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Man's Greatest Menace

IN the pre-historic days man's greatest enemies were the wild beasts, against whom he fought, and which he destroyed little by little until finally the world became tolerably safe from them. What besets the human race mostly, however, today is not the wild beast, but rather insects, bacteria and micro-organisms too small to be seen by the naked eye.

It has been stated by a well-known entomologist that if the insect world were to take it into their heads to eradicate the human race, they could do so in short order. Few people are aware of the fact of how tremendous the insect world is. If it were not that insects were always fighting among themselves, and if they were left alone to propagate and grow, life on this planet would soon become intolerable, not only for every living animal, but for the human race as well.

It goes without saying that if some of the insects, for instance, the locusts, were to propagate themselves unchecked for only a few years, they would find it possible to devour every leaf upon this planet. The minute our flora vanishes from this planet, for only two or three years, it will mean that the human race must be exterminated. Thus, if the locusts were to eat up our crops, there would be no cereals or roots for the human race to subsist upon. If other insects were to destroy our foods, which they can do very readily, there would be nothing for us to feed upon, and the human race would die of starvation.

But it is not even necessary that crops should be destroyed, because some insects, if they took it into their heads to drive us from the earth, could do so very easily. We only need mention the ant. The ant is distributed very much more densely per square mile than the human race. There is hardly a square mile upon the earth on which there cannot be found literally millions of ants, whereas there is no such density of human beings.

Some ants are quite harmless, and others are not. And there are certain species which have terrific destroying propensities and, according to newspaper despatches from Texas, we read where a destructive body of man-eating ants were marching on the capital, according to reports from Austin. The Argentine ant is a pest in a class by itself, and is not only highly destructive to all sorts of plants, as it destroys buds, blossoms and fruit, but it is also of great damage to all sorts of poultry, as it kills off the chickens, and is even a menace to human life.

Thus infants have been reported killed by multitudes of these ants. These ants are so persistent that they overrun houses, go into every crevice, and no adequate means to combat them has yet been found. They even swarm into ice-boxes, not at all deterred by the frigidity as long as the ants find something eatable there. This particular ant, which is dark brown and small in size, is a native of Brazil and Argentina, and was imported into the United States at New Orleans on ships from South America.

Anyone who has to do with the fighting of ants knows what a terrific undertaking it is to rid a house of them once they overrun it. Their very smallness makes it almost impossible to fight them without damaging the house and its occupants. Poison gas has been resorted to, not infrequently, but is not a cure, because the ants come back as soon as the gas leaves. If, therefore, the Argentine ant, or any other similar ant, were to overrun the earth in vast quantities, it can be seen that it would not take long for them to make life intolerable for us.

The average person does not realize the value of our present entomologists and of their work in general. The more we know about insects, the better off humanity will be, because the day may come when we will all have to be up in arms, fighting the common enemy that threatens to devastate this planet.

Billions of dollars worth of damage is done annually by insects, and here indeed is a fruitful field for inventors, who can enrich themselves by devising ways and means to exterminate the pests.

H. GERNSBACK.

Contents for March, 1922

SCIENCE AND INVENTION is publisht on the 25th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $2.50 a year in U. S. and possessions. Canada and foreign countries $3.00 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

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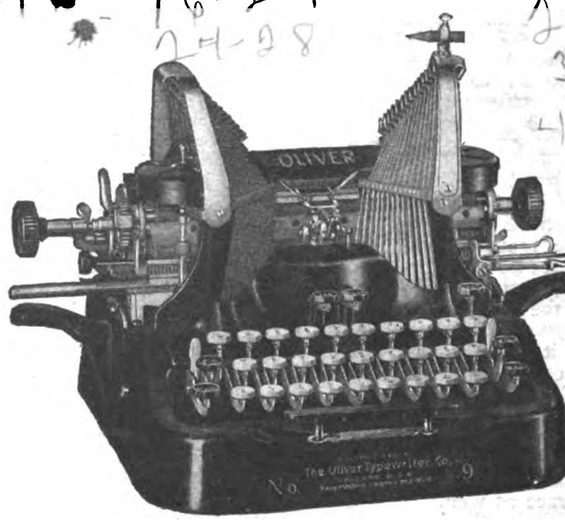
Have *You* Learned To Typewrite Yet?

Or do you still use the tiring, laborious hand-writing which is practically out of date? In hundreds of homes there are Olivers for the use of the entire family. Typing is fast becoming universal.

Free Trial

The coupon brings the Oliver to your office or home for 5 days' trial. Judge for yourself. Keep it or return it.



Easy Terms

The Oliver can be bought on easy monthly installments and you have the use of it while paying. Read our liberal offer.

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So today the Oliver offer is the most liberal of all—a brand new, standard typewriter for only $49.50 cash, or $55 in installments. Remember, this is possible only because of our simplified selling plan and enlarged output. The price would still be $100 if we sold in the usual manner.

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Over 900,000 Olivers have been sold. The Oliver is a favorite among big businesses as well as among individuals. It is famous for its speed, easy operation, durability and fine work.

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The coupon brings the Oliver for Five Days' Free Trial. When the Oliver comes, use it as if it were your own. Compare it. Then if you agree that it is the finest typewriter, regardless of price, and want to buy it, send us $49.50 cash. Or if you wish to pay in installments, the price is $55, payable $3 after trial, then $4 per month.

If you want to return the Oliver, ship it back at our expense. You do not risk a penny—we even refund the outgoing transportation charges.

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Mail the Coupon Now

Make this Oliver test. See if you want to save the $50.50, or if you would rather pay $100. The trial costs you nothing. Nor does it obligate you to buy.

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Canadian Price, $79

The OLIVER Typewriter Company
673 Oliver Typewriter Bldg., Chicago, Ill.

THE OLIVER TYPEWRITER COMPANY,
673 Oliver Typewriter Bldg., Chicago, Ill.

☐ Ship me a new Oliver No. 9 Typewriter for five days' free inspection. If I keep it I will pay $56 as follows: $3 at the end of trial period and then at the rate of $4 per month. The title to remain in you until fully paid for. If I make cash settlement at end of trial period I am to deduct ten per cent and remit to you $49.50.
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My shipping point is..........................

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name..........................

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City.......................... State..........................

Occupation or Business..........................

24-28

Volume IX
Whole No. 107

Science and Invention

H. GERNSBACK, - EDITOR
H. WINFIELD SECOR, - ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D. - ASSOCIATE EDITOR

MARCH
1922
No. 11

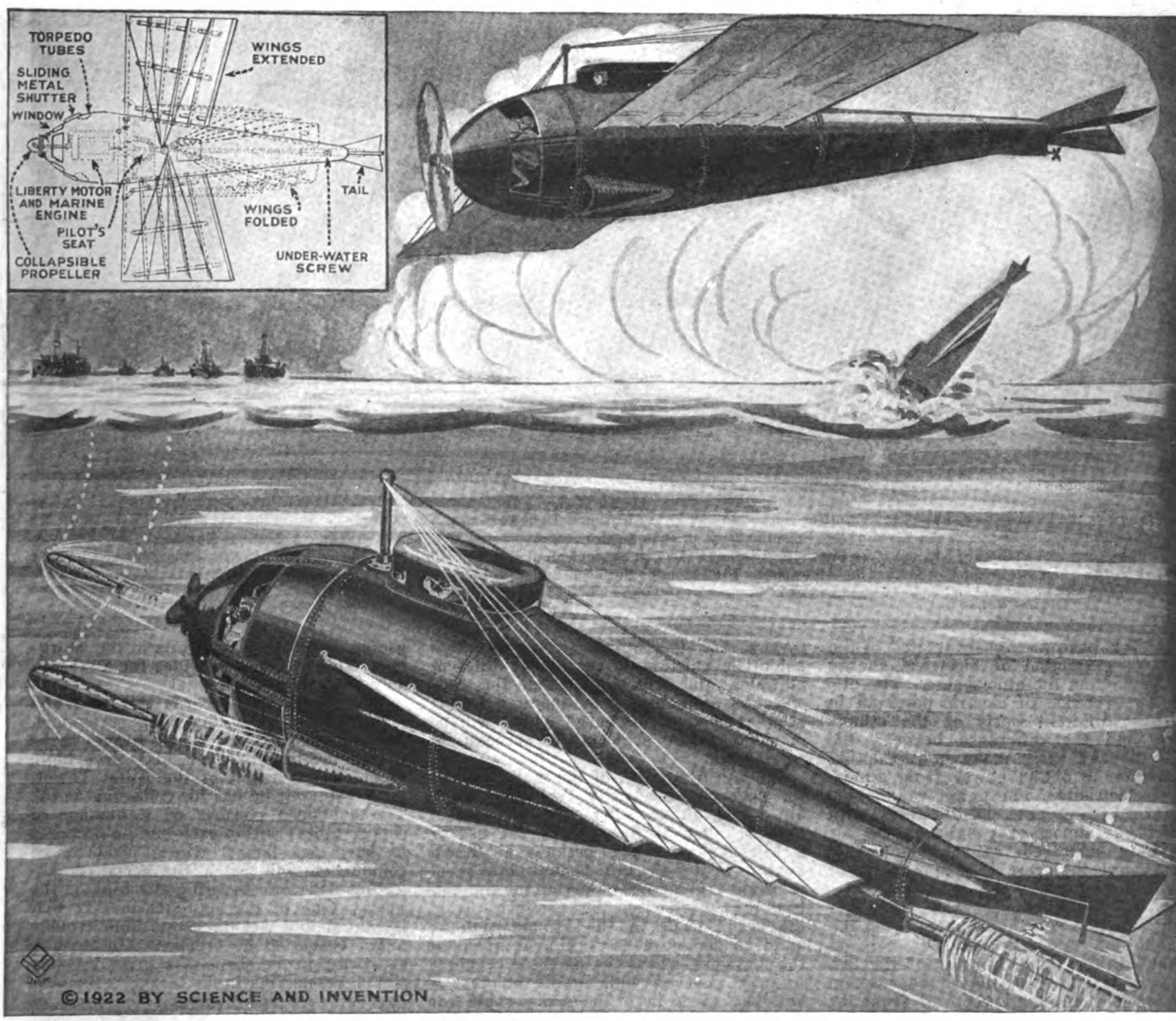
A Combination Airplane and Submarine

By EARL C. McCAIN

THIS combination airplane and submarine, invented by three men of Pueblo, Colo., may have the effect of revolutionizing modern warfare. This device combines the fundamental principles of both. Patent Office officials have written the inventor that the machine is the first of its kind ever received at the office, and shows real practicability; patents are now pending on this machine.

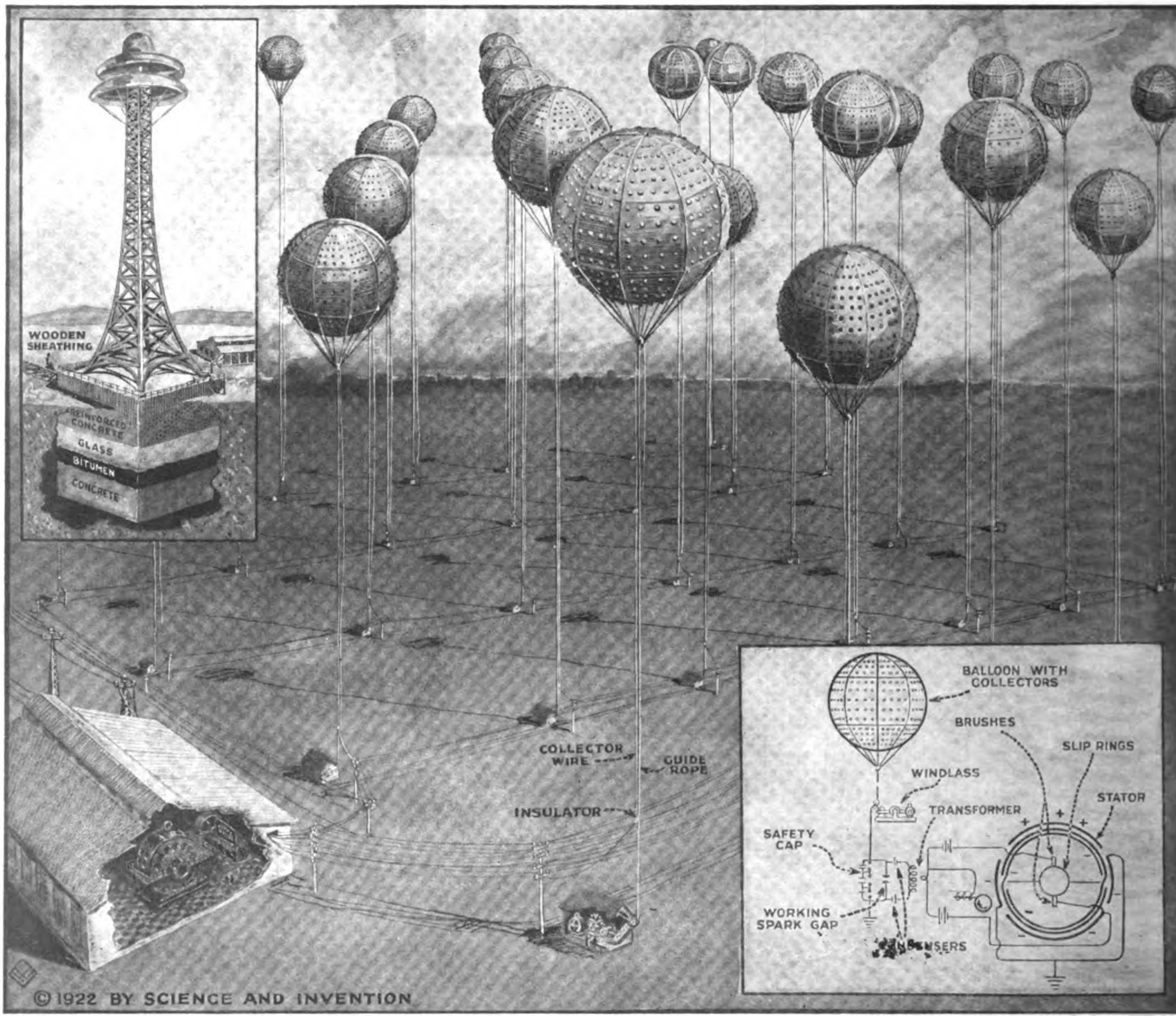
The machine is only twenty feet in length, tho the wing spread, when being used as an airplane, is thirty feet. The main secrets of the machine are collapsible wings and a folding propeller that fold up as the machine strikes the water to become a submarine. In the air the machine is driven by an ordinary twelve-cylinder Liberty motor, but under water,

(*Continued on page* 1067)



The Latest Invention in Air and Water Craft is the Combined "Airplane-Submarine" Here Illustrated. This Machine Should Prove of Considerable Use in Military and Naval Maneuvers, Owing to its Great Flexibility. This Craft can Fly Thru the Air, Gradually Descend Toward the Water, and Folding its Wings, Dive Beneath the Waves and Speed Along as a Submarine. It is Designed to Have at Least Two Torpedo Tubes for Firing Torpedoes at Ships, or These Might Be Dropt as Aerial Bombs when the Craft is Flying Thru the Air.

Power from the Air



For Many Years Electrical Engineers Have Endeavored to Devise Some Means Whereby It Would Become Possible to Utilize the Free Electrical Energy Ever Present in the Atmosphere, But They Were Not Successful, as Every Now and Then an Extra Heavy Surge of Static Current Would Rush Down the Elevated Conductor and Endanger the Lives of the Experimenters, or Else Destroy the Apparatus Connected With It. A German Engineer Has, However, Devised the Somewhat Elaborate Scheme Here Shown in Brief, and He Has Succeeded, at Least so His Report States, in Safely Extracting Several Kilowatts of Electrical Power from the Atmosphere With Metallic Surfaced Balloons, Elevated to a Height of Only 1,000 Feet.

WE have previously treated of the extraction of electrical energy from the atmosphere. The difference of electric potential in different parts of the atmosphere, and the difference between the upper air and earth make it a tempting proposition to obtain power from atmospheric electricity. The power would take the form of high potential difference with a discharge almost of a static nature. It has long appeared rather doubtful to conservative engineers if such a source of power should really be available. Yet when we see the lightning flash, it certainly suggests very high power, even tho the total of its energy may be small, on account of the small duration of the discharge. It is not to the thunder storm that we look for getting power from the atmosphere, as the subject is now being seriously investigated. A German scientist, Hermann Plauson, has publisht a very elaborate work on this subject, and has investigated the use of kites, balloons and towers, for the utilization of the high potentials existing in the air at different altitudes, and has studied out the construction of motors to be operated by the peculiar type of discharge which will be obtained, if the projects are successfully carried out.

We will first speak of the methods used for collecting electricity from the upper air. The author cites several German patents. One of them shows the use of a kite balloon. The balloon is shown floating in the air, kite fashion, and from it hangs a great net or aerial for the collection of electricity. The conductor from the aerial leads to the ground station; quite an elaborate description is given of the net-work which the patentee proposes to have covered with needle points. A windlass takes in or pays out cable for the balloon, and the patentee claims that by sending the apparatus to a height of about one mile he will have 225,000 volts to draw upon. He then speaks of a battery of 20,000 cells in series, which will use up 40,000 to 50,000 volts in the charging. This certainly provides for a reasonably large fall of potential.

But our author discards this idea and first suggests something more permanent. He proposes the erection of towers to be in the neighborhood of 1,000 feet high, or about the height of the Eiffel Tower. At the summit he has his collecting aerial. The appliance consists of a number of copper tubes; within each one he proposes to burn gas lamps, whose products of combustion will reach the aerial, a collecting net-work covering the tops of the tubes. One of his apprehensions is that if rain should wet his connections trouble might ensue, so he proposes a protection at the top in the shape of a great bell-like shield, resembling in his terms "a Siamese pagoda." He also compares the form of the protection to that of a great petticoat insulator. Another of his difficulties is that he must have his tower insulated from the earth. He, therefore describes a complicated foundation for his structure.

He proposes first to pour in at the bottom of the excavation a foundation of simple concrete. On this he places a layer of asphalt, and then a layer of cast glass, three to ten feet thick, and then comes a reinforced concrete foundation, to which the metallic foot of the tower is to be anchored. This foundation must rise at least seven feet above the ground level, and is to be boarded in on all sides to protect it from moisture. The author's idea is to erect a number of these towers connected by a horizontal cable, to which the aerials for collection of potentials are secured.

The author strongly advocates balloons as collectors of the electric power of the air. These he depicts covered with spots. These spots indicate areas to be variously coated and prepared to collect potential from the atmosphere.

In the first place he describes the balloon as made of thin metallic leaf supported by internal ribs. Steel wires silver-plated, copper-plated, or aluminum-coated, run from the balloon to the pendant or junction ring. To this ring the tether-cable is attached and runs to an insulated windlass on the surface of the earth. The balloon is to rise to an altitude varying from 300 feet to three miles.

The coating of the spots is to be of the thinnest amalgam, of mercury and gold, or zinc, or even polonium, perhaps only 1/2500 inch thick. All over the upper face of the balloon are numberless metal points. To prepare the needle-like wires, they are collected into bundles and are treated electrolytically in a bath, so as to be dissolved in part. This gives a sharp point and roughened surface, all adapted for collecting the electric energy. The points may be of copper, steel, or some hard metallic alloy. After this corrosion, as it may be termed, the wires are plated with gold or other of the so-called "noble metals." It is advised that polonium or radium salts be added to the plating bath.

Dr. Plauson devotes many pages of his book to describing his motor. This is a rotary motor including a stator and rotor and its peculiarity is that it contains no coils, develops no electro-magnetic field properly speaking, but works by static excitation. One typical arrangement is shown in our illustration. The stator plates and rotor plates are concentric with each other, representing segments of cylinders. The alternation of negative and positive charged plates produces the rotation. In the connections there is included a safety spark gap to take care of dangerous potentials. Inductances and capacities are also used and indicated. It was found that the plates heated, owing to the Foucault currents, and to overcome this, several methods of subdividing the stator and rotor plates, are described by the author.

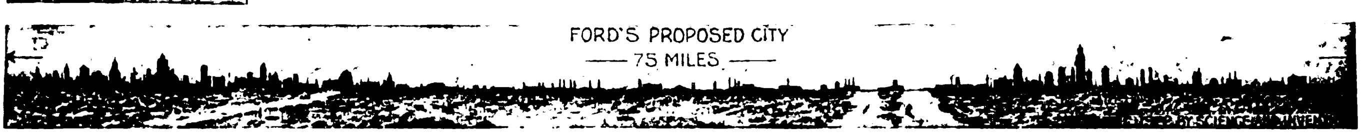
The whole subject is quite captivating, and it really seems as if the utilization of the electricity of the air may be almost in sight. It would seem possible to carry out experiments in this direction by means of the Eiffel Tower, but, of course, the trouble here is that the tower is grounded, and perfect insulation of the collecting surface is absolutely essential.

And now our author gives us some practical details. He says that on the Finland plains he carried out experiments with a balloon made of aluminum leaf with collecting needles of amalgamated zinc with a radium preparation as an ionizer. The surface of the balloon was sprinkled over with zinc amalgam. It was sent up to a height of 300 meters, nearly 1,000 feet, and was held by a copper-plated steel wire. A constant current of 1.8 amperes at an average of 400 volts potential difference was obtained. This gave nearly three-quarters of a kilowatt, or close to one horse-power. The collector of the balloon insulated from the earth showed a tension of 42,000 volts. By sending up a second balloon with an antenna to the same height at a distance of 100 meters from the first balloon, a current of over 3 amperes was obtained. Then by putting into the circuit a large condenser, whose capacity was equal to the surface capacity of both balloons, and of the antenna connections, the current rose to 6.8 amperes with about 500 volts mean tension. By the use of these two balloons, he eventually ran up the power to 3.4 kilowatts.

Ford's New City 75 Miles Long

EVERYONE is familiar with the proposition of Henry Ford, the automobile king, in his efforts to obtain possession of the Muscle Shoals electric plant, built by the Government in Alabama during the war. Mr. Ford has had his engineers draw up some wonderful plans for the future development and completion of this vast plant, and Mr. Ford hopes to make it one of the greatest undertakings in the history of the industry of America.

If Henry Ford's Plans Carry Thru, A City 75 Miles Long, will be built at Muscle Shoals.



Among other things, Mr. Ford's proposal provides for the building of a gigantic city 75 miles long, to be located in the Muscle Shoals region. New York City or Manhattan Island, from the Battery to 225th Street and the Harlem River, is 13 1/3 miles long. Compared with Mr. Ford's proposed giant city of tomorrow, Manhattan Island looks quite small indeed, as the accompanying illustration shows, the new metropolis of the South being 5.6 times as long as New York City.

This vast settlement, 75 miles long, would be made up of several large towns or smaller cities, and with the idea in mind that workmen and their families should be able to live in small communities surrounded at least on either side with all the benefits of rural or suburban life. In other words, this city is to be long and narrow instead of allowing it to spread out like a great circle, with the consequence that many of the dwellers never get a smell of the country air or see a green leaf.

