increased by the mysterious "interest" that absolutely dominates the market.

When the personal and corporate fortunes of every member of the Exchange and every professional trader, member or non-member, are reduced to their original size, and when all losses have been repaid wherever possible, the balance remaining, through inability to locate even an acquaintance of some of the old losers, will be used in paying the expenses incurred in operating the Stock Exchange from its opening day down to the present; and thus, in the end, everybody will stand even.

Then the Richest-Man-in-the-World will go back to his quiet study; the young scientist will publish the whole story, and full details of the machine; everybody will readily see the utter impossibility of conducting a speculative market—all trading will automatically cease, and the New York Stock Exchange will be no more.

TALKS FROM SHIP BY RADIOPHONE 500 MILES AT SEA

Another long distance wireless telephone conversation was reported recently by Captain Voldborg of the *United States* of the Scandinavian-American Line.

For more than five hundred miles, he said, he was able to keep in conversation with the shore station at Copenhagen. While 450 miles distant from the *Frederick VIII*, going eastward he talked to the ship's captain.

With his powerful wireless telegraph apparatus, he said, he was able to keep in touch with Nauen, Germany, until he reached a distance of 2,100 miles from that station.

New Fire Extinguisher

By WM. R. REINECKE

THE manner in which the first few minutes are employed, usually determine whether the loss is to be trifling or whether the fire has gained such headway as to involve the whole premises.

What do we generally do when we see a small fire in our house or place of business? Do we try to put it out? No. We run to the nearest fire alarm and we let the fire burn, because we believe that the firemen will soon arrive and be all sufficient. Over 50 per cent of the fires which occur are due to carelessness, and only a small percentage are put out by the fire hose. The majority of the fires are extinguished by first aids, with water, blankets or fire extinguishers.

Many of the patent containers, located in various parts of buildings have not been inspected for years, and during this time, the screws of many of them have corroded to such an extent that when they are really needed, it is almost impossible to turn the handle necessary to open the valves to allow the chemicals to run out; in some cases the material used will have lost its strength; again some of the containers are too heavy to be lifted by a frail person; the person not having previously been instructed in the manner of using it, at the time of need, becomes confused, and often loses the entire contents even if he has succeeded in opening it, or in the case of some extinguishers the contents may have hardened or lost its fire extinguishing powers, and not have been replaced at stated periods. In the late accident in the subways in New York it is claimed that the fumes from the fire extinguishers used gave out poisonous fumes which caused many persons entrapped to be overcome.

What is needed is a fire extinguisher, easily handled, even by a child, that does not give out any poisonous fumes, is not poisonous, if a child should eat the contents, is put up in a form that can be instantly opened by any one and at once used, without having to stop to read instructions telling how to open the appliance and that will not be found with its strength exhausted when most needed.

Flamicide, invented by P. A. Maignen, of Philadelphia, is a fire extinguisher, which has none of the indicated defects. It is simply a powder, which can be packed in cardboard containers, and can be placed upon a shelf or in a drawer in any room or building, and if perhaps a child would find it and eat some of it no harm would result.

In a demonstration made before the author, kerosene was poured on newspapers and a quantity of straw added to make a more combustible fire. This mass was then lighted with a match, and when the blaze was at its height, the writer threw handfuls of this powder upon it, and instantly the flames were extinguished. Afterwards the glowing embers were extinguished with water from a watering pot.

There is a peculiar sensation which comes over one when this powder is used. Almost anyone in the presence of fire which threatens to gain is afraid, bewildered, inclined to run away for help, maybe to get water, a rug, or ring a fire alarm. During all this time the fire proceeds and grows by leaps and bounds.

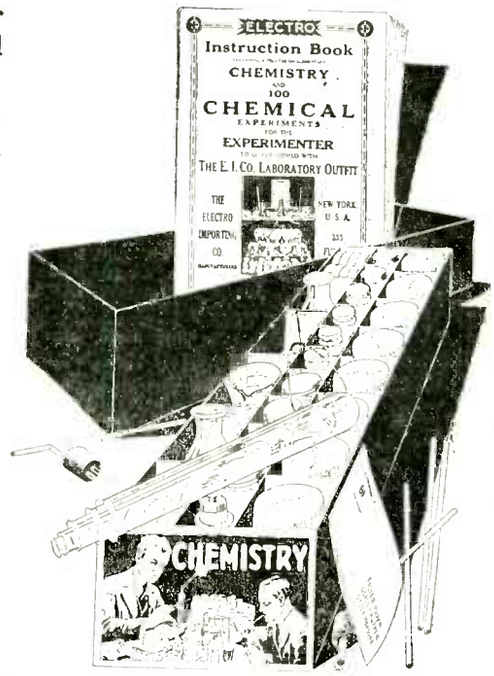
Here, on the contrary, knowing that you have on your shelf a fire extinguisher, a box of powder, you go for it, open it in an instant, and throw handfuls of it violently on the flames. Maybe one handful only puts out part of the fire. Another and another handful, and the peculiar reaction is this: That each time you throw a handful of the powder you see that you are extinguishing a part of the fire. Instead of feeling like running away, you go nearer and nearer, as you notice the effects of your work.

It is the flame that by radiation spreads the fire. When the fire is out and the embers are glowing, you have plenty of time to get water and finish the job.

A Chemistry Laboratory for $7.00

Think of it, fellows! Here is a real chemistry outfit with regular chemical apparatus that performs those fascinating, actual chemical experiments.

This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive amusing experiments.



DESCRIPTION OF THE OUTFIT

The outfit consists of forty-four (44) chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers, and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The instruction book is a real Chemistry Course for the Beginner. Some of the Contents are: Division of Matter: This is a Treatise on Elementary Chemistry, and deals with the theory of the Elements, Molecules and Atoms, etc.

100 EXPERIMENTS

How to make chemical tricks; how to make invisible and magic inks; how to test flour; how to test soil; how to make chlorine gas and smoke (German War Gas); how to bleach cloth and flowers; how to produce oxygen and hydrogen; how to make chemical colors; how to test acids and alkalies, and hundreds of interesting hints and formulas.

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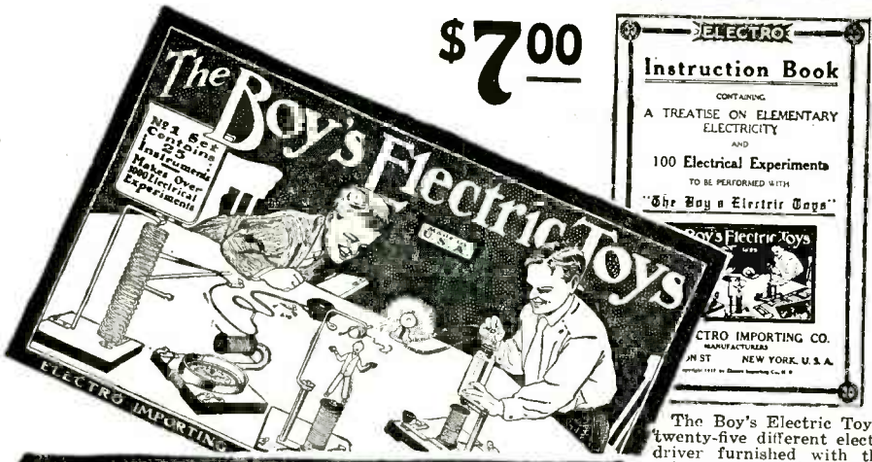