The Muscle Shoals project, however, is only the start of a greater program, it has become known. This includes the development of water-power facilities in many parts of the country by which persons in those communities would derive power to run manufacturing plants, light their homes, and run machinery, at home and on the farms. One detail of the plan is the harnessing by farmers of every sizable creek and brook that crosses their property.

If the Government accepts Mr. Ford's bid, work at Muscle Shoals will be started at once. The nitrate works and other plants would be run by steam power pending the time the great dam, that will require about two years to build, has harnest the water at this point. Then would follow rapid development, in the opinion of Mr. Ford, until within a comparatively few years an industrial center greater than Detroit would have been built up. Mr. Ford believes the Muscle Shoals plan, if consummated, would be the start toward development of the Mississippi River Valley. The automobile manufacturer believes this valley could "run the United States" if the water now going to waste could be fully and efficiently utilized.

Eventually, in Mr. Ford's opinion, the Government could derive enough revenue from these power projects to support itself, thereby revolutionizing the financial system of the country.

Night Speeding of Clocks Stirs Science

Clocks to-day are formally listed in the high life class. They run faster at night than by day.

If the first clock ever made had run correctly, at noon on Thursday it would show 8.13 P. M. Saturday; would have gained 20,293 seconds — 2 days 8 hours and 13 seconds — since clocks of our present type were invented in A. D. 996 to supplant hour glasses, water clocks and measured candles. The 20,923 seconds include the leap year gains.

At least, so the volunteer statistician says.

However, as the clocks have been corrected day by day, at noon to-day it is noon to-day.

The vagaries of the clocks have been disclosed by Dr. R. H. Tucker of Lick Observatory, a prominent astronomer, who has given special attention to clocks.

He finds that three first-class clocks at Lick Observatory have gained .06 of a second every night for several months.

The results of his investigation are included in the annual report of Dr. W. W. Campbell, director of Lick.

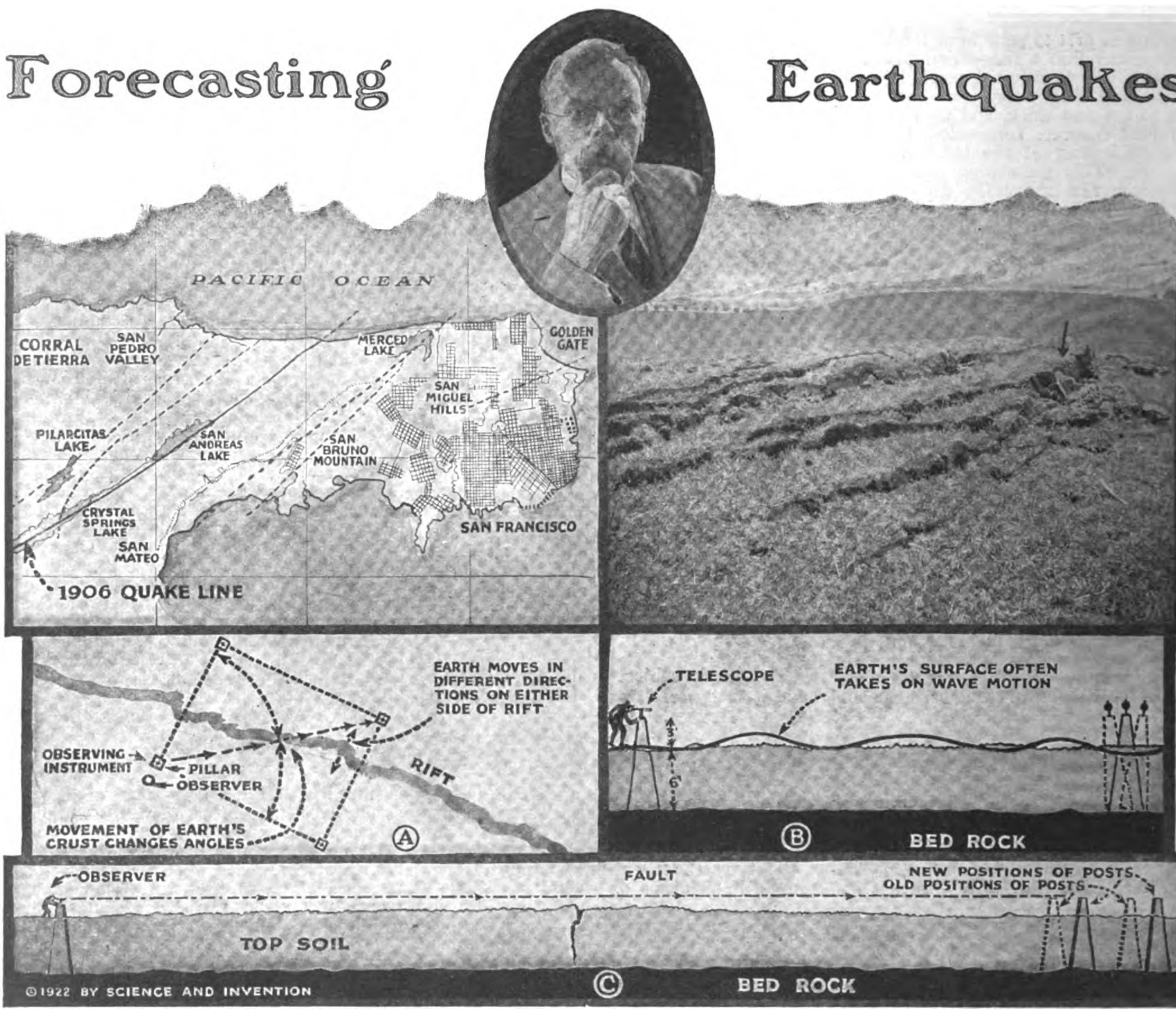
Maybe the Einstein theory is to blame. If so, the report says nothing of it.

The clocks were checked from a large list of stars whose positions are known with high precision. The report says meridian transits were recorded .06 seconds of time too early in the sunset period as compared with the sunrise period. Differences of temperature would account for only 5 per cent. of the discrepancy.

Nobody knows the cause, but Dr. Tucker is still at work on the problem.

Prof. Charles Burckhalter, director of Oakland's Chabot Observatory, asked for his opinion on it, said that Dr. Tucker was the expert of experts on this question, but that the public need not be alarmed, as the discrepancy discovered by Dr. Tucker has been rectified day by day automatically.

Forecasting Earthquakes



Center Photo is That of Dr. Andrew C. Lawson, Professor of Geology at the University of California, Who Has Discovered a Method of "Forecasting Earthquakes." Upper Right Hand Photo Shows Where the Earth's Skin Broke, Unable to Stand the Tension Caused by the "Strain Creep" of the Crust of the Earth. Note the Hat Which Gives Some Idea of the Height of These Ridges, the Result of the Earthquake of April, 1906, in the California Hills. It is from a Study of the "Creep" of the Earth's Crust, and the Limit of Tension at Which the Crust Rebounds, Causing Seismic Disturbances, That Earthquakes Are to Be Forecasted. Any Change in the Position of Concrete Pillar Set at Different Distances on Either Side of an Earthquake "Rift" or "Fault," is Accurately Checked Up as the Diagrams Here Show, Owing to the Change in the Angle Observed Between Two or More of the Marked Posts. The Map in the Upper Left Hand Corner Shows the San Francisco Peninsula With the Five Ancient "Faults" Caused by Seismic Disturbances, as Indicated by Broken Lines; While the Later Fault of 1906 Appears as a Solid Black Line, Passing Thru the San Andreas Valley and Lake. Experiments Are Being Made on Both Sides of This Rift at Widely Separated Points, to Provide the Data for Forecasting Future Earthquakes.

Method of Forecasting Time and Place of Temblors Is Discovered by California Scientists

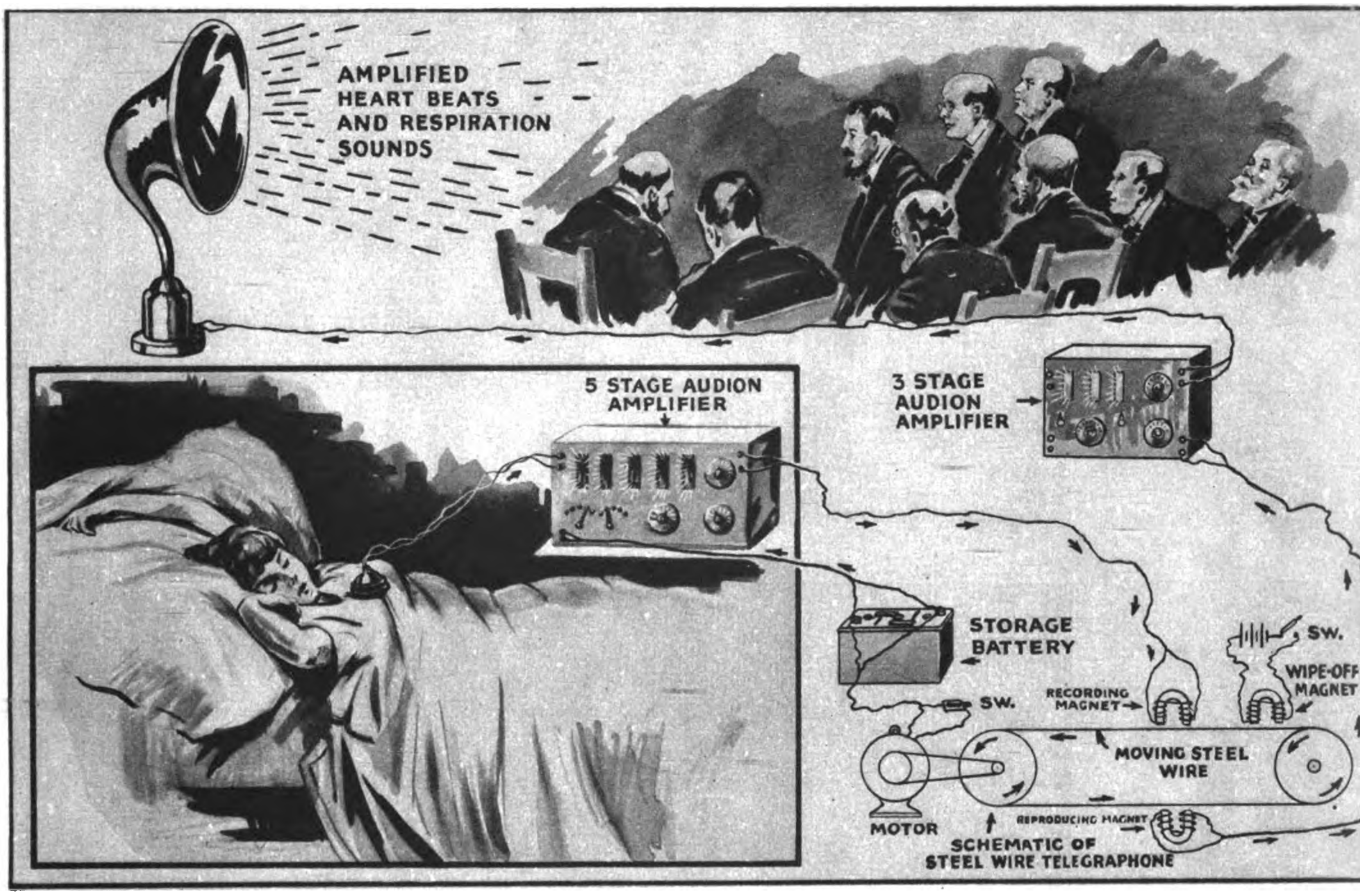
THE earthquake, which is to-day no less the dread of man than when he believed it to be a manifestation of the wrath of his gods rather than a phenomenon of nature, has been robbed of its greatest terror — its unexpectedness — by a group of California scientists, led by Dr. Andrew C. Lawson, professor of geology at the University of California, through the discovery that the coming earthquake can be compelled to warn mankind of virtually the exact time and place at which it will strike. With this discovery — or these discoveries, for Dr. Lawson has made several of them — the forecasting of a seismic disturbance will become the same matter of routine observation and careful calculation, as the predicting of the variety of weather for to-morrow or for a week hence.

So well convinced is the Board of Regents of the University of California that the geologist has unearthed the secret of the *temblor* (earthquake), that it has just appropriated $4,000 for the purchase and installation of a new and delicate piece of apparatus at the Observatory of the University on Mt. Hamilton, solely for the purpose of collecting the data necessary to the accurate prediction of these seismic disturbances. So delicately constructed is this instrument that it does not depend upon the hand or the eye of man, but makes its own records photographically upon a plate, so that the factor of human error is virtually eliminated from all the calculations based upon its work. But the machine is secondary to the man, and without the man's discoveries, the machine would be of little use. Here is what the man, in this case Dr. Lawson, has found:

It has been known for some years that the latitude of many points on the surface of the earth has been slowly but regularly and surely increasing; that is to say, those points have been moving northward. Quite obviously, the only manner in which the location of any object — no matter how "fixt" it may be supposed to be—can be establisht, is by its relation to certain stars and constellations — that is to say, the position of the object on the surface of the earth cannot be established as fixt, by comparison with any other object on earth, because that other object may be, usually is, moving just as much as is the first object. This knowledge led to the discovery of the earth's *creep*. By this is meant that the crust of the earth, for a depth of a varying number of miles, is constantly moving. This movement is due to the fact that the earth does not *run true* on its poles; the North Pole, for example, moves, during the rotation of the earth on its axis, through a circle of approximately 60 feet, a trifling distance when compared with the diameter of the earth, yet sufficient, say the geologists and the astronomers, to cause the "skin of the world" to move slowly northward.

This movement is regular, constant, and can be measured. It ranges, due to difference in mobility, ductility and other factors in the composition of the earth's crust, from a few inches to a few feet a

(*Continued on page* 1078)



The Sound of a Heart Beat is Not a Very Loud One, but Without Causing Any Inconvenience or Placing Any Strain Upon the Patient, the New Audion-Telegraphone Apparatus Here Shown in Actual Use at the Bureau of Standards, in Washington, D. C., Will Amplify Your Cardiac Sounds to Such an Extent, That a Whole Roomful of Medical Experts Can Hear Them and Diagnose the Exact Condition of Your Heart. This Heart Beat Amplifier is of Advantage in Many Ways, Particularly When Employed in Medical Colleges for the Benefit of Students, and There is Practically No Limit to the Degree to Which the Sound of the Heart Beats May be Intensified. It Also Records the Sounds on the Steel Wire of the Telegraphone.

Steel Wire Records Heart Beats

SUCCESSFUL experiments have recently been conducted at the U. S. Bureau of Standards, in co-operation with the Medical Corps, U. S. A., in which permanent records of cardiac and respiratory sounds have been made and reproduced by the use of the *telegraphone*, so as to be audible thruout the room with an audion amplifier.

A carbon telephone transmitter of ordinary type with a rubber adapter substituted for the mouth-piece was used for the stethoscope. The currents from the telephone transmitter were amplified by means of a five stage audion amplifier, which was connected to the recording element of a steel wire *telegraphone*. The magnetic records of the cardiac and the respiratory sounds thus obtained were made audible by connecting telephone receivers to the telegraphone in the usual manner. The telegraphone currents were also amplified by means of a three stage audion amplifier which was connected to a loud-speaking telephone. In this way the sounds were made audible thruout the room.

This method of obtaining permanent records of cardiac and respiratory sounds and of reproducing them offers interesting possibilities in the study of normal and pathological conditions of the heart and lungs and their demonstration to an audience for purposes of instruction.

The accompanying diagram shows in a clear and understandable manner how the heart beats and the respiratory sounds are picked up by a microphone placed over the chest region, then how the fluctuations in the current caused by the varying pressure on the carbon grains in the microphone are led into an audion amplifying cabinet. A storage battery supplies the necessary current for lighting the vacuum tubes or audions in the amplifier, and also supplies the necessary current for the microphone circuit. When the intensified current pulsations, corresponding to the heart beats or to the respiratory sounds, emerge from the audion cabinet, they pass into the recording magnet coils of the steel wire telegraphone, as shown in the diagram. The fluctuations in the magnetism at the poles of the recording electro-magnet thus created cause local magnetizations in the steel wire as it travels past the magnet poles, each of these magnetizations in the wire corresponding to a variation or pulsation in the microphone current.

Later when the steel wire is moved by the reproducing electro-magnet poles, the magnetized spots which have been induced on the wire, and which are practically a continuous variation in polarity, cause magnetic changes in the iron of the reproducing magnet, and these in turn cause currents to be set up in the coils surrounding the iron core. These reproduced telegraphone currents are then amplified by means of a three-stage audion amplifier, connected to a loud-speaking telephone as shown. Thus it has become possible for a number of physicians, in fact, a whole roomful of them, to listen to the heart beats or respiration of a patient, even tho the record of these sounds may have been taken a thousand miles or more away, and the steel wire shipt by mail or express to the experts for diagnosis of the case.

A Few April Features

Electrical Attraction Without Magnetism or Iron. By Dr. Alfred Gradenwitz. Illustrated with Photos.

If New York City Were Our Whole World—A Graphical Picture Study in Science. By Charles N. Holmes.

Einstein on the Movie Screen. Illustrated. By Edwin Haynes.

The Gravity King—The Story of a Wingless, Propellerless Airship That Defied Gravity. By Clelland J. Ball.

Photography Without a Camera. By Dr. Ernest Bade.

Enter—The Gearless Automobile. Is the Shifting Gear Doomed?

The Amateur Magician—Another Interesting Series of Parlor Experiments. By Joseph H. Kraus.

Second Popular Article on Home Radio. By Armstrong Perry.

Crystallization in a Plane—How Chemicals May Be Identified Under the Microscope.

New Gasoline Engine Plow and Stump Cutter. By E. M. Stevenson.

Food Adulterants Detected Microscopically. By Prof. Leon Augustus Hausman, Ph. D.

The April issue of SCIENCE AND INVENTION *will be a special "Radio Number," and will contain numerous articles on home-made radio sets, including both audion and crystal detectors, also the names of the winners in the $300 Radio Receiving Set Contest.*

Popular Astronomy

By ISABEL M. LEWIS, M. A.

OF THE U. S. NAVAL OBSERVATORY

OUR solar system is moving thru space, the relative positions of the sun and its encircling plants being unaffected by the translation of the system as a whole. As a result the various planes describe paths thru space having the form of spiral or corkscrew curves, while the sun, the center of the system, is moving, apparently, along a straight line.

The rate at which we are traveling thru the sidereal system to which our sun belongs is about twelve miles a second, one million miles a day, or four astronomical units a year, the astronomical unit being the distance from the earth to the sun, or approximately ninety-three million miles. In one year, therefore, the sun advances a distance equal to twice the diameter of the earth's orbit.

How far have we traveled, one may ask, since the pre-Cambrian or earliest geological period of at least one billion years ago, whither we are going and how long will it be before we reach our journey's end, if indeed there is an end to this mysterious journey upon which we have embarked?

The latest astronomical evidence seems to indicate that the system of stars to which our sun belongs is far more extensive than was formerly supposed, that the Milky Way or Galaxy, crowded with countless stars, is some three hundred thousand light years in diameter, instead of about thirty thousand, as was formerly supposed, and that it plays the part of a sort of equatorial region in one enormous spherical universe. Whether there are other distinct systems of stars or universes shut off from our own by some medium impenetrable to light we do not know. Toward the plane of the Milky Way, which is the fundamental plane in our system of stars, crowd the great majority of all the stars, including our own sun, and it is believed that the stars are distributed in this plane in a great spiral formation similar to that of a spiral nebula with a strongly condensed nucleus at the center and with spiral arms extending outward from this central nucleus in opposite directions. Along these arms it is believed the individual stars move to and fro toward and away from the central nucleus, which is believed to lie in the general direction of the star clouds of the Milky Way in the constellation Sagittarius.

The small or dwarf stars, as they are called, of which our star—the sun—is one, are moving more rapidly than the giant stars of great mass and are apparently drifting toward this more condensed center of the sys-

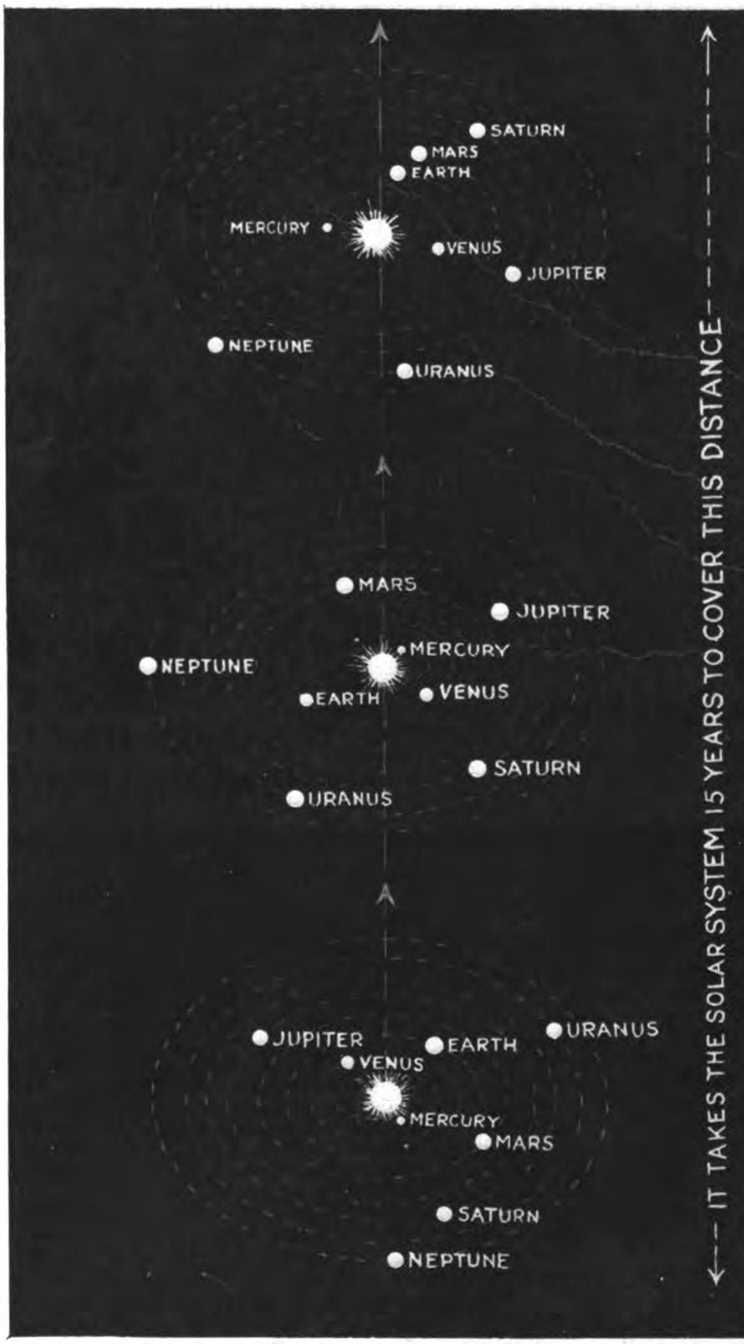
To the Center of the Universe in Eight Hundred Million Years

tem of Sagittarius which has been placed by the investigations of Shapley and others at a distance of some fifty thousand light years from the present position of the solar system. The sidereal system itself is also rotating, it is believed, at a high velocity and moving onward thru space *beyond*, just as the solar system is moving onward *within* the sidereal system, taking its planet family along with it, so that we have always a unit moving within another greater unit, and there is no such thing as a body absolutely at rest in space.

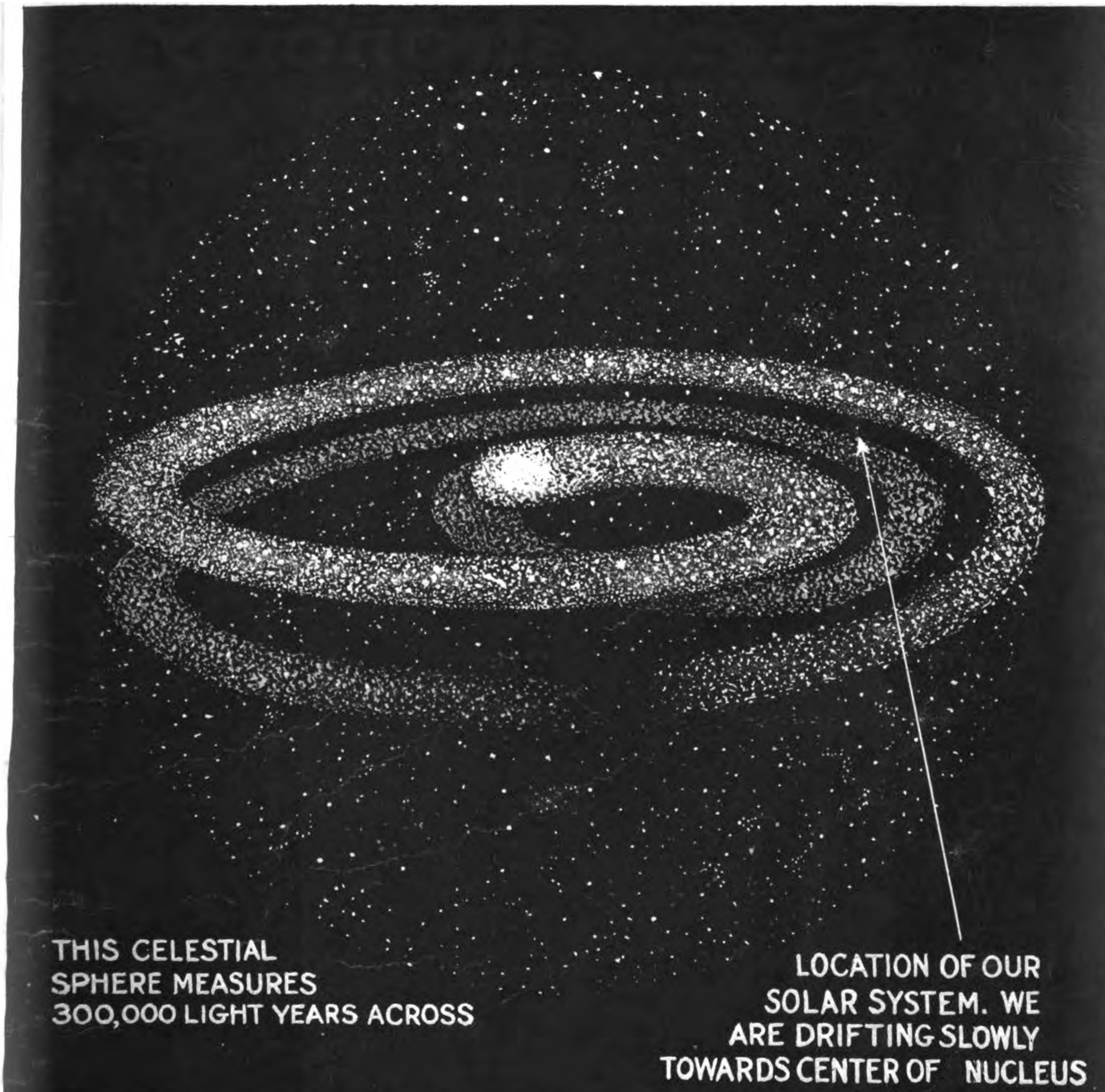
Our motion thru space, we have said, amounts to twelve miles a second, four times the distance from the earth to the sun, in a year. Compared to the terrestrial velocities with which we are familiar, this seems a tremendously high speed, but when we consider the distance to be covered in journeying thru the universe it seems as if our sun is advancing at a snail's pace. It takes fifteen years for the solar system to advance a distance equal to its own diameter, taking as the diameter of the solar system the diameter of its outermost planet, Neptune. Of course the gravitational attraction of the sun is powerful enough to control bodies at a far greater distance than that of the planet Neptune, and the aphelia points of many periodic comets lie far beyond Neptune's orbit, and for all we know to the contrary there may be several trans-Neptunian planets at enormous distances from the sun. Measuring the diameter of the solar system by the extent of the sun's gravitational attraction, several centuries must pass before the sun advances thru space a distance equal to this diameter.

After traveling for about sixteen thousand years our solar system advances as far thru space as light travels in *one* year, but light takes four and a third years to travel to the solar system from the nearest star, so it would take about sixty-eight thousand years for the solar system to cover the same distance at the rate of four astronomical units, or twice the diameter of the earth's orbit, in a year. Assuming that one billion years have elapsed since the pre-Cambrian days, when the earth had a surface crust but was not yet fitted to be the abode of life, then a little computation will show that the solar system has traveled about sixty-five thousand light years since that earliest geological period, or about one-fifth of the extent of the Milky Way, if the latest estimates of its extent are to be accepted.

To travel from our present position in space to the center of the universe—if it is situated in Sagittarius, fifty thousand light years away—would take about eight hundred million years. Our solar system is now located about half way between the outer limits of the Milky Way and this central nucleus in Sagittarius, it is generally believed, and is drifting toward the center



The Solar System is not Fixt in the Heavens, as Was Thought Formerly. On the Contrary, the Sun with Its Planets Moves Quite Rapidly Thru Space, and in About 16,000 Years it Advances as Far Thru Space as Light Travels in One Year. It Should Be Remembered That Light Travels at the Rate of 186,000 Miles per Second. The Illustration Above Shows That it Takes the Solar System About 15 Years to Traverse a Like Distance, as That Represented by the Diameter of the Orbit of the Farthest Planet, Neptune.



This Illustration Depicts the Latest Conception of Our Universe. Our Universe Seems to Be in the Form of a Sphere With a Great Nebula—the Milky Way—Forming its Equator. This Whole Universe Moves in the Heavens as Well, Carrying All Stars and All Systems With it. Our Universe is Now Thought to Be Some 300,000 Light Years in Diameter. Most of the Stars Crowd in the Region of the Nebula, Which Seems to Be a Form of a Double Spiral With a Strongly Condensed Nucleus at the Center, and With Spiral Arms Extending Outward in Opposite Directions. Our Own Solar System is Now Located About Half Way Between the Outer Limits of the Milky Way and This Center Nucleus. It is Slowly Drifting Towards the Center of the System.

of the system. From the extremely short period for which we have observations of the sun's motion with respect to the stars, it is impossible to determine whether our sun is moving along a straight line or in a closed orbit. From other considerations, however, it seems fairly certain that the stars are not moving in closed curves, but are drifting to and fro in or parallel to the plane of the Milky Way along spiral arms that originate in a central nucleus of closely condensed star clouds and branch out from this center of the system in diametrically opposite directions.

The age of our sun and of the solar system is now believed to be of the order of one thousand billion years. Newly discovered facts regarding the source of the radiant energy of the sun show that we do not have to attribute its output of light and heat to gravitational attraction alone, which would limit its age to about twenty million years, an absurdly short period within which to crowd all the great geological changes that have taken place in the past history of our planet. The revolutionizing discovery that atoms of other elements are being built up from the hydrogen atom with a liberation of energy that is enormously greater than we would have dared to assume in our wildest speculations permits us to extend the period during which the sun has been giving forth light and heat at its present rate to something like one hundred billion years. It is now believed that within the interior of the sun atoms of more complex elements are being formed from atoms of simpler elements with the release of inconceivably great quantities of radiant energy. It is known, for instance, that the energy liberated in turning a gram of hydrogen into helium is about five million times as great as would arise from burning the same amount of hydrogen in oxygen!

The one billion years that have elapsed since the earliest geological days is but a comparatively short period in the history of the development of the solar system. If in the past billion years we have traveled one-fifth of the distance across the sidereal universe it is conceivable that in the period of the development of the solar system prior to that time the sun and its attendants may have traveled many hundred thousand light years along the spiral arms of the Milky Way. An age of one thousand billion years would imply a journey of over sixty million light years for our sun, assuming that it has always moved at its present rate, which is doubtful, however, for in its days of maximum brightness, long before it contracted to its present state of a dwarf star, our sun probably moved far more slowly than it does today. Yet whatever its velocity may have been billions of years ago, we may feel certain that our sun has covered a distance of many mil-

(*Continued on page* 1066)

The Ninth Spool

By CHARLES S. WOLFE

THE swarthy little man at the Chief's side was controlling himself with an effort visibly painful. Twitching lips and trembling hands spoke eloquently of nerves on the verge of a spree. I threw aside my book and the twang of Fenner's banjo dropped to an almost inaudible strumming. Fingers moving nimbly over the frets, he arched questioning eyebrows at Davidson.

The Chief answered the unspoken question with a gruff introduction. "Mr. Alvarez, Fenner," there was, I fancied, not a little disgust in Davidson's rumbling tones, "Mr. Alvarez is having domestic difficulties. He—"

Alvarez's nerves slipped their leash right then. The Chief's bass boom was drowned in a falsetto torrent. "My wife—she's a gone—went—she's a desert! She's a fly with Senor Smeethson. Heem I will slay! Heem I will run thru! Heem ——"

The corners of Fenner's mouth were twisting into a grin. "If you've come to borrow the swords, Chief," he began, sweetly sarcastic, "I'm—"

Davidson cut in in hasty defense. "Oh, I know what your thoughts are, Fenner, and what you're going to say. The fact that his wife ran away with Señor Smithson isn't particularly our business. She can fly with a regiment of Smithsons if she wants to, and all she'll get out of me is a few telegrams to neighboring authorities. But that isn't all she flew with. She's a fly, as this guy says, with about twenty thousand dollars' worth of jewelry and a wad of money. And that is our business."

Alvarez leaped from sputtering incoherence into full eruption. "Yes! Yes!" he cried, while threshing arms strove to aid a badly handicapped tongue, "She'sa take diamonds — pearls — the rubies! Froma my safe there is gone five — six — ten thousand dollairs — more — I don't know. She'sa ——"

He became unintelligible. English, at the speed he was making, proved an unmanageable vehicle and he lapsed into his native tongue. Squealing out his wrath in a rising crescendo of fury, he fairly danced in rage. Twice Davidson made a tentative move toward the infuriated little foreigner, but each time Fenner shook his head warningly. And at last the storm spent itself. The torrent slowed, stumbled, spluttered into silence.

Davidson turned to Fenner. "Now that that is out of his system," he said, dryly, "We'll get down to business. Mrs. Alvarez, apparently, has eloped with Señor Smithson — whoever he is — and has added insult to injury by plundering her husband's strong box. I hate to bother you with a routine case of this type, and I know that it is out of your line altogether. But this precious pair left nothing to betray their destination and that's why I'm here. The United States is big, you know. They may have slipped quietly over into the next county, or they may be going fast for the Coast. Or Canada. Or the Gulf. It puts me up against a needle in a haystack problem, and I'm in hopes that you may have some scientific method of locating fleeing culprits worked out and waiting for trial."

Fenner tossed his banjo upon the table. "If they've left no trace," he said, thoughtfully, "They've made an unusually clean job of it. Try the railroad stations?"

Davidson looked pained. "Sure," he said, heavily, in the tones of a man who will not deign to resent an implication of incompetency, "No good. If she left over any of the roads, she went so well disguised that the station agents, who all know her by sight, were unable to recognize her. Nobody seems to know just who Smithson is. At his lodgings they know nothing of his occupation or his antecedents. He's been gone for a week — more or less. No one seems to have noted just when they last saw him. From their guessings I put it at about a week."

"And Alvarez? Had he no inkling of what was on foot?"

Davidson chuckled. "Our friend here is the goat!" he guffawed. "It seems that

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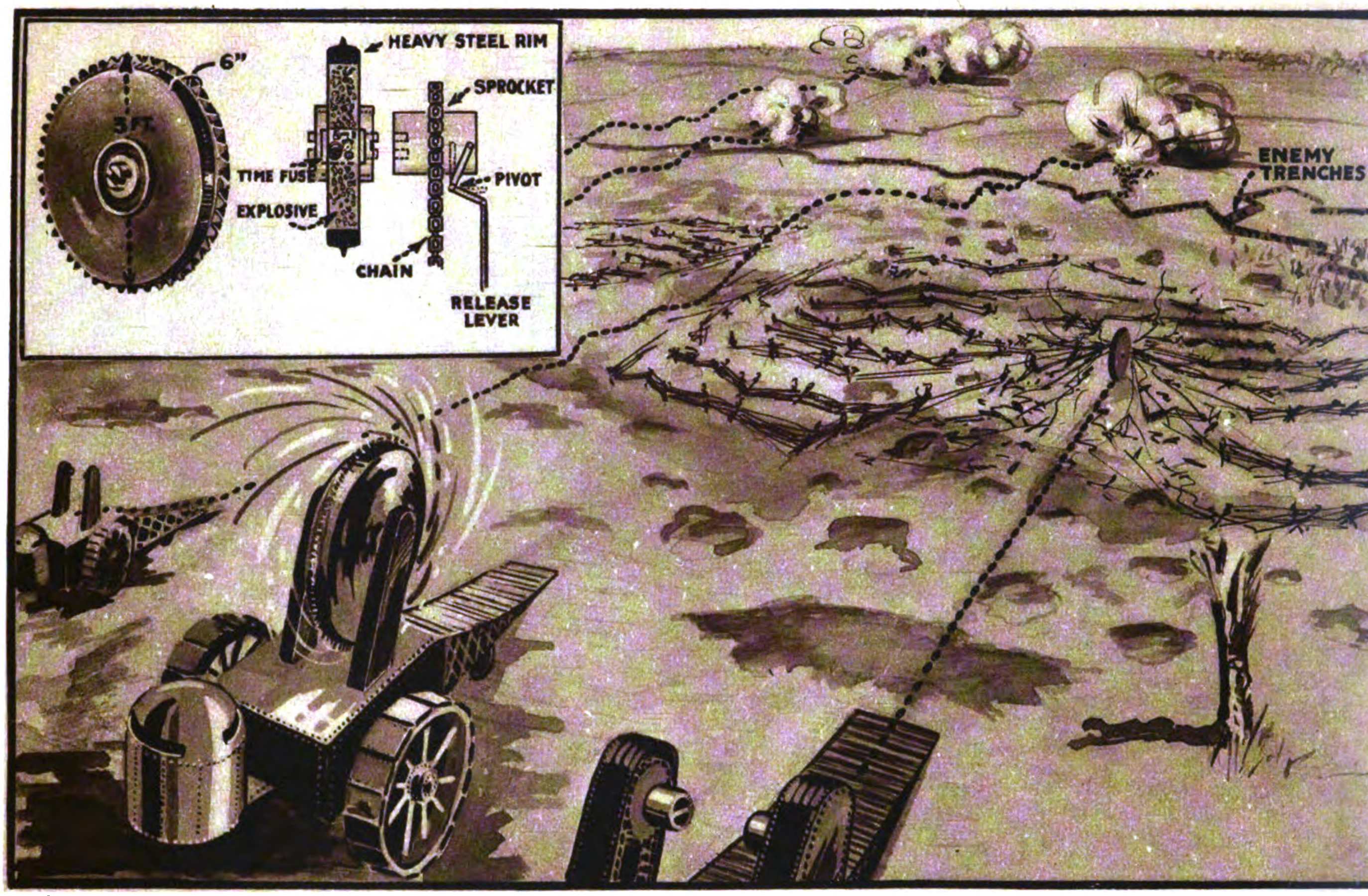
"Without Comment He Picked Up the Spool Numbered One and Placed it on the Spindle. Deftly He Threaded the Wire Thru the Guides, Dropping the Little Loop Over the Hook on the Empty Spool of the Machine. With a Flick of His Finger He Started the Motor and the Wire Fed Evenly Off of Its Containing Spool. From the Horn Came the Strong, Vibrant Voice of a Man. And What an Outpouring of Endearing Terms, What a Wealth of Romance and Feeling Came to Us on That Pleading Voice. Dumbfounded, I Listened. . . ."



A War Invention Recently Disclosed to the Public by Thomas A. Edison, and Which Was Devised by His Son, is the Trench Destroyer Here Illustrated in Action. This Trench Destroyer Was Tested Successfully Under Actual Conditions Over a Large Tract of Ground, and Was to Have Been Adopted by the War Department, but the Armistice Was Signed Before it Had a Chance to Show What it Could Do. A Hollow Steel Disk Filled with High Explosives, and a Fuse Set to Detonate After a Certain Elapsed Time, is Whirled at High Speed on Its Axis, and then Released, When it Tears Thru Barbed Wire Entanglements as if They Were Mere Cobwebs. When it Bursts it Blows a Hole in the Ground Resembling a Giant Shell Crater.

Edison's Son Invents Trench Destroyer

AMERICANS know that Thomas A. Edison produced many important inventions during the World War. Recently while on a visit to his friend, Henry Ford, the well-known automobile manufacturer, Mr. Edison disclosed a novel invention developed by his son, which took the form of a steel disk or wheel filled with explosives, which was rotated at very high speed and then released and which device demonstrated its great value by mowing down barbed wire entanglements, tearing thru walls and trenches, and finally exploding, thanks to a time fuse attached to it, with such violence that everything was leveled within a radius of 150 feet.

"These disk destroyers were designed," said Mr. Edison, "to be dispatched for the German trenches in order to clean them out before a charge, but we never got a chance to use them before the War stopt."

Mr. Edison further explained that successful tests had been made with the disk destroyer on an island in the Key West group. The steel wheel which was to form a compartment for the TNT. or other high explosive, measured about 3 feet in diameter and 6" in thickness. Around the edge was a steel rim made smooth and heavy, but it would seem advisable to place teeth around this rim, so as to more effectively cut thru barbed wire entanglements and fences. A time fuse which could be set to detonate the TNT. after a given number of seconds, served to explode the high explosive after the disk had travelled a predetermined distance.

The steel wheel was arranged to be held on the driving shaft attached to a Ford tractor motor geared to a high ratio. In this fashion, the disk was revolved at a tremendous velocity and when the speed had risen to 35,000 feet per second at the perifery, it was automatically released from the driving shaft by suitable clutches. In front of the tractor there was built a suitably inclined plane down which the revolving wheel sped with lightning-like velocity; from this it fairly flew along, bounding thru the air now and then, like a young lion, as it hit a small hill or knoll. In some of the tests, the whirling disk travelled for two miles, cutting like a buzzsaw thru everything in its path, including in one case 150 feet of wire entanglements, closely set, just as if they had been mere cobwebs. It ate its way thru walls and other impediments until finally the time fuse exploded, the charge blasting a mighty hole in the earth and killing every living thing within a goodly distance.

How Much Mineral Do You Drink?

When you take a drink of water how much mineral matter do you swallow? Dr. W. W. Skinner and J. W. Sale of the *Bureau of Chemistry* of the *Department of Agriculture* have made an investigation of the amount of dissolved mineral matter in the water supplies of seventy of the large cities of the country.

If you are in Oklahoma City, Okla., where the water contains the largest amount of minerals known, you will take in 12.1 grains with every quart. The inhabitants of Atlanta, Ga., enjoy water which contains the smallest amount, 0.2 grain per quart.

Washington water has a comparatively small amount of mineral matter, only 1.5 grains per quart.

This is the first compilation of the figures of mineral composition of the different drinking waters of our large cities, it was announced. The quantity of minerals in water is of interest to physicians, travelers, and certain industries which utilize processes influenced by the dissolved matter. The dissolved mineral matter ordinarily consists chiefly of dissolved limestone, together with smaller quantities of gypsum, common salt, iron, magnesia, etc.

The Psychic Lens

By CARL S. WALLACE

WITH fingers deft from years of practise, Lohr shook the plate loose from the restraining springs of the plate holder and flipped it into the developing bath. Gently rocking the little tray, he watched the creamy emulsion blacken and the faint tracery of outlines form under the magic touch of the chemicals. The red light of the darkroom was feeble, sickly, weird. By it the sides of the tray cast deceptive shadows across the surface of fluid and plate, shadows that bewilder the novice. But, accustomed to the semi-darkness, Lohr followed closely the growing intensity of line, awaiting the instant of perfect development.

Suddenly, with an oath of annoyance, he bent forward to a closer scrutiny of the plate. A little tc the left of the center of the negative a dim outline was forming, as yet a mere misty blotch. He knew that it should not be there. It meant a spoiled plate, and he was very anxious to have this picture perfect.

Disgruntled, he watched sullenly as the blotch grew stronger, brighter. Then, as definite outline came, he gave a cry of surprise, of incredulous amazement. Ceasing his methodical rocking, he brought the tray closer to the glowing red bulb, expecting to find himself the victim of an illusion. Surely he was being deceived by a queer prank of shadows!

The stronger light seemed only to verify his first impression. With a muttered imprecation he jerked the plate from the bath and dropped it into the hypo. Impatiently he waited during the brief interval necessary to render the negative impervious to strong light. Then he switched on the white incandescent.

Holding the dripping glass between his eyes and the light, he stared stupidly. Charmingly backgrounded by the strip of country road he discerned the graceful outlines of Miss Meredith's figure. A little to the left of her, almost as sharply defined, stood another female figure, equally graceful. And when he had made that exposure there had been no one else in the camera's focus!

A long moment he gazed at the image of the intruder. Then he carefully slid the plate back into the fixing bath and sank into the one chair his darkroom boasted. Mentally he reviewed in detail the circumstances of the exposure. Made only that afternoon, the events were quite clear. He had taken pains in posing Miss Meredith, for the picturesque bit of country road had appealed to him, had cried out for an artistic rendition of the human figure that was to embellish it. He had wanted her to seem as if she belonged to the scene, he wished the surroundings to indicate a definite reason for her presence, to blend his subject and her environment into an harmonious whole. It had been tedious work, and he recalled the many focusings and changes. They had been uninterrupted. He was quite sure that no one had past before the camera prior to exposure, and the shutter had been closed before he slipped the plate holder into place.