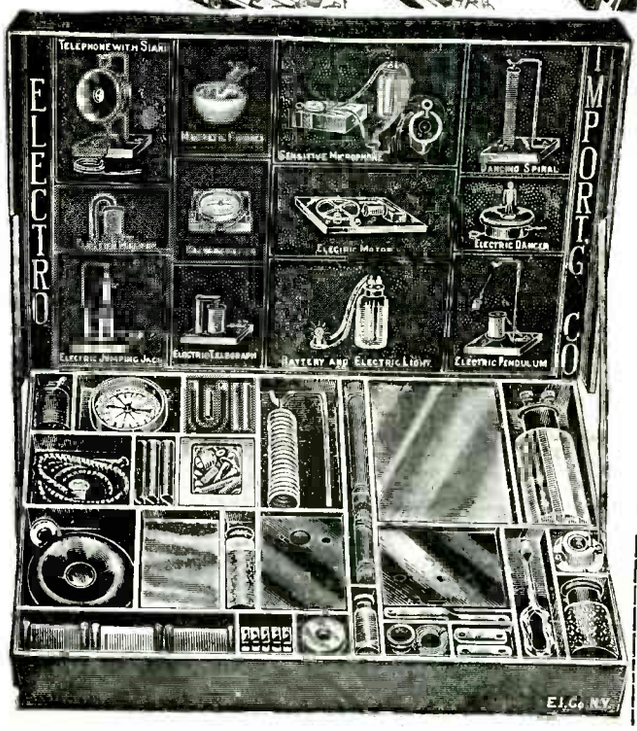

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The Boy's Electric Toy contains: Enough material to make and complete over twenty-five different electrical apparatus without any other tools except a screwdriver furnished with the outfit. Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephones, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.,

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book we furnish one hundred experiments that can be made with this outfit, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by the means of this outfit, two hands and a screwdriver.

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Experimental Electro-Chemistry

By RAYMOND B. WAILES

(*Continued from page* 657)

raised. This is actually the case as can be found by a hydrometer reading which indicates the condition of the battery at the time of reading.

The voltage which the battery will give, too, becomes greater as the charging current goes on, and is proportional to the specific gravity of the electrolyte.

READING STORAGE BATTERY VOLTAGE WITH HYDROMETER

The voltage of a storage battery can be readily computed by using a hydrometer and the following formula:

$$V=1.85+.917(S-s)$$

Here V is the voltage which the battery will produce, S is the specific gravity of the electrolyte as found by a hydrometer reading, and s the specific gravity of water at the time the hydrometer reading is taken. This factor, s, can be taken as 1.0 in practical work.

It must be remembered that a hydrometer reading, say, 1300, means in terms of specific gravity, 1.300, or, the electrolyte is 1.3 times as heavy as water. Similarly, the reading of half charge, 1225, should be taken as 1.225 in the above formula.

On discharging, or actual operating of the battery, the following change occurs:

$$Pb+PbO_2+2H_2SO_4=2PbSO_4+2H_2O.$$

It will be seen that this equation or action is exactly the opposite of the charging current.

GAS BATTERIES

A simple gas battery can be made from an H tube, or two large diameter T tubes joined together as shown in Fig. 3. Platinum wires are thrust into the liquid in each limb as shown, one twice as far in as the other. To the ends of the platinum wires are affixed small pieces of spongy platinum, which can be taken from a *magic* or instantaneous gas lighter. This type of lighter simply needs to be held in a jet of gas, when the gas will light, owing to rapid aborption of the gas by the metal.

On passing an electric current through the H tube using the battery connected as shown, hydrogen gas will collect at the cathode and oxygen at the anode. Twice as much hydrogen as oxygen will be formed. This is due to the decomposition of the water of the sulphuric acid by the electric current. As soon as the acid surfaces just barely touch the tips of the spongy platinum electrodes, the battery should be cut out and the sensitive ammeter thrown into the circuit. A current of electricity will flow through the upper wire in the direction of the upper arrow. This is the polarization current.

Another type of gas battery can be set up per sketch, Fig. 4. Here a battery jar containing dilute sulphuric acid holds a lead electrode. A glass lamp chimney having a stopper and a glass tube, T, at its upper end is arranged as shown. The chimney contains a lead electrode. Both lead electrodes are led to a galvanometer or sensitive ammeter. When the tube T is connected with a rubber tube leading from the illuminating gas jet in the laboratory, the gas will force the acid down the chimney. The tube T should then be closed tight by means of a pinchcock. The indicating instrument will then indicate a current.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

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Agents Wanted in every city and town to sell standard radio apparatus. Attractive discounts given. If interested, write us at once stating age and radio experience. Wilmington Electrical Specialty Co., Inc., 912 Orange Street, Wilmington, Delaware.

A Business of your own—Make sparkling glass name plates, numbers, checkerboards, medallions, signs; big illustrated book Free. E. Palmer, 513 Wooster, O.