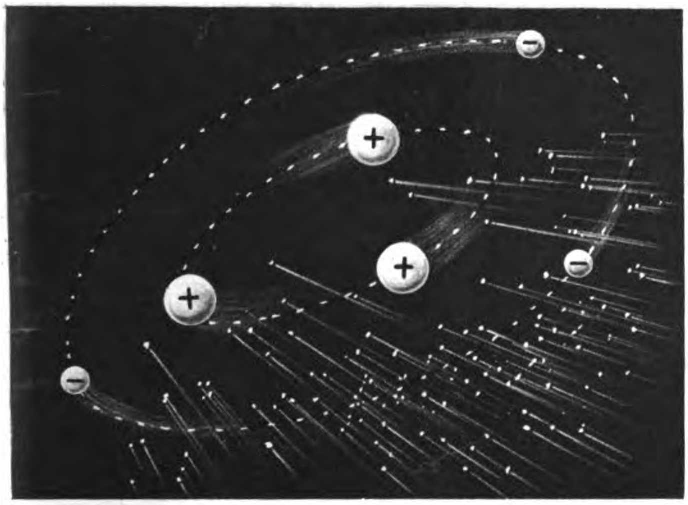
There had been spectators. Three girls, from a nearby farm no doubt, had looked on with interest during the posing. But they had stood well to one side. He remembered making sure that they were well out of the field of view before he had pressed the bulb. At no time, in fact, had they been within range of the camera's lens, and he remembered how grateful he had been for their silence and unobtrusiveness. There had been no glittering wall, nothing to play the mirror. It was impossible that he had photographed a reflection.

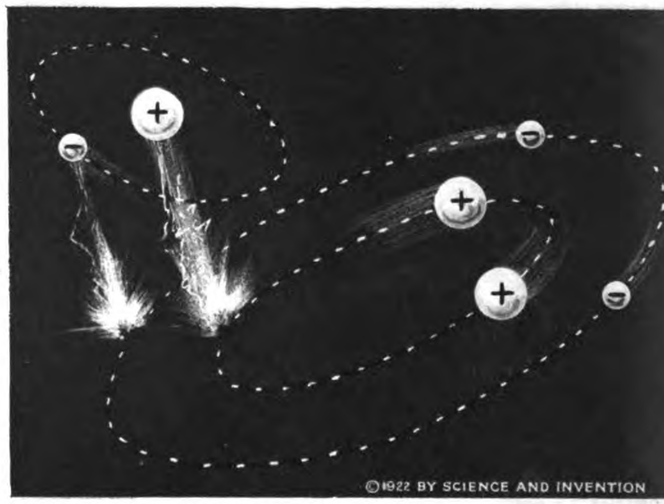
The theory of double exposure occurred to him, but he was forced to quickly dis-

(*Continued on page 1087*)

"Holding the Dripping Glass Between His Eyes and the Light, He Stared Stupidly. Charmingly Backgrounded by the Strip of Country Road, He Discerned the Graceful Outlines of Miss Meredith's Figure. A Little to the Left of Her, Almost as Sharply Defined, Stood Another Female Figure, Equally Graceful. And When He Had Made That Exposure There Had Been No One Else in the Camera's Focus! . . ."

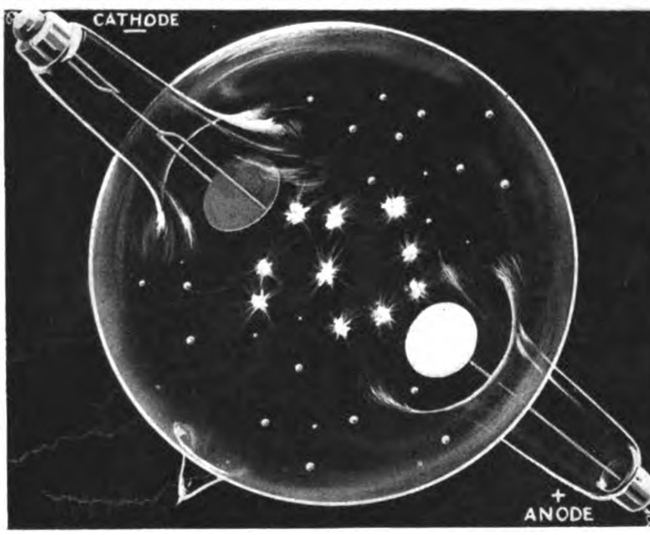
Ten Million Horse-Power in a Pebble





Picture Above Shows Nitrogen Atom (Three Positive Suns and Three Negative Planets) in a Field of Electronic Hail. New Atoms Are Born When Some of the Electrons Are Knocked Out of Their Orbits, as Shown in the Picture at the Right.

Miniature Atomic Worlds in the Making Would Be Seen by the Scientist if He Had a Microscope Sufficiently Powerful to View the Electrons and Nuclei of Atoms as They Collide and Whirl Around Their Orbits at Terrific Velocities. The Picture Above Shows the Formation of a New Element or a Helium Atom, Due to a Positive Particle and a Negative Carrier or Electron Being Knocked Out of Their Orbits in a Nitrogen Atom by Electronic Bombardment; the Result Now Being a Helium and a Hydrogen Atom.



Several Things Happen in an Evacuated Glass Tube, Such as Shown Below at Right, When an Electric Discharge is Past Thru it. The Illustration Herewith Shows the Bursting of Atoms in a Cathode Ray Tube Due to Collisions of Free-flying Electrons.

TOWARDS the end of the last century, the English physicist Sir Oliver Lodge, made public the astonishing theory that all ethereal space was filled with energy to the bursting point, that every cubic centimeter of space contained about 40 billion horse-power hours of energy. The theory remained a theory, upheld by some scientists and contested by others.

The century came to an end, and brought with it the discovery of radio-active substances. The subtle researches of Mme. Curie, of Rutherford, and of other scientists, showed that a gram of the new mysterious element, radium, in the course of its changing into common lead, gave out the enormous quantity of 3 million horse-power hours in the form of heat and electric radiation. Here one came suddenly against a definite quantity of energy of the same order of magnitude which Lodge had predicted.

If the sun contains proportionately as much radio-active substance as the earth, the riddle of its inexhaustible radiation of energy undiminished for thousands of years, is solved. For then the heat of the sun would be born new every hour after the emanation of the material into nothingness; and all theories of an approaching cooling of the sun, and of an accompanying freezing of the earth, with the death of mankind by coid, would fall away.

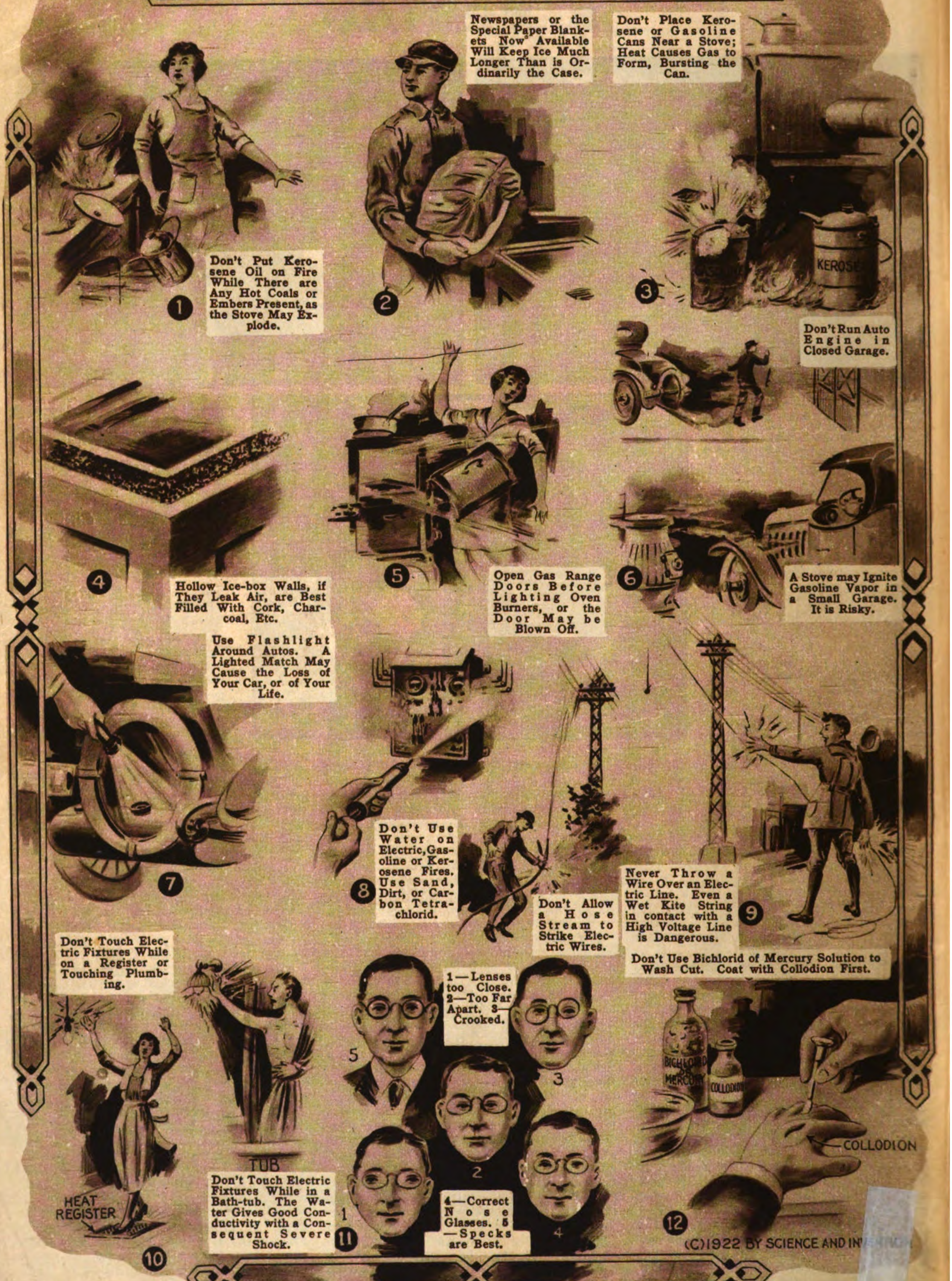
The investigation went further. It touched upon the physical basic relations of space and time, and produced in the first ten years of the new century the relativity theory, linked with the name of Einstein.

The basic laws of the relations of energy and material go into the wider and greater law, according to which energy and matter are only various forms of some unknown third entity. Matter can disappear from the world without leaving a trace and turn itself by a fixt law of proportion into anything. Energy can convert itself again into mass. A gram of any given mass, it may be water or air, it may be sand or garden earth, according to the new theory, must, on disappearing from this world, leave an amount of energy of 34 million horse-power hours; and another riddle of the world approaches its solution. What becomes of the inconceivably great amount of energy which the many thousand suns of our milky way ceaselessly radiate into endless space? We are face to face with the possibility of an answer. Somewhere in endless icy distance the energy will again turn itself into matter, perhaps forming itself into luminous spiral nebulae evolving new world systems. Increasing knowledge solves the hitherto unsolved riddles of the world. The atom, so long regarded as the smallest and indivisible particle of matter, reveals itself as a complicated structure, a complete sun and planet system of incredible smallness. An electron which is a quantum of negative electricity rotates about an elementary quantum of positive electricity, and we then have the hydrogen atom. The electron whirls around its central star six billion times in every second, bound to it by enormous stress. Ever more complicated and more involved as these endlessly small world systems become, the greater the atomic weight of the matter involved in them is. Hundreds of planets, in dozens of orbits, whirl around the positive central system of the atom of uranium. The structure is here so complicated that it does not remain stable, but in the course of millions of years grows simpler by the shooting out of single suns. This gives us the spontaneous breaking down of these radio-active substances, in virtue of which atomic energy is set free in what was formerly termed colossal quantity.

But what means do we possess to get control of this enormously powerful source of atomic energy for our own desires and uses? If the hypothesis is correct, then free electrons which one directs with approximately the speed of light against the atomic world systems, must bring about a catastrophe, such as a swarm of great comets would cause which suddenly burst into our sun's orbit. Single elementary quantums must be torn out of the system, just as an enormous comet would draw the earth or Jupiter out of its orbit, and might carry it off with itself.

That is the conclusion of theory, and experiment has wonderfully confirmed it. In the evacuated cathode tube the atomic structure of nitrogen has been broken down into the simpler system of hydrogen and helium. The atomic structure of chlorine has been broken down into two new hitherto unknown atoms. So far have we gone to-day. We only hope that our age will find the way which leads from the first breaking down of an atom by accident to the definite control and utilization of the new sources of energy; a supply of energy which a handful of dull, worthless stones broken into nothingness gives us may amount to hours of horse-power, for which to-day hundreds of miners must break down coal for months at a time in danger and darkness; a world in which energy in excess is at our command. (Excerpted from *"Die Woche."*)

HOUSEHOLD SCIENCE



Household Science

By H. WINFIELD SECOR

ASSOCIATE MEMBER AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

IN the accompanying illustrations some ordinary yet frequently disregarded scientific facts, which concern our daily life are vividly shown. How many times have you heard the admonishment not to pour kerosene oil on a stove fire? Dozens of times possibly, but if you are the average housekeeper, you will always try it "just once more." If you must put kerosene oil on a fire, care should be taken to pour out a small quantity, not more than a tablespoonful in a cup or can, and this may be thrown on the paper and kindling, but always before the fire is lighted. Danger from pouring kerosene upon a fire is caused usually in one of two ways: either by throwing too much kerosene into the fire, which will cause the lids to be blown off, starting a conflagration, perhaps, by throwing the hot brands or coal on the floor; or again, the oil may ignite when poured from the spout of the oil can, and follow up the spout, and before one knows it the can may explode, due to the heat and gas formed within the can, and the clothes catch afire. Put the oil on first, if you must use it; but use a small quantity, poured from a cup. Keep the oil can at a distance from the stove at all times.

HOW NEWSPAPERS REDUCE ICE BILL

As a matter of economy it is well to know that a cake of ice may be made to last from two to four times as long as it does normally, by wrapping newspapers or other paper around it. Several thicknesses of paper will serve to keep the air currents away from the ice, and this helps admirably, especially in the case of a poorly insulated ice-box, or one that has no cork or felt filling or tight air pockets surrounding the ice chamber. If the ice is to be kept in an open container, such as a tub or boiler, it should be wrapt all around tightly, but if it is to keep victuals cold in an ice-box, then the paper may be placed over the top and sides only. There are paper ice blankets now on the market sold for this very purpose of improving the economy on the household ice bill.

HEAT NEAR GASOLINE TANK DANGEROUS

Gasoline as well as ether, kerosene, et cetera, are more or less dangerous and liable to form gas and ignite, or if the vapor mixes with the air they may explode in their container, if a certain amount of heat is applied to these containers. It is dangerous for one thing, to place a gasoline can behind or near a stove. If the stove throws a considerable amount of heat, there may be a sufficient amount of gas formed in the gasoline can by vaporization of the gasoline to ignite. Most people do not understand why gasoline is so liable to catch fire without an open flame or extreme heat in its vicinity, but a little experimenting will soon convince them of the prolific vaporizing faculty of gasoline, just to mention this one liquid.

The writer remembers seeing a striking example of this, when a piece of cotton waste soaked with gasoline, was ignited by an electric spark three feet away. The explanation was, of course, that due to a draft of air blowing thru a window over the gasoline-soaked waste, the gasoline started to vaporize and formed an easily ignitable mixture with the air, so that when the spark was struck the piece of waste immediately jumped into flames. The waste was picked up with two long sticks and thrown out of a nearby window. This instance took place in an electrical repair shop situated alongside of a police station. Five policemen were sunning themselves in the narrow street running between the shop and the police station, when the blazing waste was thrown out of the window, and it landed right in front of them. There was some scramble for the door on the part of the policemen, and they probably thought at first that it was a bomb or something about to explode.

There is not as much danger, of course, with kerosene, which vaporizes much more slowly than gasoline, except under certain conditions. It is very dangerous to have a flame near ether, as it vaporizes quickly, and alcohol is also a prolific vaporizer, as you have probably noticed when rubbing this liquid on the muscles of the arm or over the hand, for rheumatism, etc., when the rapid evaporation of the alcohol into the air caused that extremely cold feeling.

> **$50.00 ELECTRIC ICE SKATE CONTEST POSTPONED**
>
> **The $50.00 prize contest described at length, with illustrations and details in our January number, has had to be postponed as to the closing date, for the reason that none of our readers have been able to get the materials together and build the complete pair of electric ice skates.**
>
> **We are, therefore, postponing the closing date of this electric ice skate contest until March 20th, which will give ample time to build the skates and try them out. We want to hear how you make out with them as regards the speed and the size of motor and storage battery employed. The first prize in this contest is $35.00 for the best set of photographs and short article of 300 words or less, showing how the builder constructed the skates and telling the results obtained with them. A second prize of $15.00 will be paid for the second best article. The skates must be full size, as mentioned in our announcement in the January issue, and not a small model affair. Address all manuscripts to EDITOR, ELECTRIC ICE SKATES.**

WHY SOME ICE-BOXES ARE WORTHLESS

In one of the accompanying illustrations the trick of improving ice-boxes by filling the space between the inner and outer walls of the ice compartment with charcoal, cork, sawdust or mineral wool, is shown. Some of the better class of ice-boxes to-day are made with hollow air pockets surrounding the ice compartment, but these must be absolutely air-tight to be of any value. The writer remembers distinctly several ice-boxes which he had experience with, which were notorious ice wasters, and upon investigation the reason proved to be that they were cheaply built with alleged air pockets, and these were not air-tight at all, permitting the warm air from the room to seep thru them, which, of course, helped to melt the ice at a very unhealthy rate. This trouble was overcome by removing the wooden top strips covering these pockets, and filling the same with one of the aforementioned heat insulators, such as granulated cork, sawdust, etc. The better class ice-boxes of to-morrow will be made undoubtedly with vacuum pockets, thermos bottle fashion, surrounding them, when a cake of ice will last about four times as long as it does now.

There are some very interesting ice chests and ice-cream containers now being built by an American concern, in which balsa-wood, which is a much better heat insulator than cork, is employed. The balsa wood surrounding the ice-cream or ice compartment, is 4 to 5 inches thick, but not heavy for it is considerably lighter than cork. The balsa wood ice-cream container does not require any ice.

DANGER WITH GAS STOVES.

Gas ranges and stoves are used by the thousand all over the country, and now and then one hears of an accident with one of these heating and cooking devices, which could have been avoided with a little care and forethought. One of the accidents with which the writer has frequently come in contact, is that where the oven of a gas range has exploded, blowing the door or doors off the hinges, and in one case, knocking down the lady who had lighted the stove. Now how did this accident happen, you ask? Very simply. Instead of taking the precaution to first open the door, when the odor of gas would have been instantly detected, this was not done, and the lighted match was applied to the pilot or starting burner, from the outside of the range. Unbeknown to the operator, one of the oven burner valves had become partly turned on and the oven had filled with gas. When the pilot burner was lighted, this ignited the mixture of air and gas in the oven, with the resulting explosion. The *safety maxim* here is "to open the door and leave it open for a few minutes, before lighting the oven burners"; or it may be left open while lighting it for that matter, and closed afterward.

Some people always light gas stoves or gas radiators in such a way that there is a loud boom! which scares them half to death, and in some cases a flash of flame leaps from the heater or stove, and may even set their clothes afire. This is invariably caused by bone-headedly turning the gas valve on and allowing the burner chamber to fill with gas, before applying the lighted match. The lighted match should be applied thru the ignition hole at practically *the same time the valve is turned on,* when there will be no explosion. The writer never has any trouble once in a hundred times by following this rule. Sometimes this popping back will be caused by the air mixer being out of adjustment.

CONCERNING STOVES IN AUTO GARAGES

Practically every owner of an automobile has been cautioned by those who are in a position to know, not to use or have an open flame of any kind near the car, for the reason that there may be, and usually is, a slight amount of gasoline vapor present, which may ignite. It is dangerous, therefore, in the first premises, to have any kind of open flame, such as a coal, oil, or gas stove in a garage, especially in a small garage, and then trust this stove over night. Some people do it and get away with it, including quite a few of the writer's friends, but it is a ticklish business, especially when no fire insurance is carried on the car. Even electric heaters are dangerous in a small garage if left on over night, unless it is one of those carburetor and engine heaters, which do not glow red, but whose heating coils remain dark.

If it is desired to use a 400 or 600 watt electric reflector heater, the danger of igniting any gasoline vapor from the incandescent heating coil in the focus of the

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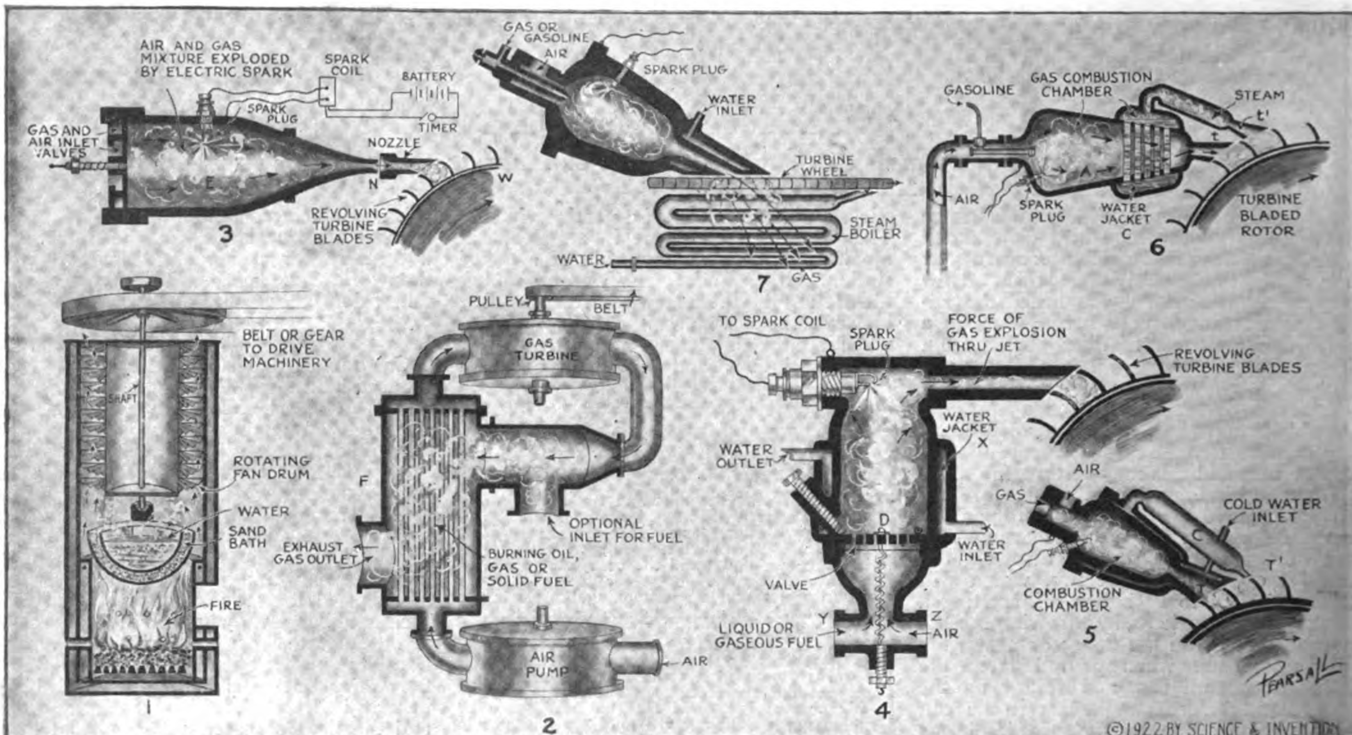

This Article on Gas Turbines by Prof. Sloane Will Undoubtedly Be of Great Interest to Our Readers, As Very Little Has Been Written on This Greatly Misunderstood Engine. The Gas Turbine Operates With Natural or Artificial Gas, or Else With Gasoline, Properly Vaporized. Fig. 1 Shows a Very Early Design of Gas Turbine, Which is More Like a Toy than Anything Else. Fig. 2 Shows a Turbine Operated by Hot Air. Fig. 3 Illustrates the Discharge Nozzle of a Simple Explosion Type Gas Turbine. Fig. 4 Shows the Combustion Chamber and Inlet of the Karavodine Turbine. Fig. 5 Shows Gas Turbine With Auxiliary Steam Jet, While Fig. 6 Shows a Combustion Chamber, Traversed by Boiler Water Tubes Generating Steam to Feed Thru an Auxiliary Jet. Fig. 7 Shows a Variation of This Gasoline Turbine Jet.

How Gas Turbines Work

Prof. T. O'CONOR SLOANE, Ph.D., LL.D.

LOVERS of the old time history of invention in tracing back the development of the steam turbine refer to to the old smoke jack, which was the horizontal windmill installed in a chimney and turned by the uprising draft of air. This is assumed to be a sort of gas turbine. It was used in old days for turning the spit, when meat was roasted instead of being baked as is usually done nowadays. Then we come down to something more tangible in the shape of John Barber's English patent of 1791. Like many English patents it is rather hard to understand, and the drawings are not very good, but it is taken as representing the first patented gas turbine. Then we come to Dumbell's gas turbine of a somewhat later date, shown in Fig. 1, which in a way resembles the smoke jack. The picture shows a rotating horizontal mill wheel or drum with a multiplicity of wings on its perifery to be acted on by the draft from the fire. Above the fire he has a boiler in a sort of sand bath arrangement of no particular utility from the present-day point of view.

Coming down to more modern times, the diagram Fig. 2 shows the elements of a turbine actuated by hot air. The pump at the bottom pumps air thru the tubular boiler-like structure F. Within this is a furnace, so that a cubic foot of air pumped into it emerges as several cubic feet of air from the top. The blast whirls the turbine around and then goes into the furnace surrounding the tubes, and in the furnace heats and burns a combustible which may be oil or may be a solid fuel. This, however, is hardly the conception of a true gas turbine.

Fig. 3 shows the discharge nozzle of a simple explosion type gas turbine. This is a very curious machine. Gas and air are past into the chamber E, and are exploded by a spark between the electrodes I. The hot gas from the explosion rushes out, blowing against the turbine, whose wings are indicated at W. The wheel whirls around and at the end of the explosion a slight vacuum is created by the inertia of the outrushing gases. This draws air and fuel by inspiration into the chamber E, from their respective pipes, and another explosion takes place, followed by a slight vacuum. The pressure is supposed to be about five pounds to the square inch above, and the vacuum about one pound below the atmospheric pressure. It is said that this turbine will give thirty-eight explosions a second, and as much as 12,000 revolutions per minute are assigned to the wheel with a periferal speed of 258 feet a second. Its efficiency is put very low, less than 3 per cent. Yet in the descriptions of it one can read between the lines that it appeals to the engineer. Its utter simplicity and absence of any pumping arrangement, and its automatic action, are quite impressive.

Another construction of combustion chamber and inlet is shown in Fig. 4, the Karavodine explosion chamber. Y and Z are the inlets for fuel and air, and at X is indicated the water jacket. This, with the turbine wheel, also works automatically, the valve D rising and falling as required.

The more practical type of turbine includes a pump to force air into the combustion chamber and some arrangement for introducing the fuel, usually also a pump. The combustion chamber gets red hot, and if cooled by a water jacket will produce steam, and one of our illustrations, Fig. 5, shows the combustion chamber with its jet T and water jacket receiving cold water thru the pipe as shown, and delivering steam thru the receptacle C, whence it is blown upon the wings of the turbine so as to economize that much energy.

A variation of the above is shown in the next cut, Fig. 6, where the combustion chamber is traversed by tubes *a*, which arrangement virtually constitutes a water tube boiler, and which delivers steam thru the jet *t'* upon the wings of the turbine. A further variation on this theme is shown in the jet in the next picture, Fig. 7, where the hot gases from the turbine are made to traverse the outside of a serpentine boiler, generating steam therein which blows against the wings of the turbine in front of the gas blast.

It is fair to say that the problem is yet unsolved. Many turbines have been constructed, but none have come into very extensive use as yet, and the field for invention still lies fallow. For many years inventors have been striving to produce the rotary steam engine, and lately have attained some slight degree of success. Years of work have brought the steam turbine really to perfection, and it is used on a very large scale for high powers.

If one may venture to summarize the difficulties of the gas turbine, the result may be put in three or four divisions. The high heat is very hard on the wings of the turbine, but by using high speed steel this trouble has been overcome to some extent. The escaping gases after the combustion do not bear as favorable a ratio to the incoming air and fuel, as exists in the ratio of water to steam in the steam engine. A cubic inch of water pumped into the boiler of a steam engine will give hundreds of cubic inches of steam, the quantity depending on the pressure at which it is measured, but no such favorable ratio exists in the case of the gas turbine. Therefore, one of the great desiderata is an efficient rotary pump to force the air in. Finally, unless the abnormally high heat of the explosion is

(*Continued on page* 1075)

Electric Desk and Auto Clock

Back in 1915 a man became dissatisfied with the service he was getting from his clocks. He had clocks of various kinds in his home, his automobile and his office —and they were as good clocks as he could buy. The largest cause for dissatisfaction was the ever-present necessity for winding—some needed it each day—but they all ran down sometimes. This man happened to be A. E. Keith, the inventor of the automatic telephone and a world famous electrical genius. He made a clock that not only needs no winding, but which keeps remarkably accurate time. As his experiments progressed he not only did away with main springs and their temperamental troubles, but he eradicated the bugaboo of isochronal adjustment. This is the adjustment for the varying power supplied the movement by the main spring—strong when fully wound and gradually diminished to nothing when the spring is completely unwound—the most difficult to make.

Mr. Keith simplified the entire movement—made it foolproof, tested it thoroly in his laboratory, and then put it in a medium priced car in everyday use. That car during the next five years covered 100,000 miles of city and country roads and was subjected to the strain of long tours. The clock kept running—kept accurate time—without winding or attention, and other models have proved equally perfect in other cars.

The high-grade jeweled watch movement is remarkable for its accuracy. The automobile models secure their electric current from the car battery, while the other models contain a small dry cell sufficient to operate the movement for over a year, when they are easily replaced at a very low cost. The amount of current required is so small that it is impossible to measure it with ordinary laboratory instruments.

Briefly, the electric mechanism operates as follows:

The current in all models except the automobile clock is supplied by a dry

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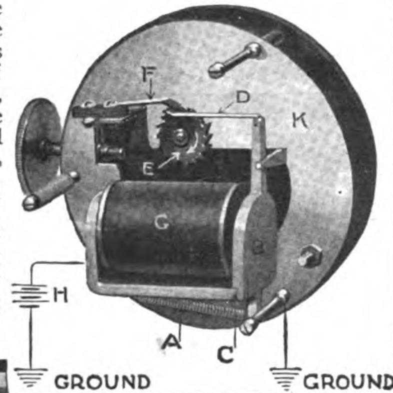
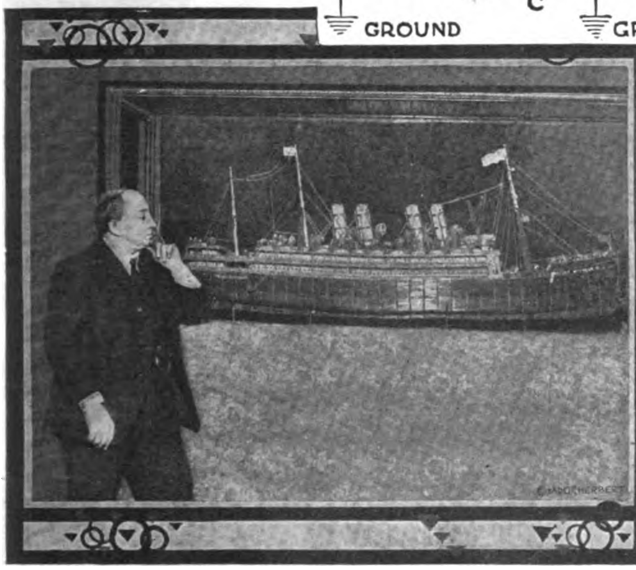


Two Views at Right Show New Electric Desk or Library Clock of Small Size Which is Operated From a Flashlight Battery. The Clock Comes in Different Styles From $35.00 Up, But it Requires No Winding, Thanks to the Dry Battery Which Lasts One Year or More. It is Also Supplied for Autos to Operate From the Car Battery.



Wonderful Model of Ocean Steamship Below at Left is Built All of Straw, and is Over 6 Feet in Length. It is Valued at $5,000.

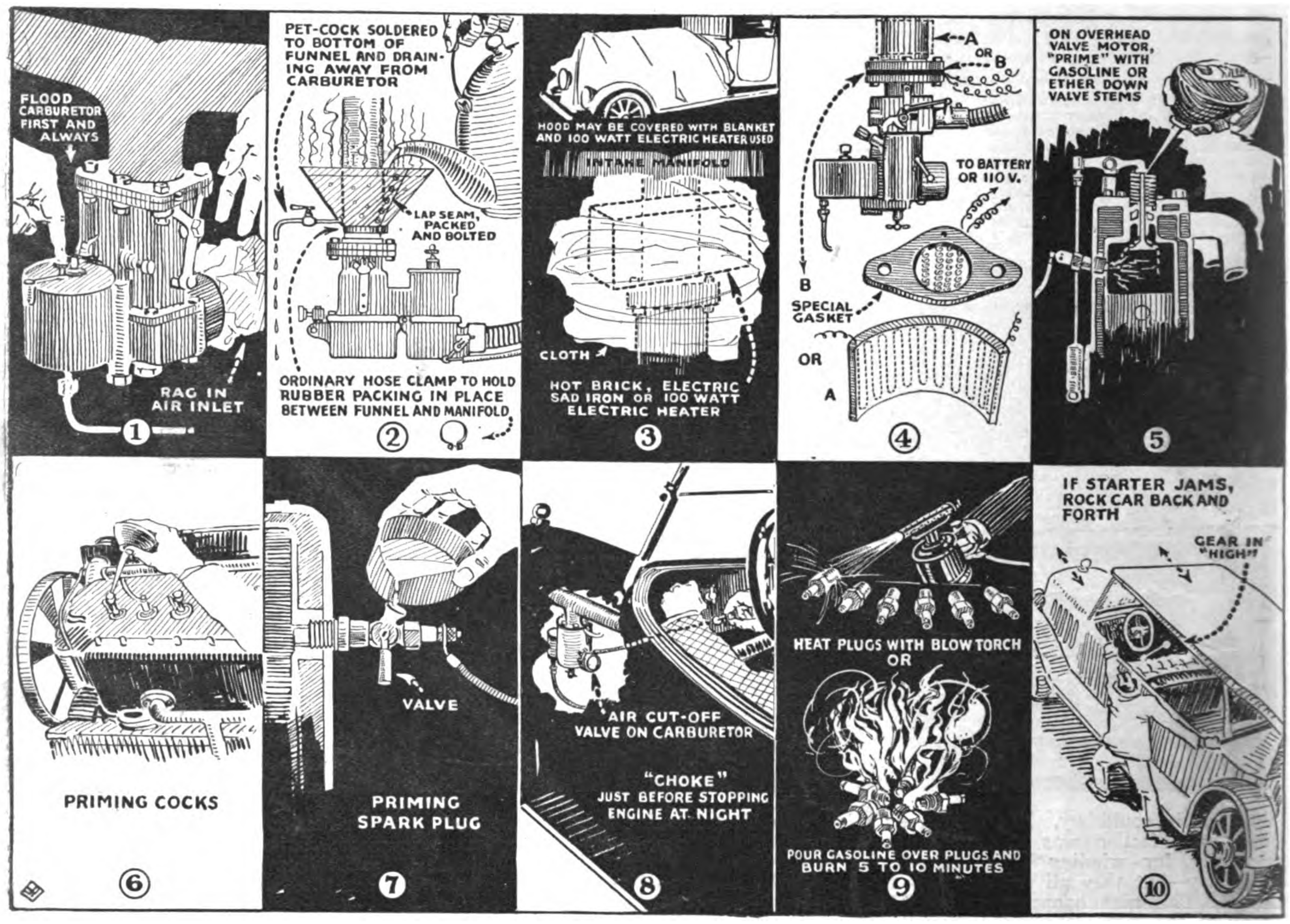
At Last We Have the All Metal Airplane Propeller, and it is, Moreover, Reversible, So That Planes Can Be Stopt in a Short Distance.

Had Your Portrait Typewritten?

Mr. Hobart Reese, of Washington, D. C., has gained considerable fame for himself by the remarkable likenesses of famous people which he hammers out on his typewriter. Mr. Reese would make an able detective, wouldn't he? He could type a likeness of a visitor on his machine unbeknown to the party before him. The three celebrities shown to the right are President Harding, Mary Pickford and Douglas Fairbanks, respectively. It is a little difficult perhaps, at first, to believe that an ordinary typewriter could be used to turn out such a portrait.

The Latest in Portraits—Typed While You Wait, as it Were. President Harding, Mary Pickford and Douglas Fairbanks Are Shown in True Likeness Here in Mr. Hobart Reese's Novel Creation—Typewritten Portraits. To Analyze These Pictures Use a Magnifying Glass to Ascertain the Letters Used.

Starting Autos in Cold Weather



In Cold Weather, Even in the Spring and Fall, When the Damp, Chilly Days of Medium Temperature Are with Us, it is Often Difficult to Start a Gasoline Engine. Several Useful Suggestions Which the Author of This Article Has Tried Personally, Are Shown Above. The Three Best Tricks in Starting a Cold or Stubborn Auto Engine are Probably: 1—To Prime the Cylinders or Major Number of Them with Gasoline; 2—Apply Heat to the Carburetor and Intake Manifold by Pouring Hot Water Over Them and, 3—Keeping at Least the Engine Warm Thru Cold Nights. There is a New Kerosene Heater on the Market Which is Guaranteed to be Fire-proof, and Built Especially for Heating Auto Engines Thru the Night. A Radiant 600-Watt Electric Heater and Copper Reflector Placed in Front of the Radiator for Half an Hour or so Before Starting, Will Heat the Radiator and Also the Engine, and Help to Start a Stubborn Engine. A Piece of Copper or Brass Gauze, No. 24 Gage, is Best Placed Over the Wire Guard, so as to Entirely Enclose the Heater; no Gasoline Vapor Can Now be Ignited. This Arrangement Corresponds to the Principle on Which the Miner's Safety Oil Lamp Operates.

SOME automobile engines are more stubborn than others to start in cold weather and with some cars it is quite a problem to get the engine started on a cold winter morning, particularly where the car has leaky valve stems and a poor or worn out carburetor, or badly worn cylinders. Some of the hints and ideas illustrated herewith will be found useful, as experience proves, even in the case of many new cars.

Possibly one of the oldest tricks known to motorists in order to start a stubborn engine at any time, whether in cold or warm weather, is to *prime* it. Some engines have priming valves or pet-cocks on them which can be opened and a little gasoline or ether squirted into these valves by means of an oil can. Where priming cocks are not provided and this method is found the best for a stubborn engine, priming spark plugs may be installed in the major portion of the cylinders which will enable some gasoline or ether to be injected into the cylinders for starting. They cost but little more than the ordinary spark plug. Engines having overhead valves may be primed by applying some gasoline or ether down over the intake valve stems. It is best after the engine has been started to put a little oil on the valve stems as they may stick, the gasoline having the effect of cutting the grease and oil off again.

Next we have in the bag of tricks for starting in cold weather, the panacea of applying heat to the carburetor or intake manifold. As the accompanying drawings show, there are several ways in which heat can be very effectively used to aid in vaporizing the gasoline, which will not vaporize when the carburetor and engine are cold, until the engine has run for five or ten minutes and warmed up. Pouring hot water over the intake manifold is an old dodge, and it is best to build a funnel around the intake pipe where it leaves the carburetor, so that this water can be retained and then emptied by means of a pet-cock, or else a piece of brass pipe should be soldered in the bottom of the funnel surrounding the pipe, so that the water drains off below the carburetor, and not one drop of it will get into the gasoline; it will raise some mischief if it does. An electric grid or quick-start vaporizer is supplied by one manufacturer, current for the heating coils being supplied from the car storage battery or else from dry cells. This intake manifold heater is made in the form of a gasket about ¼" thick and is placed between the flanges on the pipe connecting the carburetor with the intake manifold, and the bolts are then replaced and tightened up. Another kind of an electric intake heater is made in the form of a coil to surround the intake pipe, and this is likewise supplied with current from the car battery, or it may be designed to be operated from 110 volts A. C. or D. C., so as to be supplied with current from the lighting circuit in the garage.

A standard electric carburetor and engine heater is available on the market which appliance consumes but 100 watts. This heater is designed to be used to keep the engine and carburetor warm thru the night in a cold garage, it being necessary to place two or three blankets all around the engine in order to retain the heat and cause it to accumulate and thus keep the engine compartment warm. A better way would seem to be, from the writer's experience, to place this electric heater (which, by the way, stays dark and does not become incandescent, which would make it liable to ignite any free gasoline vapor), alongside of the intake manifold just above the carburetor, and then to cover over the carburetor and heater with a piece of carpet, or, better still, asbestos cloth, in order to retain the heat more effectively.

(*Continued on page* 1075)

Snow Crystals

THERE are in Nature a number of substances which form crystals, and it is very wonderful how exactly these crystals obey strict mathematical laws. The section of a quartz crystal is a perfect hexagon, with the angles mathematically true. It is interesting to observe that the hexagon occurs elsewhere in Nature. It is present in great abundance and almost infinite multiplication in the combs of the beehive; the section of each cell is the hexagon. Again, if a man places the tip of the fingers together, holding the arms horizontally in front of him and keeping the hands straight, he will form the contour of a hexagon, an angle at each wrist, an angle at each elbow and an angle at each shoulder, and one theory is that it is by a similiar use of his legs that the bee gets the shape of the cell.

Quartz crystals make one of the most beautiful exhibitions of hexagonal forms on a large scale, but almost everything in the way of crystallization on a large scale must yield in beauty to the almost microscopic *snow crystals*. These are formed by the freezing of water vapor. If the water vapor, which is really water in the condition of gas, is gradually cooled, it first forms a liquid which is simple water. On further cooling it forms ice, a solid. But if the vapor of water mixed with air as in our atmosphere is exposed to sudden freezing, it passes directly from the gaseous to the solid state and forms snow.

The first effect is to produce minute crystals, and these crystals consolidate very lightly and form the slow descending snow flakes. When examined with a microscope, the crystals of snow always show the hexagon aspect, and long ago, under the microscope or magnifying glass were found to be most beautiful objects. They form little stars of quite elaborate design and surpass in symmetry and complexity almost any inorganic structure. They have long been a favorite object to be drawn by hand, but now photography is called in and the somewhat difficult operation of taking photographs of the fast vanishing crystals is often carried out quite successfully. The crystals are collected on a black card so that they can be seen, are sorted out, and good ones are transferred to a glass slide for examination under a microscope.

The observer must be willing to work in the cold, for it is obvious that the least rise of temperature will melt the snow. He must not breathe upon the little stars of ice, for that of course would melt them. One or more are carefully disposed upon the glass slide with a feather; the microscope which is arranged for photography is focust upon it, and an exposure of some seconds to perhaps several minutes, according to the conditions of light, is given.

The star-shaped crystals have six rays; if needles are formed, which sometimes happens in very cold weather, they end in six-sided pyramids; and if little ice flakes appear, which also form under some conditions, they too are subject to the law of the hexagon, and are six-sided. If the formation of the crystals has not been interfered with by any condition of the upper atmosphere, the little stars will be found to be perfectly symmetrical, each of the six radiating members corresponding exactly in shape with its companions. The extreme regularity of the flake, every specimen being an accumulation of crystals, is very remarkable. In the mineral world aggregations of crystals are very

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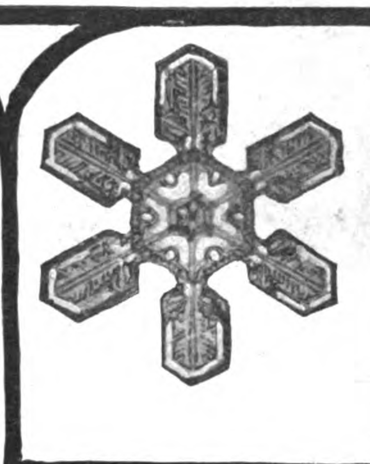
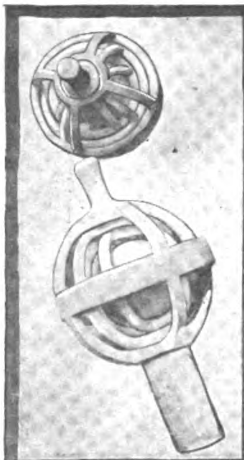
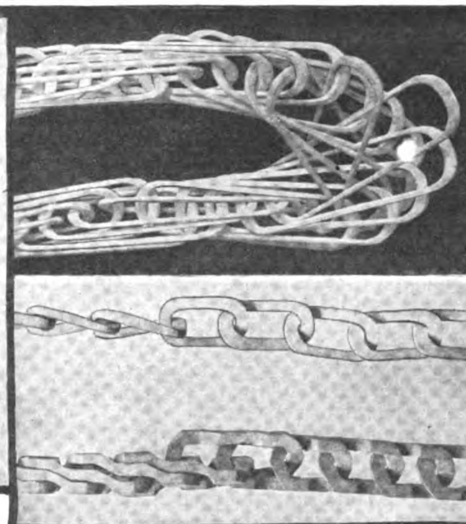
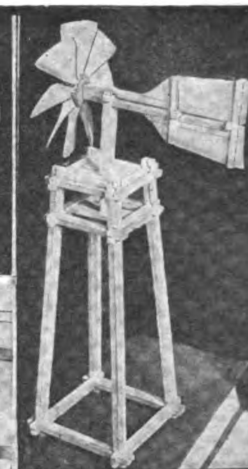
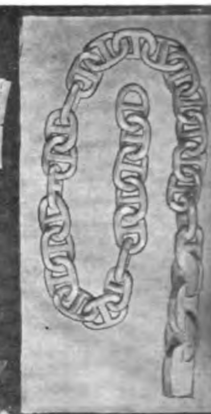


The Accompanying Six Photos Show Some of the True Wonders of Nature—Snow Crystals As They Appear Under the Microscope. They Must Be Photographed, of Course, Out-of-Doors, or Else They Would Melt if Brought Into the House and the Beautiful Designs Would Be Lost. The First Effect in the Upper Atmosphere is to Produce Minute Crystals and These Crystals Consolidate Very Lightly and Form the Slow Descending Snow Flakes. When Examined With a Microscope, the Crystals of Snow Always Show the Hexagon Aspect, and Long Ago, Under the Microscope or Magnifying Glass, Were Found To Be Most Beautiful Objects.