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We want men and women who are desirous of making $25.00 to $200.00 per week, clear profit from the start in a permanent business of their own. Mitchell's Magic Marvel Washing Compound washes clothes spotlessly clean in ten to fifteen minutes. One hundred other uses in every home. Nothing else like it. Nature's mightiest cleanser. Contains no lye, lime, acid or wax. Free samples make sales easy. Enormous repeat orders—300 per cent profit. Exclusive territory. We guarantee sale of every package. Two other "sight sellers" and sure repeaters give our agents the fastest selling line in the country. No capital or experience required. Baker, Ohio, made $600 last month. You can do as well. Send for Free Sample and proof. L. Mitchell & Company, Desk 79, 1302-1314 E. 61st, Chicago, Ill.

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Only one sale a day means $200 per month! Five sales, $1,000 per month! Marvelous new adding machine. Retails $15. Work equals $350 machine. Adds, subtracts, multiplies, divides automatically. Speedy, accurate, durable, handsome. Five-year guarantee. Offices, stores, factories, garages, buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial offer. Lightning Calculator Co., Dept. W., Grand Rapids, Mich.

Jaco Sanitary Strops sell on sight to everyone using combs. Three dozen, $3.60 delivered; easily sell for $9.00. $5.40 profit sure every day. Get particulars quick. Jay Company, 113 Jay Building, Washington, New Jersey.

Risk a postal and learn how to start profitable business without capital or experience. $60 weekly easy. Silvering mirrors, refinishing tableware, reflectors, plating. Complete outfit furnished. International Laboratories, Dept. 25, 309 Fifth Ave., New York City.

Rummage Sales, make $50.00 daily. We start you. Representatives wanted everywhere. "Wholesale Distributors," Dept. 32, 609 Division Street, Chicago.

Agents—Make big money the year 'round selling latest New York fashions, so smart looking and low priced no woman can resist buying. Strump & Co., Dept. 17, 29 West 34th Street, New York City.

Sell the latest nationally approved cooking utensil, the Squire Broiler. Sells on sight. Convenient to carry and show. $30 profit weekly easy for live agents. Get full details from A. J. Squire Mfg. Corp., 280 Madison Avenue, New York.

We want you to sell radium lighted articles "that shine in the dark." Demonstration means a sale and large profits. Demonstration outfit free. Radium Application Company, 44 Paterson Street, Jersey City, N. J.

Money-back guarantee makes Premier Sharpener fastest seller. Hundreds getting rich. You can. Write Premier Mfg. Co., 819 E. Grand Blvd., Detroit, Mich.

Wanted, General Agents—or Managers of Good Live Crews, to sell our Super-Bag. This bag sells on sight with a good profit. For particulars, write to Presto Bag Co., 81 So. Howard Street, Akron, Ohio.

We wish representatives in every community to secure subscriptions for Science and Invention, Radio News, and Practical Electrics. This is a wonderful opportunity for Amateur Radio Enthusiasts to make big money quickly. Write Experimenter Publishing Co., Inc., 53 Park Place, New York City.

Agents. Our soap and toilet article plan is a wonder; get our free sample case offer. Ho-Ro-Co., 138 Locust, St. Louis.

Great Profits Assured capable men joining immediately national organization for Evenflo Self-filling Ink-pencil Pen. Writes with ink instead of lead. Send for Profit Proposition. Evenflo Pen Company, Dept. 63, Grand Rapids, Mich.

Agents Wanted (Continued)

Ambitious men, write today for attractive proposition, selling subscriptions to America's most popular automobile and sportsman's magazines. Quick Sales. Big profits. Pleasant work. Digest Pub. Co., 9541 Butler Bldg., Cincinnati, Ohio.

$10 a Day and More, our new book, shows clearly how you may gain sure success and large profits selling Guaranteed Hosiery and Underwear factory to family. It is Free. Write today. C. & D. Company, 37-E Grand Rapids, Mich.

Make $25 to $50 week representing Clow's Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clows Company, Desk 27, Philadelphia, Pa.

Agents—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent.; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., Dept. 601, Philadelphia, Pa.