Snow Crystals Form Little Stars of Elaborate Design and Surpass in Symmetry and Complexity Almost Any Inorganic Structure. The Operator Must Not Breathe Upon the Little Stars of Ice, For That of Course Would Melt Them. One or More Are Carefully Disposed Upon the Glass Slide With a Feather; the Microscope Which is Arranged for Photography is Focust Upon It and an Exposure of Some Seconds to Perhaps Several Minutes, According to the Conditions of Light, is Given, and the Negative is Thus Secured.

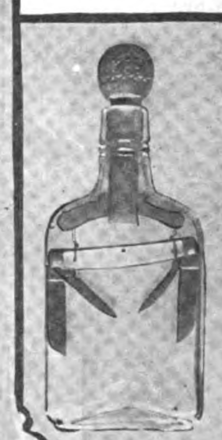


Figs. 4 and 8 Above, Show Respectively Triple Top Carved From One Piece of Wood With a Pocket-Knife, and a Miniature Wooden Barrel Assembled Inside of a Wine Bottle. The Two Top Center Views Show Excellent Examples of Carved Wood Chains, the Lower Chain Representing Fig. 2 in the Text. The Wooden Wind Mill to the Right is Fig. 1 of the Author's Description and Represents a Very Fine Piece of Work, No Nails or Glue Being Used in its Assembly, Simply Locked Corner Joints.

In the Lower Row of Pictures, We Have at the Extreme Left Figs. 6 and 10 of the Author's Text, Showing Respectively Glass Beads Assembled on Cross Arm in Bottle, and a One-piece Wooden Fan Opened Inside the Bottle. Center Cut Shows, at Top, Wooden Chain Whittled From Match (3) and Wooden Goblet (5) With Rings Cut From One Piece. The Two Photos Below, Figs. 7 and 9 Respectively, Show Pocket-Knife With Blades Opened, Suspended From Cross Arm in Bottle; the Last Bottle Containing a Chinese Wood Puzzle Assembled Inside it, Together With a Wooden Star.




Carving With a Pocket-Knife

By G. E. WILLIAMSON

THE boy of to-day is the expert mechanic of to-morrow, his pocket-knife is the forerunner of tools of greater scope and accuracy, and his first crude efforts may be the spark of genius that will later startle the world. The class of work shown in these photographs, is not carving in the usual sense of the word, but is more properly designated by the word freak. Carving tools or a dull knife would be equally useless, as the most of it requires a point like a needle and an edge like a razor. Any ordinary two-bladed medium-priced knife will do the work, but the small blade should be ground perfectly straight on both edges for about two-thirds of the length and very thin so it will not split the wood where it is thin. The big blade should have a straight cutting edge with the back rounded; any blade can be ground to this shape.

The most suitable wood for this kind of work is any soft straight-grained wood having no hard streaks in it. For all around work and especially bent work, basswood is the best; for straight work white and sugar pines, such as are used to make doors and window sash, are very good.

While all of the work in these illustrations has been done with a knife, with the exception of drilling small holes where necessary, a large part of it can be done quicker and better with other tools. Small saws, chisels and blades of convenient forms and sizes can be made from dress and corset stays by means of grindstone and files, while knitting needles and parasol ribs make fine drills; flatten the end and file to size. Needles and the many kinds of hooks and other desired forms can be made from suitable sizes of wire. In drilling long holes, for the best results, fasten the drill and turn the wood.

To make a needle out of a wire or dress stay, flatten and bend slightly at the point where the eye is wanted and file a notch nearly thru with the edge of the file, then bend the other way and finish. Smooth the inside of the eye with the point of a nail.

For roughing out the work, grasp the knife firmly with the end of the thumb between the first and second fingers out of the way of splinters, lay the work on the knee, the hand also resting on the knee with the blade almost flat and crossing the stick at a slight angle; hold the hand firmly and pull the stick.

To use the knife for a turning lathe, turn the blade nearly straight up and down and with the hand still on the knee, turn the top of the stick towards the blade. A few trials will demonstrate the idea. For heavy cutting use the big blade, but not to pry with. To cut a small tree or a board when there is no better tool at hand, take the knife in the hand with the blade towards the little finger and cut along the line where wanted. Cut lightly until started, then make another cut parallel a short distance away, with the point leaning towards the first cut. Go down with both cuts until the chip is all out. Make a third cut near enough so that the chip will come out easily and go to the bottom again. When about half way thru, turn the board over if possible and if you can bend it away from the blade a little it will help greatly.

To do scroll work on thin wood, use the needle point. To demonstrate, take a piece of cigar box and push the blade in from the back of the work so that the point is just thru and in the line to be cut; work the handle forward and back in the line you want to cut, maintain a slight pressure, keeping the point on the line and you will soon get the idea.

Solomon's Knot Puzzle

To make this interesting puzzle which can be easily whittled out of wood, take six pieces of wood about ⅜ inch square

(*Continued on page* 1052)

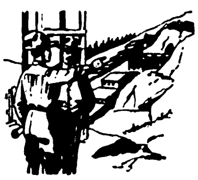
Shall I Take Up Engineering?

By H. WINFIELD SECOR

(CONCLUSION)

Associate Member of American Institute of Electrical Engineers

AN engineering education always stands a man in good stead whether he may become associated as an employee, partner or owner, in his future years. And it is a well-known fact that a technically educated man will always get along better in any business, than will the man who lacks this technical training. The exacting requirements of the engineer's profession will invariably develop his mind in a business sense, so that he will be able to figure on profits and sales as well as on buying costs, so that there will be a small chance of a loss.


The Mining Engineer

THE PRINCIPAL CLASSES OF ENGINEERING

The six principal branches of the engineering profession are perhaps the Electrical, Mechanical, Civil, Mining, Chemical, and Radio. The latter branch is one of the newer specialized departments and a man invariably has to be or should be a good electrical engineer, before he takes up radio engineering, as the two are inseparably associated.

THE ELECTRICAL ENGINEER'S WORK

The electrical engineer, as might be expected of course, specializes during his college work on electrical and allied subjects, but it is quite surprising to those who have not studied the list of subjects covered in such a course, how great is the amount of mechanical and other similar subjects, which the future "E. E." has to master. He should and usually does take up the German and French languages, as both of these are rich in engineering literature, and in many cases after his graduation he will find it useful to be able to consult the original technical papers publisht in foreign journals, particularly in German and French periodicals, and to read them completely; the excerpts publisht in the review columns of American or British journals not being of any great value, owing to their brevity and lack of details.

It is surprising how many excellent electrical engineers one meets in his travels, who have graduated with the degree of mechanical engineer. One reason for this is that some colleges and technical schools do not give an "E. E." course, but only an "M. E." course, the latter being very broad and comprehensive in the electrical subjects embraced. In conversation with Dr. Nikola Tesla, he has frequently mentioned the interesting fact that he graduated as a mechanical engineer and furthermore, that the fundamental elements involved in mechanics usually governed his train of thought, when he started to develop some of his many electrical inventions, even including polyphase alternating current apparatus. Those who have studied mechanical engineering and physics will at once see that there is indeed a very strong bond of correlation between the two sciences, especially when we think of the wave-forms and vibrations occurring in the study of sound, etc. When studying or computing the harmonics for example, of a compound curve or vibration, it does not matter whether we study this from the electrical or mechanical point of view, the results will be the same.

The electrical engineer should and usually does have the opportunity to study steam power plant operation, either near the school at which he studies, or else at the school power-plant itself, as is frequently the case. Among the subjects studied are water-power electric generating plants, the elements of telephone practise, the design and calculation of electrical transmission lines, the layout and calculation of proper candlepower and number of lamps to be used in illuminating residences, industrial plants and cities, as well. He must be thoroly versed also in the design and operation of dynamos and motors, transformers, the controlling apparatus for the same, electric railways, etc.

The college educated engineer of no matter what branch of the science, is given a thoro course in mathematics thru algebra, trigonometry, geometry, and the calculus. One of the greatest boons to any engineer is the slide-rule for use in calculating any mathematic values, computing costs, designing apparatus, etc., an instrument which saves many hours of time and relieves the mind of the tedium of multiplying and dividing quantities, which is really the work of a machine.

When the electrical engineer graduates, he usually associates with some concern, where he can use his knowledge to good purpose. Some "E. E.'s" gain their first practical experience out in the open, building transmission lines and erecting power plants; others make their first start in the designing and drafting departments of electrical and mechanical manufacturing concerns. Frequently the junior engineer starts in at the drafting board, this work combining drawing and original designs, which gives quite a free rein to his "idea factory." From the drafting and designing departments the engineer advances to higher positions of responsibility and frequently his work merges into the business and executive activities of the concern. As will be seen, the technical man who is ever alert and capable of bringing out new ideas is ingreat demand. "We can find followers," say the heads of business concerns, "but show us the men with initiative and originality." The electrical engineer by advancing himself in the concern with which he is connected, or by eventually developing his own private business, may increase his earnings to a very satisfactory degree. The writer knows several engineers who have established themselves as associates in the business concern with which they started, and who now draw a yearly salary of $20,000 to $30,000. One of the most brilliant electrical engineer of today in this country is Charles P. Steinmetz, chief consulting engineer to the vast General Electric Company interests, who it is said receives a salary in excess of $100,000 per year.

The future of electrical and radio engineers is bright indeed, as Dr. Nikola Tesla pointed out in a recent interview with the author of the present article. The question asked Dr. Tesla was, "What are the chances today and in the immediate future for electrical and radio engineers"? And his reply was:

"As regards the application of electricity, altho the development of late years has been proceeding at a bewildering pace, the future offers incomparably greater possibilities. Especially bright appear to be the prospects for wireless experts, if the art is permitted to expand freely and the enterprises are raised to a higher level and dignity."

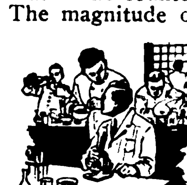
MECHANICAL ENGINEERING

The curriculum or course of study in colleges and schools teaching mechanical engineering is closely akin to that given in electrical engineering schools. This is so for many reasons, and as mentioned above, the mechanical engineer, who receives a goodly portion of electrical subjects in his course, is very likely to concentrate his energies, so as to materialize more as an electrical engineer than as a mechanical one. Usually the mechanical engineer student takes up in much greater detail the subjects more in line with his work, such as steam engines and their design, steam turbines, ships and their propelling machinery, including engines and boilers, the design of steel-frame buildings, including an exhaustive study of the stresses and strains in steel columns, beams and trusses, etc. Hydro-electric plants are usually studied also, as well as the engineering mechanics of locomotives and railway trains, and many other interesting and important subjects.

The graduate mechanical engineer frequently takes his first job with a concern in his line, who may manufacture anything from a road-scraper up to a battleship. It is thus easily conceived that the "M.E." has indeed, as we might say, a large part of the world to conquer, and we meet him everywhere. We cannot help but think of his calculations and designs everytime we see a steam engine or turbine operating. The high speed elevators which carry you skyward 30 or 40 stories in New York's great skyscrapers are the result of the finest mechanical and electrical brains imaginable, and are not the result of simple rule-of-thumb design, as followed in our grandfather's day so extensively. The opportunities for advancement in the mechanical engineering profession are legion, as may well be imagined, and to a very large extent the emolument and honors accruing to mechanical engineers, the same as in other engineering branches, depend upon the integrity, initiative and industry of the individual.

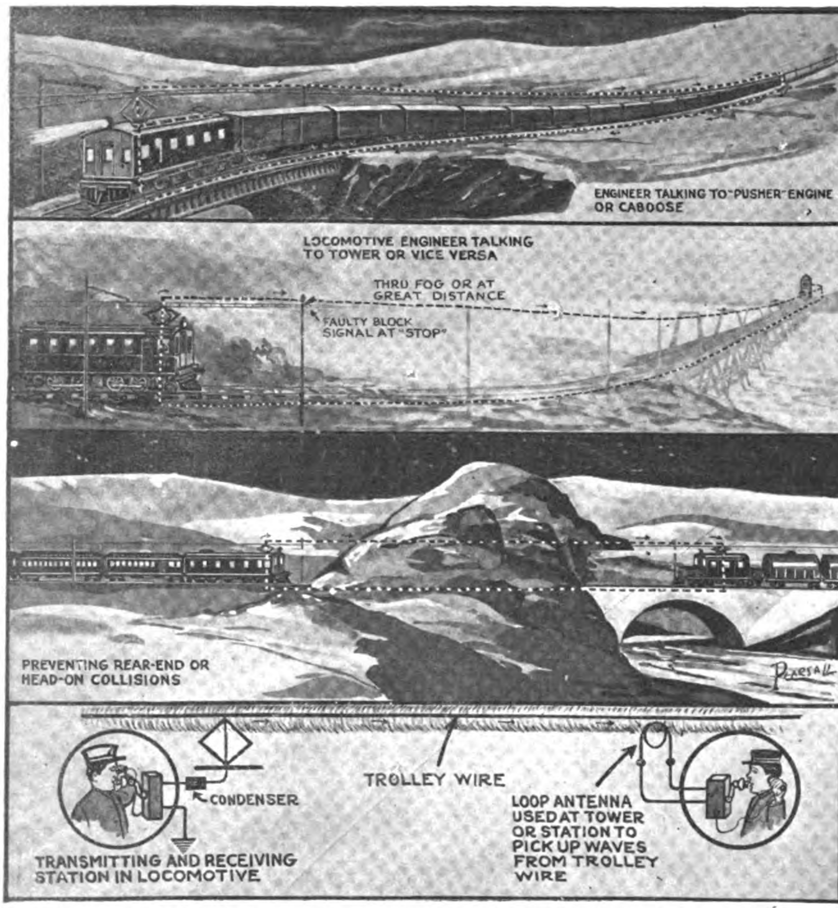
THE CIVIL ENGINEER'S FIELD

Time was, and not so many years ago, when a civil engineer was usually looked upon in his community as the "boss surveyor," and that was about all he counted for, to many people. The magnitude of the engineering work to be studied and absorbed by the civil engineer today is indeed very surprising, for, unlike many of the other branches of engineering, the "C. E." frequently has to do with the laying out of entire cities. Not only, however, is he concerned with the accurate surveying of the land and laying out of the streets and avenues, but farther than this he has a great deal to do with such things as water works, the design of water supply systems of cities, the design and layout of sewerage systems. Aside from all this, the well read "C.E." will be able to tell you whether or not you should build an electric central station at a certain locality, how much it will cost to develop a kilowatt-hour of electrical energy in dollars and cents, and many other surprising things which a first glance at the man behind the theodolite would not disclose to your innermost conscience, if you did not know these things.


The Chemical Engineer

Surveying is, we might say, the first "stepping stone" to the civil engineer's

(*Continued on page* 1071)



As the Accompanying Illustration Shows, "Talking Over a Trolley Wire" Has Many Advantages. It May Spell the Difference Between Safety and Disaster in the Operating of High Speed Inter-urban Trolleys, and in Communicating Between Railroad Trains or Between the Engine and the Caboose in Foggy Weather or at Night. The Apparatus Used is a Combination of Telephone and Radio, and the Transmitting Carrier Wave is Guided Along by the Trolley Wire. The Message is Picked Up at Tower Stations with a Loop Antenna, the Same as Used in Radio Reception.

Talking Over a Trolley Wire

A GROUP of prominent technical experts representing eastern railroad systems witness a demonstration of what is known as the *carrier current* system of communication, at Schenectady, recently.

The system makes use of a second current superimposed on the same trolley wire which supplies current to operate the car. This *carrier current*, which is generated at higher frequency than the power supply, serves to transmit messages along the wire, from which it is picked up at any convenient point and made to energize a telephone instrument.

The demonstration took place on the lines of the Schenectady Railway Company, five miles from the city, and was arranged by the Railway Department of the General Electric Company, which is interested in the development of the new system.

From the moving trolley car the railway men were enabled to talk successfully with a substation on the line *several miles distant* and also to listen to conversation from the operator in the station. The second feature of the demonstration was listening to the conversation of the substation attendant at a waiting room two miles from the substation, the messages being transmitted over the trolley wire and amplified in the waiting room by a loud-speaking telephone instrument.

The demonstration was designed primarily to show the application of the system to communication on electric railways, especially as regards expediting train operation. It was developed particularly to afford an effective means of communication between the head and rear ends of long freight trains and to prevent pulling out drawbars. Experience with the system on the C. M. & St. P. R. R. where it has been given exhaustive tests, shows it to be well adapted to communicating ahead of trains stalled by a faulty block. In one case cited the use of the system on a single track portion of the C. M. & St. P. cleared up a misunderstanding on signals, and saved one or two hours' time, the loss of which would have been caused by having to send the flagman ahead to the next block.

The apparatus used for carrier current communication is small and simple of operation. It consists essentially of vacuum tubes used as oscillators, rectifiers and detectors, making up a telephone equipment equalling in sensitiveness and simplicity the most modern apparatus.

(*Continued on page* 1091)

Stories That Tend to Show That Fishes Are Able to "Think"

Sportsmen, and even the hardened fisherman, bear witness that fish do possess some intelligence, citing their marked increase of wariness in waters that have been fished over often. Young trout under the circumstances are less wary than the old ones. The carp, according to Kirby's book on fishes, thrusts itself into the mud in order that the net may pass over it, and if the bottom is stony makes great leaps to clear the net.

It has been said that fish which have been kept for many years in a basin of the Tuileries come when called by name, but it is of course the sound of the voice and not the articulate words to which they respond. In Germany trout and carp are summoned to their food by the sound of a bell.

A small perch's nest of young was disturbed one day, and upon the next day the fish and young were searched for in vain. Upon further investigation it was discovered up stream, the parent guarding her young with jealous care in a cavity scooped out of sand. Another story is related of a skate which was observed in an aquarium at Manchester. A morsel of food was thrown into the tank, which fell directly in an angle formed by the glass front and the bottom.

The skate, a large specimen, made several attempts to seize the food, unsuccessful owing to the position of its mouth. He lay quite still as though thinking, then suddenly raised himself into a slanting posture, the head inclined upward, and the under surface of the body toward the food, when he waved his broad fins, thus creating an upward current in the water, which lifted the food from its position and carried it straight to his mouth.

The blue shark and his pilot fish also come in for a story. Captain Richards, R. N., tells one about a blue shark following a bait which was thrown out to it from the ship. The shark, which was attended by four pilot fish, repeatedly approached the bait, but every time he did so one of the latter rushed in and prevented him from obtaining it.

After a time the shark swam away, but when he had gone a considerable distance he turned back again, swam quickly after the vessel, and before the pilot fish could overtake him, seized the bait and was caught. While hoisting him on deck one of the pilots was seen to cling to his side until above water, when it dropped off. All the pilots then swam about for a time, as if searching for their friend, "with every mark of apparent anxiety and distress."

Making Ice on a Stove

By GEORGE G. FELT

IT is a long step from a hot flame to a bar of ice but this step is shortened by the latest achievment of science and chemistry. Can you imagine placing your ice machine over a gas or oil flame for about thirty of forty minutes, and then cooling it for a few more minutes in a pail of water, putting the whole outfit in your ice chest to have refrigeration for twenty-four hours? What would your grandmother say to this one? What will the housewife say when she finds she can do away with the messy iceman and all her worries, when he fails to show up? What will hubby say when he finds the ice bill is out of his way?

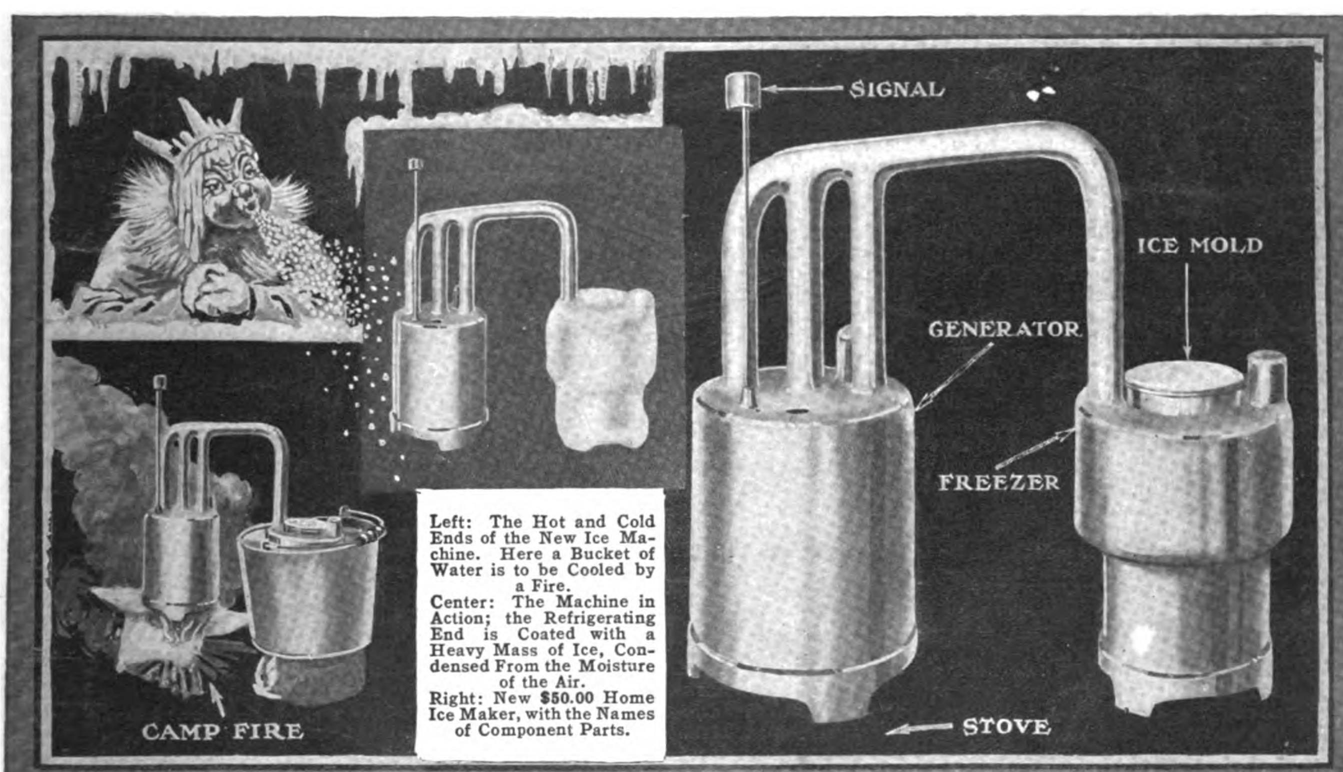
The article can hardly be clast as a machine because there are no movable parts, motors, screw adjustments or switches to fuss with. It is a container constructed of malleable iron, made to withstand many pounds pressure to the square inch. In this container are certain chemicals the formula of which is kept secret. The container is composed of two cylinders, which are connected by a small tube of the same material as the cylinders. A more clear conception of the device can be obtained from the accompanying photographs. There are three sizes of ice maker manufactured; the smallest size will take the place of a twenty-five pound cake of ice in an ice box. The medium size is equivalent to a seventy-five pound cake and the largest to a hundred pound cake. This does not mean that the machine will make a twenty-five, seventy-five or a hundred pound cake of ice; but it does mean that it will give the equivalent in work of that sized cake of ice when placed in an ice box.

The operation of the machine is very simple. All that is required is a pail of water, some heat, and the machine itself. The heat is applied to the generating cylinder, while the other end is placed in a pail of water until the gauge indicates that the chemicals have been heated sufficiently and forced over into the refrigerant cylinder. To complete this operation takes about thirty or forty minutes. The generating cylinder is then placed in the pail of water for ten minutes, after which the outfit is placed in your ice box and refrigeration begins at once. The refrigerating cylinder will become coated with frost and remain so for twenty-four hours. A thermometer on the refrigerant cylinder will read *40 below zero Fahrenheit*, a few minutes after the machine is placed in the ice box.

There are many other uses to which the new refrigerating machine can be put, chief among them being its use in the home. A brass cylinder comes with the machine, that can be inserted in the refrigerant cylinder and a bar of ice can be made suitable for table use. Or else ice cream can be made in this cylinder with the addition of a stirring paddle. Ices are frozen thoroly and rapidly in this vessel. A special size that is compact will be made for campers, hunters and autoists. The uses to which this machine can be put are endless.

The device is covered by foreign and domestic patents. The inventors are Maxwell Karge and Mr. E. J. Connill. The latter resides in Marseilles, France. Mr. Karge is a noted New York inventor.

The history of the invention is as follows: In 1853, a French physicist by the name of Carré, demonstrated for the first time that it was possible to produce cold by using the action of the return of certain gases to the gaseous state after having been previously liquified. But in order to carry out his calculations and theories required continuous experimenting and research work. A machine has been developed which is a marvel of precision and simplicity. All cumbersome mechanical appliances, and many drawbacks have been eliminated, especially the one of complicated heating apparatus. As the machine is now manufactured, it is possible to make ice and cool liquids in the most isolated and torrid places. The expense is the first cost, as there is no refill, and no parts to wear out or corrode. There are no valves or gauges to manipulate and no danger of explosion.



Left: The Hot and Cold Ends of the New Ice Machine. Here a Bucket of Water is to be Cooled by a Fire.
Center: The Machine in Action; the Refrigerating End is Coated with a Heavy Mass of Ice, Condensed From the Moisture of the Air.
Right: New $50.00 Home Ice Maker, with the Names of Component Parts.

How Lost Children May Be Recovered

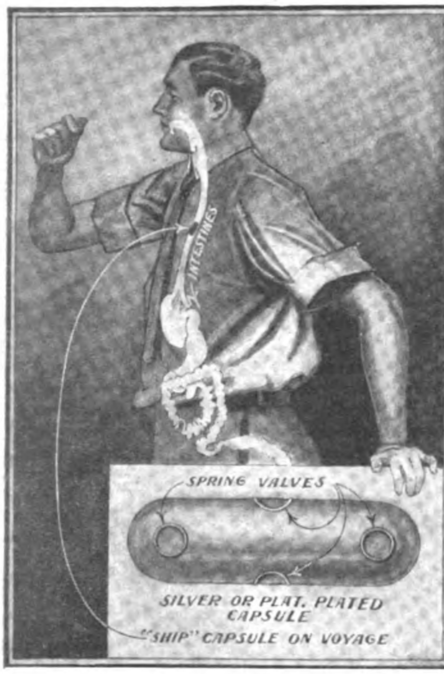
Every day dozens of children are lost, and the first thing the mother does, as a rule, is to rush around, waving her arms and crying that her child has been kidnapt, and in this excited state, she is seldom able to give an accurate description of the clothes the child was wearing at the time.

The police, generally take the lost little ones to the police station, and search for any means of identification, so that they may notify the anxious parent as soon as possible, who often forgets about the police station in her excitement, but seldom do they find any.

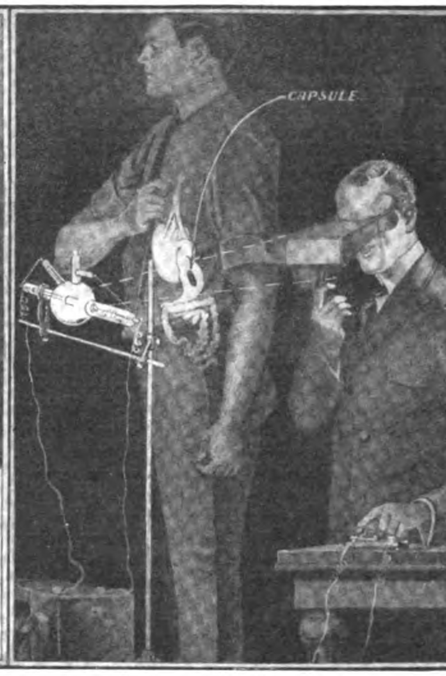
In some of the maternity hospitals, they have a large assortment of beads, which are lettered, and as soon as a baby is born, the letters composing its family name are strung upon a cord, plain beads are used for the rest of the string, and the complete string of beads is placed around the infant's neck.

All children are fond of beads, and if the mothers of little children would follow the scheme used in hospitals, adding the home number and street, there would be little delay in returning the lost tots, and saving of much mental anxiety on the part of the mothers.—*William Reinich.*

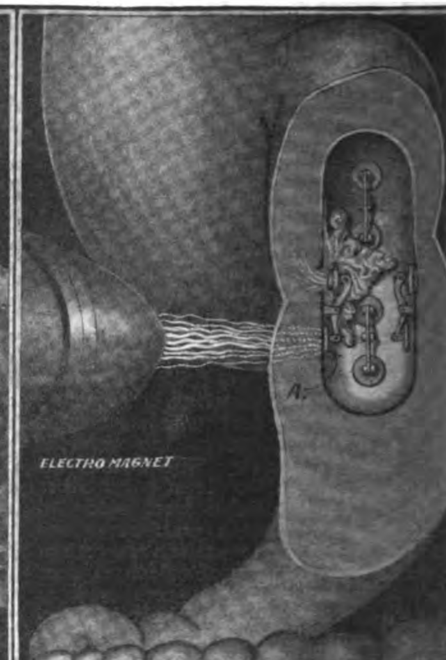
Tiny "Ships" Probe Human "Seas"



The Illustration Above Shows Platinum or Silver-Plated Capsule Fitted With Spring Doors or Valves, Being Swallowed by Patient.



Second Illustration Above Shows How Physician Locates the Exact Position of Collector Capsule Swallowed by Patient.



When the Capsule Has Reached the Right Point, the Physician Switches on Electro-Magnet Which Opens the Capsule Doors to Take a Sample of Secretion or Else to Discharge Bacteria.

Bacteria Laden Metal Capsules Swallowed in Experiments by Medical Students

DID you ever stop to think for a moment that much of the knowledge we have about a certain medical case is more or less guesswork, especially when it comes to ascertaining the effect of certain bacteria or medicines on a particular part of the gastro-intestinal tract? Such is the case, however, and in order to accurately determine just what effect the bacteria in buttermilk, for example, have on certain sections of the intestinal canal, Professor von den Reis of the University of Greifswald, Germany, according to cable dispatches, has been using with considerable success tiny, electro-magnetically controlled metal "ships" fitted with iron doors. One of the accompanying illustrations shows the shape and size of one of these metal cylinders, and anyone who has swallowed quinine capsules or especially the larger gelatine capsules containing various oils, et cetera, will realize that quite a large cylinder can thus be easily swallowed. The cylinders, which, by the way, are used to unload bacteria at any desired point in the intestinal tract, as well as to take on samples of the secretions at certain points in their travels, may be made of silver or some other metal plated with silver or platinum. A series of small iron doors or valves are fitted on the capsule and these can be opened and closed by means of a powerful electro-magnet placed against the back or abdomen of the subject, the position of the "ship" being accurately determined by means of the X-ray.

When the metal capsule with its load of bacteria, or else traveling in *ballast* reaches the desired point, Professor von den Reis excites the powerful electro-magnet, which causes the iron valves to open, these valves being closed by the pressure of a spring when the magnetic attraction is cut off.

The method of procedure in making a scientific test for the effect of certain bacteria on the digestive processes is as follows: The patient first swallows one or more of the capsules containing the bacteria and the travels of the capsules are traced with the X-ray, and their cargoes are discharged at the proper moment. Shortly afterward when sufficient time has elapsed for the bacteria or medicine to act upon the food in the intestinal tract, empty capsules are swallowed and when these reach the scene of action, as determined by the use of the X-ray once more, the trap doors are opened and a sample of the food being acted upon by the bacteria and the bodily secretions is trapt, and later these samples of the contents of the intestines are studied minutely in the experimental laboratory.

The layman might be somewhat alarmed at this remarkable method of accurately ascertaining just what is going on in his digestive processes, especially as he might suspect that ill effects would ensue from the powerful magnetic rays passing clear thru his abdomen, but his mind may be perfectly at rest on this score, for extensive tests made in Paris some years ago failed to show any effect whatever on the human body when it was subjected to the field of the most powerful electro-magnet obtainable.

Heart Tissue Alive After Ten Years

Ten years ago Dr. Alexis Carrel of the Rockefeller Institute isolated a fragment of tissue from the heart of an embryonic chicken. The tissue kept on growing; it has kept on growing ever since. At first it was real heart tissue, and for 104 days, as the cells multiplied themselves, pulsations could be detected under the microscope — the beating of a heart. Then the connective tissue cells overran the others, and since then it has been connective tissue.

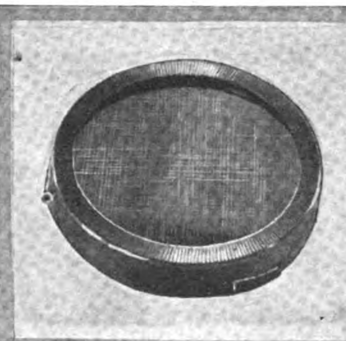
So fast does it grow that it would now be an enormous mass except for the fact that every forty-eight hours it is subdivided and part of it discarded. Many generations of chickens have been hatched and have gone where good fowls go, but the substance of the chick that happened to be selected for Dr. Carrel's experiment on January 17, 1912, is perpetuating itself at just as lively a rate as ever. It is, so far as those who are watching and nourishing it can see, immortal.

The original culture has been subdivided nearly 2,000 times. The cells increase so fast that on the average the area of the culture is trebled in forty-eight hours. At the end of that period it is divided into two or three pieces, which are transferred to a bath of Ringer's solution. After forty-five seconds in this bath they are transferred to a fresh mixture of the medium used for perpetuating the strain, composed of equal volumes of chicken plasma and chick embryo extract.

They are then placed in an incubator and kept in an average temperature of 103 degrees Fahrenheit. The best plasma is obtained from healthy chickens not more than two years old which have not been fed for twenty-four hours. The tissue extract employed is obtained from chick embryos seven to eight days old. In his last report, publisht three years ago, Dr. Ebeling said the rate of growth seemed to have increased progressively during the first seven years of life outside the chicken heart from which the original tissue came.

During the first year the growth was slow and irregular, because it was not yet known that certain substances contained in embryonic juices were essential to permanent life.

The method of cultivating the chicken tissue is similar to that of cultivating disease germs. The use of culture material within sealed receptacles is necessary. The receptacles being of glass, the living tissues may be studied constantly.



On the Left is a Photograph Taken With an Ordinary Camera in Which the Image of the Person Was Focust Upon the Ground Glass Very Sharply. Note the Intense Shadows, High Lights and Facial Defects. On the Right the Same Focus, Stop, and Time Interval Were Used, But a Diffuse Focus Screen (Center) Was Placed Over the Lens. Above is Shown the Lens Attachment Itself.

New Soft Focus Screen

SOFT or diffused photographs are now in vogue, and very few professional photographers can boast of producing real good pictures, unless their studies include some diffust focus effects. In pictures of this nature the sharp outlines, the intense shadows and the brilliant high lights all blend into each other, giving the picture a very mellow, smooth effect.

Heretofore, expensive lenses, costing several hundred dollars, have been used for this purpose, and the amateur has found it impossible to duplicate the results obtained by professionals, and at the same time many professionals have found that they could not compete with their rivals in business because of the rather prohibitive cost of these lenses. A New York inventor has solved the problem, however, by supplying a lens attachment which can be placed upon any camera, and with which results comparable with those obtained in our well-known photographic studios are possible.

This lens attachment fits over the outside of a lens of a camera in the same manner as the copying or telephoto lenses do. It consists of a photographic reproduction of a fine ruled glass screen.

A Binocular Eye-Piece for Telescopes

By DR. ALFRED GRADENWITZ

INASMUCH as our eyes are used to binocular vision, the continued use of only one eye, as in the case of telescopic observation, of course, imposes upon the eye actually disengaged a marked and in the long run intolerable strain. While this disadvantage, in connection with microscopes, has long been helped by doubling the instrument or eye-piece, the case of the telescope has been much less amenable to a successful solution. Duplex telescopes for terrestrial observation have, truth to say, been advised (Fig. 1), but this solution, on account of the considerable dimensions and difficulties of construction and adjustment, could not be applied to instruments intended for astronomical observation.

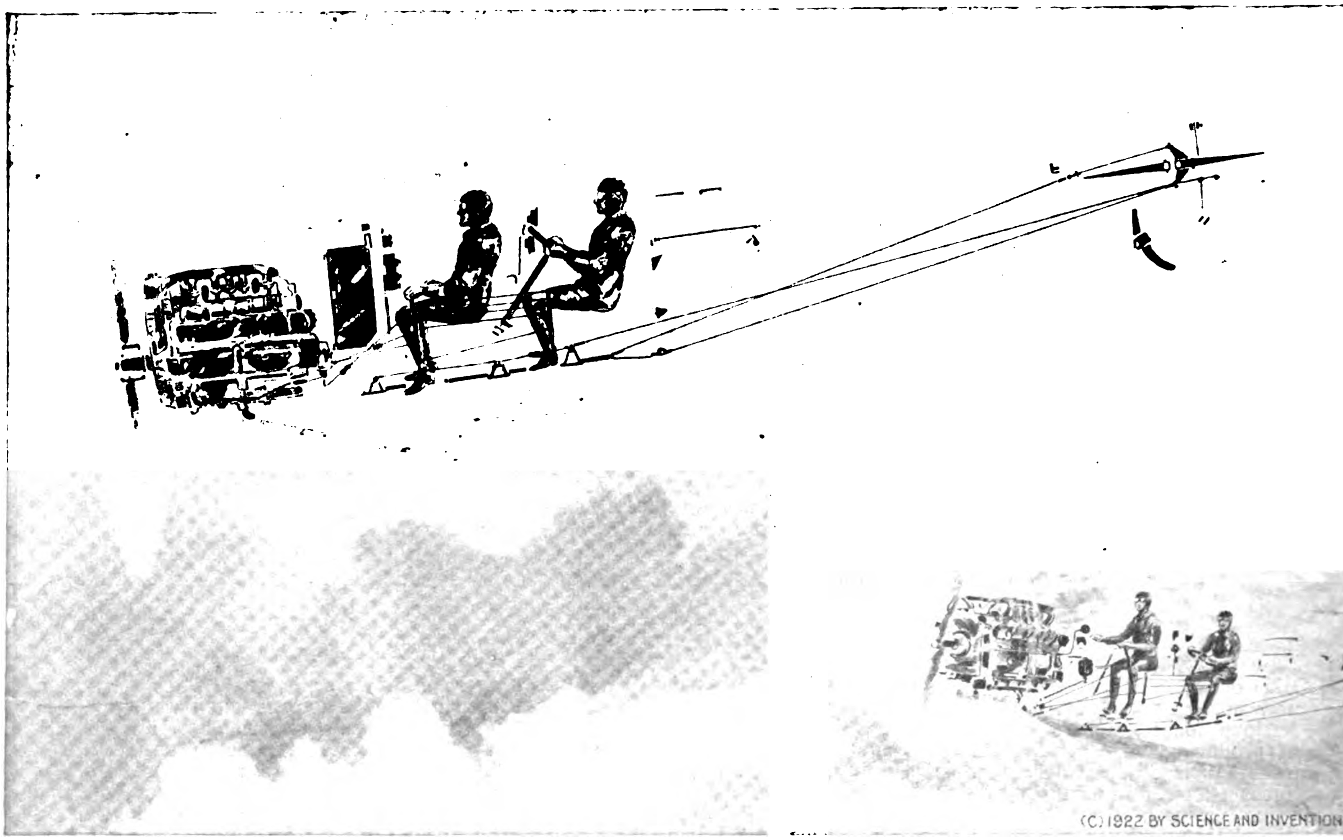
The problem has, however, now been solved by Carl Zeiss, of Jena, Germany,
(*Continued on page* 1070)

Fig. 1 at Right: Duplex Telescope Which Gives Stereoscopic Views of the Heavenly Bodies, Has Been Built for Some Time, But it is Too Expensive and Also Inconvenient to Build Such Telescopes in Very Large Sizes; What Was Needed Was a Binocular Eye-Piece, Which Would Give This Much-Desired Double Eye Vision with Any Ordinary Telescope.

Fig. 2 at Left: This Shows a Small Terrestrial Telescope Fitted With New Duplex Eye-Piece. This Binocular Attachment Comprises Two Sets of Inverting Prisms Arranged Behind One Another.

Fig. 3: Hand Telescope Formed of New Binocular Eye-Piece Combined With an Objective Lens.

Invisible Airplanes



Here's What We May Expect to See To-morrow, if the Dreams of an English Inventor Come True—Invisible Airplanes Which Will Dash Thru the Sky Like a Bird, Presenting a very Difficult Target for Anti-aircraft Guns, not to Mention Many Other Possibilities Resulting from This Novel Construction. The Invisible Airplane is to be Made Possible by the Employment of this Englishman's New Structural Material Which is Transparent Like Glass, but as Strong as Steel. If the Engine Can be Made of the Same Material, Then We will not See this Either, and When Fitted with a Suitably Approved Muffler or Other Silencer, the Airplane of To-morrow Will Truly Represent a "Terror of the Skies" in the Event of War.

DID you ever stop to think what would happen if we could build flying machines of some invisible transparent material, such as glass for example? For one thing this design of airplane would make flying machines pretty difficult targets to hit with any kind of gunfire. And speaking of bombing-planes the metal parts of such transparent planes, if once adopted, would provide such a small object to the sight that, at an elevation of 7,000 to 10,000 feet, such planes, if made of transparent material, except the engine and a few minor parts, would be practically invisible even with high powered field glasses.

Well, just to prove that we are not exhibiting one of our dreams, we are glad to state that an English inventor, Mr. Ernest Welsh, has discovered a material having all the transparent properties of glass, while he confidently believes that this new structural material can be used in the manufacture of aircraft. If the airplane which now roars thru the sky over our heads could be rendered not only transparent and invisible, but provided with a first-class muffler, which is not improbable at all, its war-time possibilities would surely border on the supernatural. It may take some time, even several years, before such a machine is successfully designed and built, but the country which holds the secrets of the building of such a flying machine will, it would seem, possess a tremendous advantage over its enemies.

Looked at from the humorous point of view, this transparent airplane stunt suggests some very desirable features indeed, especially on the morrow, when we have air traffic lanes policed by eagle-eyed air cops, for then we can speed right along and disappear into the fourth dimension, as it were, owing to our invisibility. Also when we are courting a pretty girl and papa objects, we can dive down in front of her home right before his nose, and whisk her away.

The inventor of this new transparent glass-like material does not state whether he believes the engine could be built of it or not, but if all of the rest of the material except the engine could be built of this material, it would still be a great boon, especially in military and naval maneuvering.

"Gold Maker" A Fake, Prof. Fisher Finds

Prof. Irving Fisher of Yale University, who recently caused a sensation by stating that a certain German scientist had apparently discovered a method of producing synthetic gold, has abandoned his treasure hunt.

"I met a man who, I was told, had succeeded in making artificial gold," said Prof. Fisher, "and he offered to demonstrate his claims. He said he submitted samples of gold which he alleged he had made to the Reichsbank in 1917, and that the authorities of that institution found it to be 99.9 pure. Herr Havenstein, President of the Reichsbank, told me this was correct, though there was no proof that the gold was synthetic. The alleged inventor gave me to understand he used mercury as a basis and said he employed an electric vacuum furnace with a more perfect vacuum than had ever before been obtained."

"Did you go to see the inventor's experiments?" I asked the professor.

"No," he replied. "I saw a distinguished German scientist this morning and he told me the man is a fraud and has a prison record. My friend who originally gave me the information about this man had known him for years and assured me the man is not a fraud, however mistaken he might be about his invention. I am disposed to believe my friend has been misled."