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Live Agents make $10 Day selling Eureka Strainer and Splash Preventer for every water faucet. Takes on sight. Widely advertised and known. Get details today. A. J. Seed Filter Company, 73 Franklin, New York.

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Make $50 weekly plating, refinishing, oxidizing, on nickel, silver, copper, steel, for automobile and household lines. Lane-Metalcrafts, 28 West 22nd Street, New York.

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No capital needed; no canvassing required; regular income earned in spare time selling all nationally advertised correspondence courses at half price; experience unnecessary. Economy Educator Service, 1664I Broadway, New York.

300 per cent. Profit; Selling Kleanrite Magic Clothes Washing Compound. Sells, 25c; Profit, 19c. Sample free. Bestever Products Co., 1941-W Irving Park, Chicago.

Old worn out casings will give 3 to 5 thousand miles more service with Insyde Tyres. Positively prevent punctures and blowouts. Double tire mileage—any tire, old or new. Use over and over again. Low priced. Agents wanted. American Accessories Co., B 884, Cincinnati, Ohio.

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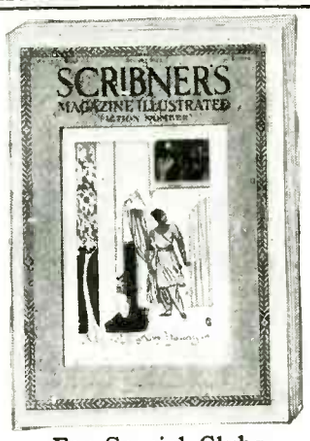

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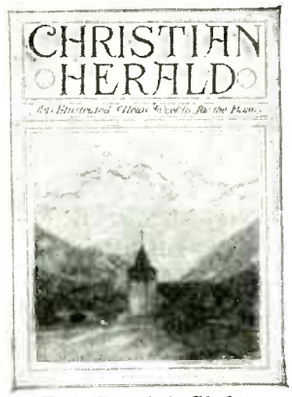

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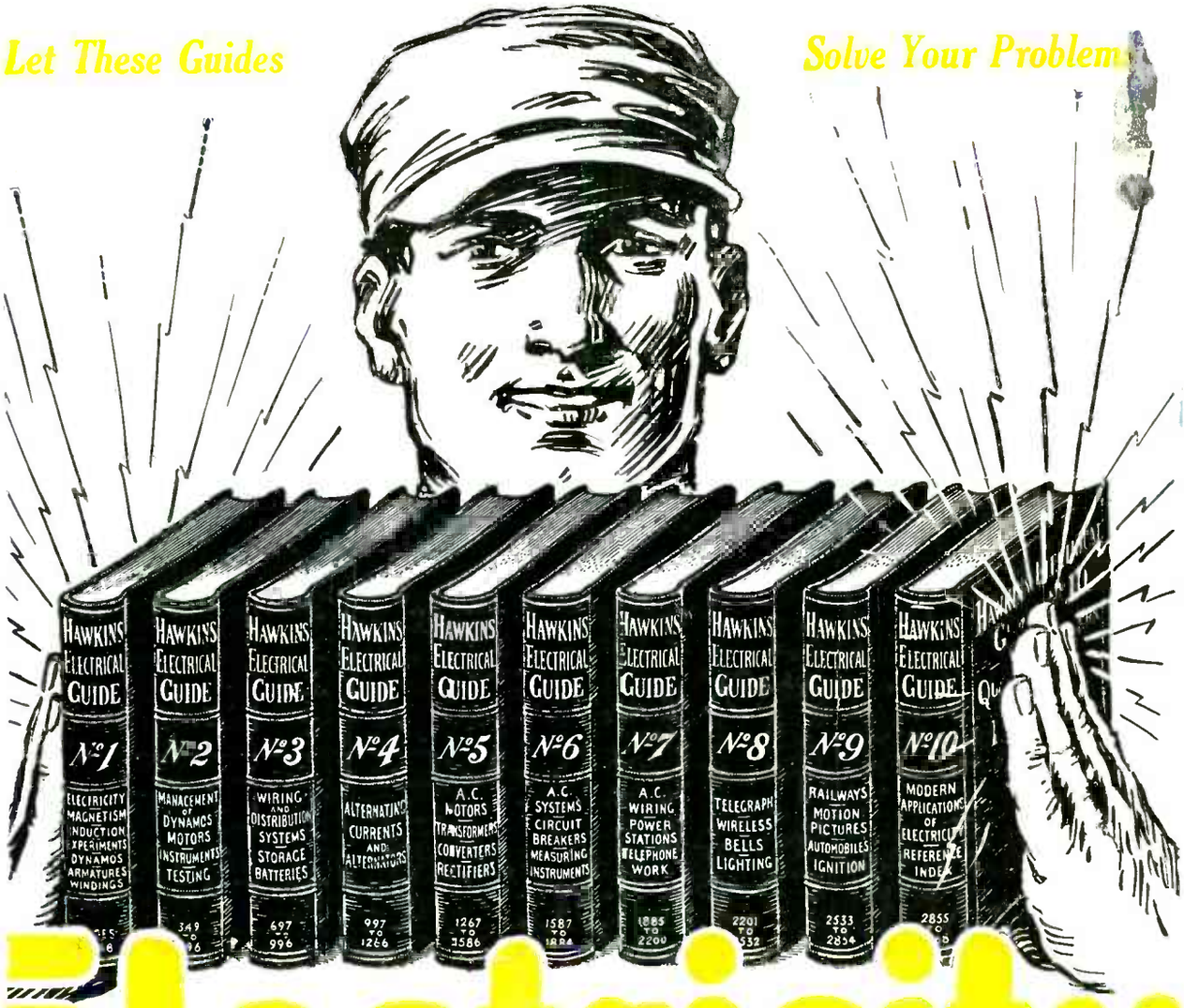

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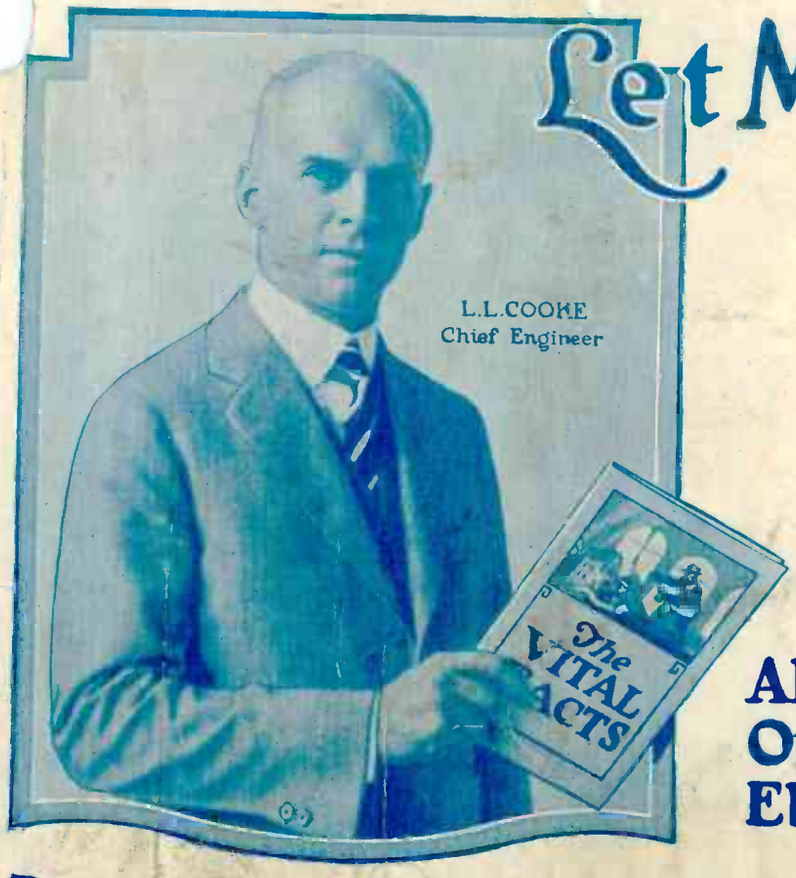

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