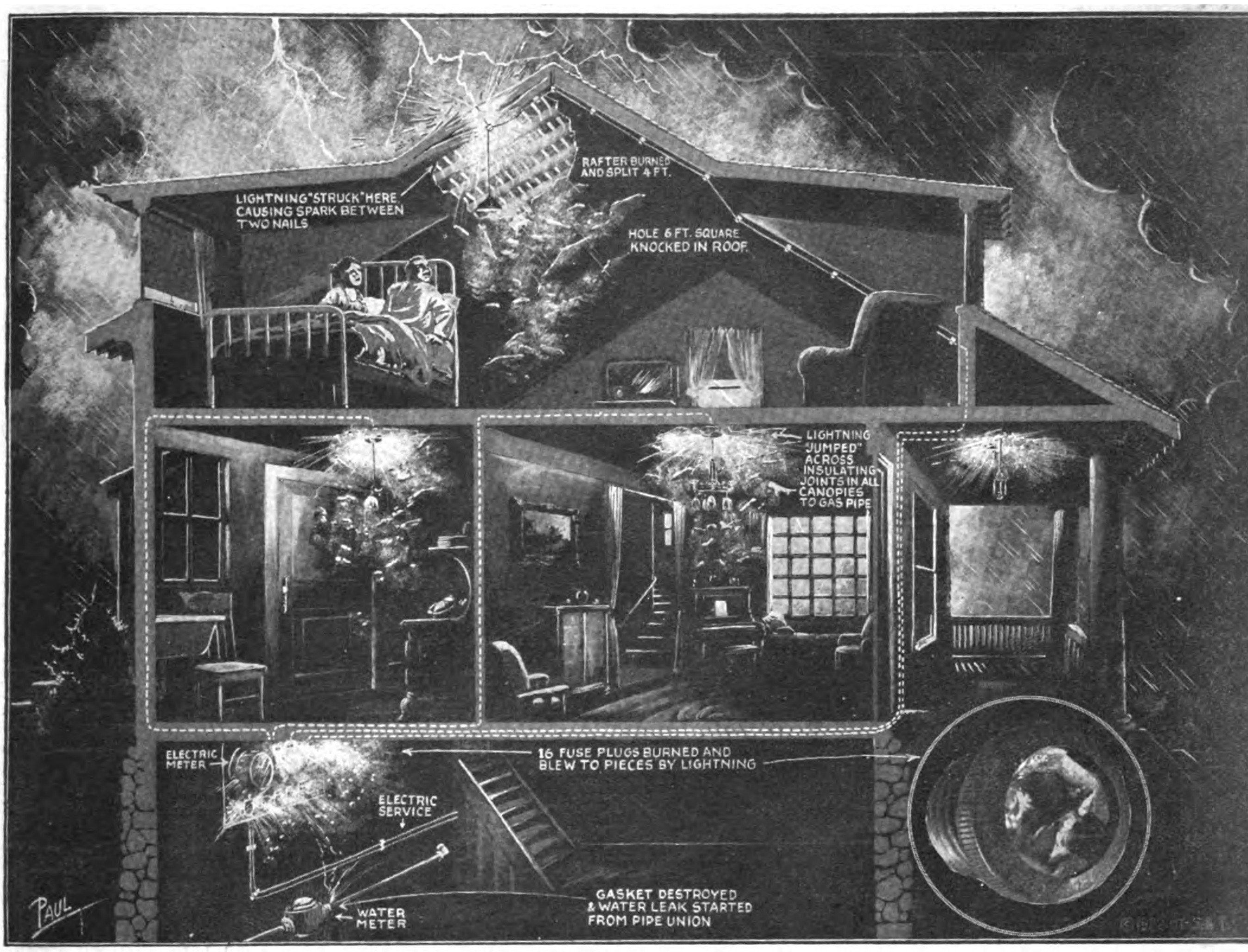
Prof. Fisher went on to say the alleged inventor declared he could produce synthetic gold for "10 per cent. less than the present price of silver," a curious statement, though it might be accounted for by the man having used silver as one of his bases for experiments.

"But why has he done nothing since 1917," I asked, "if he has made such a tremendous discovery?"

He explained that quite plausibly by saying he had been busy with other inventions which would benefit Germany, while he was doubtful if synthetic gold would help the country.

Prof. Fisher, who has come to Germany not only to investigate this matter, but to study the currency question, told me he found that during the war the German Government did make serious attempts to produce gold in new ways. They did, in fact, succeed in extracting gold from sea water, but not at a profit.

"These attempts," he added, "have been abandoned, and I have no evidence that the German Government is making further efforts."



It is Not Often that Such a Vivid Description as the Accompanying One By Mr. Kent Can be Given of an Accident, Such as When Lightning Struck His Home. The Subtle Power of Lightning is Brought Home to Us Very Strongly, When We Note All of the Different Effects That This One Bolt Was Responsible for. Even the Cellar Was Flooded with Water Because a Gasket Was Blown Out at the Water Meter, Due to One of its Freaks. Sixteen Fuse Plugs Were Literally "Blown to Pieces," One of Which is Shown in the Insert Photograph at the Right. It is Truly Remarkable that No One Was Injured or Killed.

When Lightning Struck My House

By JAMES M. KENT

ELECTRICAL AND MECHANICAL ENGINEER

IN SCIENCE AND INVENTION I noticed an article on *Lightning*. I had an interesting experience when my residence was struck by lightning. Myself and family were sleeping in our third floor room—a finished attic—and the stroke occurred during the night.

The bolt first struck a nail head—one of the nails which holds on the sheathing boards right underneath the shingles. Directly opposite to the ten penny nail struck was another similar nail holding a porcelain knob supporting one of the No. 14 copper wires on the attic ceiling. This was one of the wires supplying service to my attic lights. Jumping across the space of about one foot between these nail points, the bolt whipt around the head of the knob to the No. 14 wire, which was melted off at the point where struck.

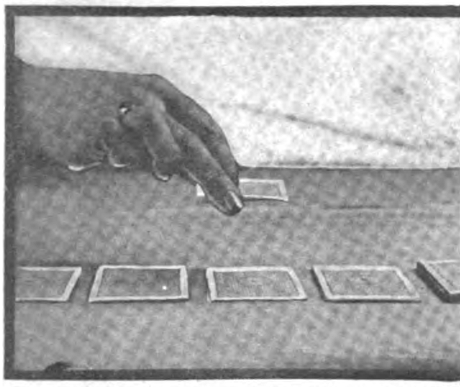
From this No. 14 wire the lightning current spread all over my house wiring, jumping across from the top of each fixture (under the canopy) to the gas piping above the insulating joint and blackening the ceiling at each fixture, thus seeking paths to the ground thru the gas piping. The inductance impedance of the gas piping proved to be so high that large portions of the charge got across, at various points in my house, to the water piping and thus escaped to the ground partly in this manner. The current flow thru the water piping was so great that a leather gasket where the service pipe entered the water meter (in a brass union connecting the pipe to the meter) was burned up and my basement was flooded with water before I got down there. I had to turn off the water and break the sealed meter coupling to put in a new gasket of rubber before I could proceed further with my investigations.

In escaping from my house wiring the path thru gas pipes and water pipes did not prove sufficient. So a very large portion of the charge rushed back thru my service wires, out to the secondary of our supply transformer on the pole, and thus spread to neighboring houses, to some extent.

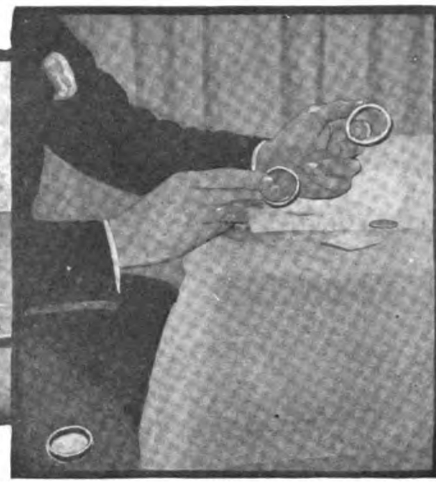
My main service fuses were sixty ampere cartridge fuses. These were not merely melted, but absolutely exploded by the current leaving my house thru the service wires. I had eight branch circuits in my house. The fuse plugs in all of these circuits were not only melted out, but exploded as shown in the photo herewith. You will note that the pressure developed inside the plug by the gas of the volatilized fuse was sufficient to bulge out the edge of the brass cap holding the mica disc of the plug. All sixteen of my plugs were in this condition, tho I cannot account for the flow in those not located in the circuit struck—other than the feeding back of current to points where it jumped to gas pipes.

The inside of my electric light meter was burned to a crisp. At the point where the bolt jumped across between the points of the two nails the wood rafter was split to powder for a length of four feet (two feet each way from the nails) but was split on one side only, the other half remaining intact. A hole six feet square was knocked in my roof and a similar hole of equal size in the ceiling right underneath. The shingles over the entire roof were slightly loosened, either by the air pressure or possibly by the intense sound wave. The points of the nails were not melted—only slightly blackened, at the place where the main flow took place between them.

To volatilize the fuses in these sixteen plugs and produce a gas pressure inside them sufficient to blow out the mica and bend the brass cap in the manner seen must have required a current of not less than 100 amperes thru each plug (possibly much greater). Sixteen plugs were treated in this manner. The plugs carried out only a part of the charge. These facts will serve to illustrate the probable great value of the momentary current that flows from such a lightning discharge.



Five Card Monte. From the Last Pile, One Card is Taken Off Each Time and Placed on Each of the Other Four Piles.



The Vanishing Coin. Note the Substitute Ring on the Knee of the Performer, Upon the Bottom of Which is Attached a Piece of Paper Identical With the Sheet on Which the Trick is to be Conducted.

The Card Jumps Out of the Deck and Turns Over, Face Upward, When the Deck is Dropt Upon the Table, by the Simple Process Here Depicted.

The Amateur Magician

By JOSEPH H. KRAUS

A Few Good Parlor Tricks Without Apparatus

THE Japanese servant at Professor Hargrave's New York residence admitted me without question. I had just walked briskly thru Central Park. The air altho very invigorating had enough of that cold tang to it to create a numbness of the fingers and a tickling sensation in the vicinity of the auricular members exposed to the elements. I entered Hargrave's studio without the usual announcement, and found him reclining in an easy chair, a circle of smoke wafting upward above his head, while he himself was yawning. Hargrave has a peculiar trait of constantly reminding a person of what he already knew—as many barbers do—and greeted me with, "Well, well, old timer, rather cold out." I informed him that I was very well aware of the fact, to which he replied, "Well, I'll soon make it hot for you." And rising he repaired to another part of the room returning with a large figure of a devil. "If that's another of your tricks," I interrupted, "just lay low for a while."

"So this is to be merely a friendly visit? Quite a pleasure indeed, but rather unusual. What's the matter, old man, out of a job?"

"This is not to be a friendly visit," I retaliated, "and I am not out of a job either, but I might be soon, unless you make this a real good snappy entertainment. The class of tricks particularly desirable should come under the category of 'parlor magic.'" "I can't say that I appreciate your telling me what tricks I should show you," he laconically replied, "but," here he hesitated, opened the drawer of his desk and produced a deck of cards.

FIVE CARD MONTE

These he fingered for a while and then deftly making five piles by allowing some of the cards to drop off the bottom and remain on the table, he removed a card from the top of the fifth pile and placed it on the first; then another and placed it on the second, a third and fourth from the same pile and placed it on the third and fourth piles respectively. Touching the fifth pile, he said, "Take a look at the top card." I did as I was bid. "Put it back." I followed instructions. "Shuffle up the pack." I knew I had fooled him this time as he hadn't even seen the card, nor did he know where it was. He picked up the deck and turning it face upward, rapidly ran thru the cards. Evidently he could not locate it. He asked me whether I was sure it was in the deck, and I told him I was positive of that fact, tho I do now recall that I used the word positive rather meekly, in that I had been positive of so many things in the past much to my discomforture. Raising the deck about fifteen inches above the table, he dropt it, and seemingly from the center of the deck, a card flew out, turning itself face upward on top of the fallen pack. Before I could get over my astonishment, he had picked up all the cards and started to shuffle them.

He requested that I choose a card when I interrupted him, "Hold on a minute, haven't you forgotten something?" Hargrave was in the habit of jumping from one trick into another, not even giving his audience a chance to recover fully from one shock before the second one presented itself, and such simple tricks too. He assured me I would get the explanation later, but I informed him that I would rather have it now while the memory of the trick was still fresh in my mind. "Very well," he answered. "First we will count off from the face, one, two, three, four, five cards." His action suited his words, as he transferred five cards from the deck turned face upward to his right hand. Then he placed these on the bottom. "Lifting the entire deck we make five neat piles thus." Here his hand moved from left to right with the deck of cards. He stopt at intervals to drop a few from the bottom. The cards were now of course turned face downward.

"From the top of the fifth pile (back), I removed one and placed it on the first thus. I removed another and placed it on the second pile, always of course taking the cards from the fifth pile, or the very last one placed on the table. I repeated for the third and fourth piles and then asked you to look at the top card in the fifth pile, or what is now the top card."

"But how did you know the name of that card?" I had again interrupted him which I must admit was a rather rude thing to do. I also knew that Hargrave did not like it very much because he snapt right back at me saying, "Now, what in the world do you suppose I took five cards off the top (face) for at the beginning of the trick." I hadn't the slightest idea. "When I reached the fifth card, I remembered what that card was and in laying out the piles, I removed four and then the fifth card became the top card of the last deck, n'est—ce pas?"

"Of course, of course, but you shuffled those cards."

"To be quite sure I did, but you have noticed that in doing so I used the riffle method of shuffling cards. In other words, I placed the two halves down on the table, lifted the corners and let them run together, but I took particular care that at least five cards which were originally on the top of the deck retained their original positions, by keeping the top half in my right hand, and making sure that five or more cards from the right hand were seemingly accidentally but purposely riffled to the top again. This thus preserved the original order of the top five. Is that clear?"

"Yes, but——"

"Now what?"

"How did that card turn over?"

"Oh, yes, how stupid of me. You see that is the extremely simple part of the trick. I, knowing your card, brought that card to the bottom of the deck. Then under cover of the hand, I pushed the card out so that it extended from the side of the deck. Still under cover of the hand, I dropt the entire deck, but due to the weight of the cards themselves the cards fall solidly or en masse. They are preferably dropt from a height of twelve to fourteen inches, and in order to give a better effect, the downward travel of the deck may be speeded up by a slight throw. The air affecting the thin card as it impinges upon that extended portion, causes that card to turn around and of course face upward."

THE DISAPPEARING CARD

Picking up the pack again, Hargrave shuffled it. "You fooled me like that once before. You had better let me shuffle them this time," I exclaimed. To this he assented. Turning the entire deck face down upon the table, he said, "Think of any number, then counting from the back

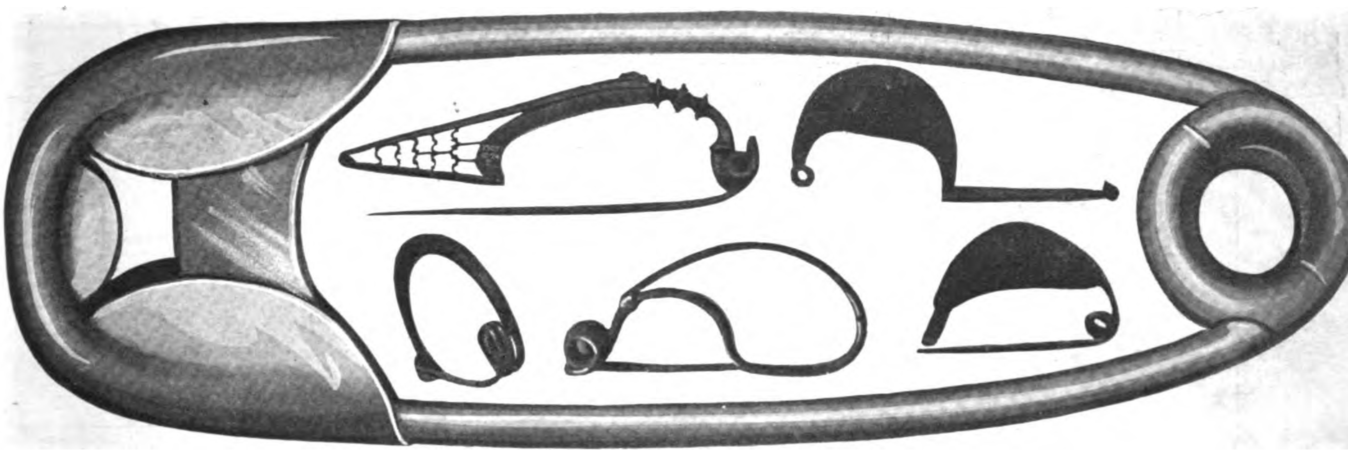
(Continued on page 1063)

Fortunes from Little Things

By CHARLES FREDERICK CARTER

No. 9. Story of the Safety Pin

NEXT time you see a safety pin take off you hat and kowtow respectfully three times to it. For this humble utility is deserving of deference on three counts: First, on account of its age; second, on account of the highly important part it played in the war; third, on account of its ever-increasing usefulness in civil life, now that the world is more or less demobilized.



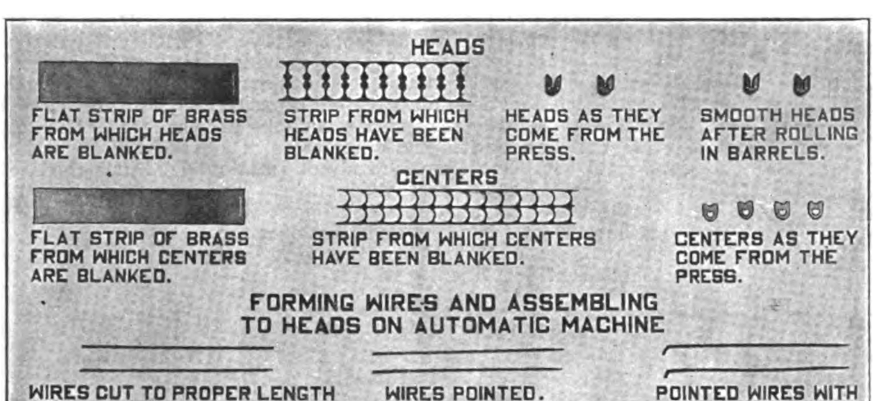
Above Are Shown Some Very Interesting "Safety Pins," and Unlike the Neat and Simplified Form of This Fastener With Which American Women Are Familiar, These Relics Photographed in the British Museum Show That in Our Grandfathers' Day the Safety Pin Makers Had a Great Deal of Art Mixed Up With Their Practical Ideas. Imagine the Cost of Making Such Elaborate Pins as These Even Today, and if They Were Available Who Would Want Them?

There seems to be a pretty general impression that Foch "sewed up" Ludendorff's forces, to use a slang phrase. Well, he didn't do anything of the kind. Literally, the Allied generalissimo pinned up the Germans; and to prevent any embarrassing slips he used safety pins.

Why, one of the first things the American Government did after declaring war was to place a rush order for 300,000 gross of safety pins, followed soon after by a second order for 200,000 gross. These pins were all of a single type for a single purpose—japanned black pins to fasten canvas bandoliers containing each 60 cartridges, or a grand total of 4,320,000,000 of these slight tokens of our esteem for the ex-Kaiser and his gang. Vast quantities of safety pins were used in hospitals and dressing stations to pin bandages. There were many other uses.

Altogether the American army alone used 2,000,000 gross, or 288,000,000 safety pins, or an average of 75 pins for every man in the army, and we won the war. No safety pins were used in the Spanish-American War, and we had embalmed beef scandals and other unpleasant things. Draw your own conclusions.

Apparently all America took note, for ever since that affair with Spain the manufacture and use of safety pins has been increasing at a most amazing rate. In the quinquennial period from 1909 to 1914 the production of safety pins in the United States increased 189 per cent in quantity and 164 per cent in value; or from 1,640,284 gross to 2,550,650 gross. The average annual increase was 182,000 gross. Today the annual output is 10,000,000 gross, or an annual average increase of 465,584 gross for the last 16 years.



The Chart Above Shows the Successive Stages Thru Which Safety Pins Pass in Their Manufacture. A Very Remarkable Machine Turns Out These Safety Pins from Wire and Sheet Metal Stock at an Unbelievable Speed. The American Army Alone Used 2,000,000 Gross of Safety Pins in Winning the War. No Wonder the Ex-Kaiser and His Gang Got Stuck.

Ten million gross is 1,440,000,000 pins. To make this enormous quantity requires 68,181 miles of wire, or enough to reach twice around the globe at the equator and leave enough over to make six strands in an air line between New York and San Francisco. Exclusive of the material for the head and guard, this calls for 4,167 tons of material. To ship the pins from the factories would require 278 cars.

Americans, more particularly of the younger generation, are notoriously lacking in veneration for age, but even an American office boy ought to be imprest by the knowledge that the safety pin was in use by the Romans centuries before the Christian era. Charles Dudley Ward found some safety pins of this age in making some excavations at Colchester, England, in 1911. A skeptic may step into the British Museum and take a peek at the fine collection of safety pins there, dating away back ever so long before our era.

But the history of the safety pin has not been continuous. It died, was buried and forgotten. Its second incarnation took place in the

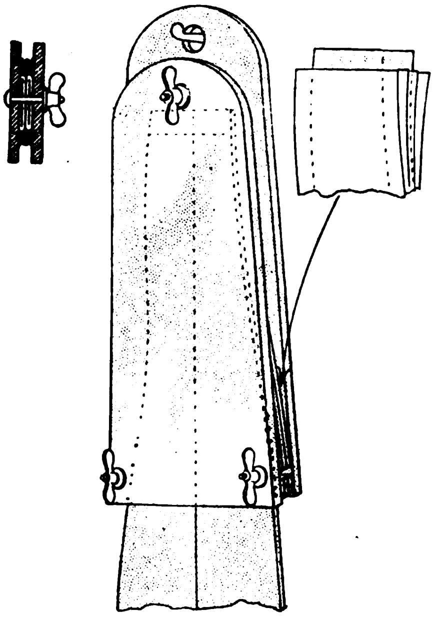
(*Continued on page* 1076)

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

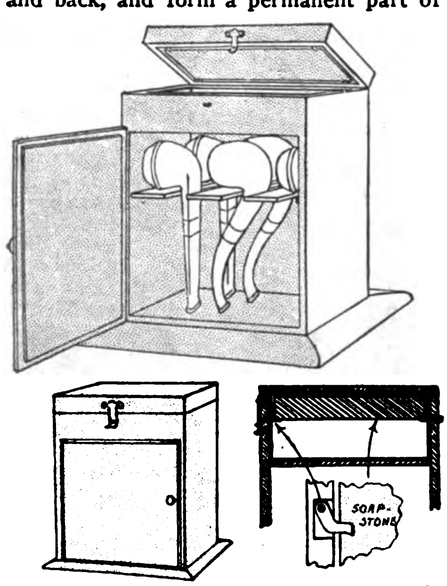
A PRESS FOR TROUSERS

HEREWITH we show a press for putting creases in trouser legs while the wearer of this article of wearing apparel sleeps the sleep of the just. It is the handiest automatic valet yet devised for the



This Handy Pressing Device for Trousers Will Prove a Boon to Many Individuals Who do not Have a Tailor in the Vicinity, or Who for Other Reasons Prefer to "Press Their Own."

natty business man, who considers prest trousers essentially a necessary part of his sartorial outfit. A simple press of the above style has been out of use since the pant-cuff came in, probably because a way has never occurred to the inventive mind for pressing the legs and cuffs between flat boards at the one time—the increased thickness of the cuffs have prevented successful operations along this line. This unfortunate condition can be overcome by using four sheets of red binders' cardboard of the thickness of cloth—say 1/32 inch thick. These sheets are cut so as to project 1 inch beyond the legs on front and back, and form a permanent part of the press. The cardboard is placed, when in use, one sheet under the lower leg next to the cuff; then two sheets are similarly placed between the legs, and lastly one sheet over the top leg. The whole thus arranged forms a surface that is flat and pressable, both for the cuffs and the trouser legs. As binder's cardboard is quite waterproof the legs and cuffs can be slightly dampened before they are put in the press, this will help in producing a sharp crease.



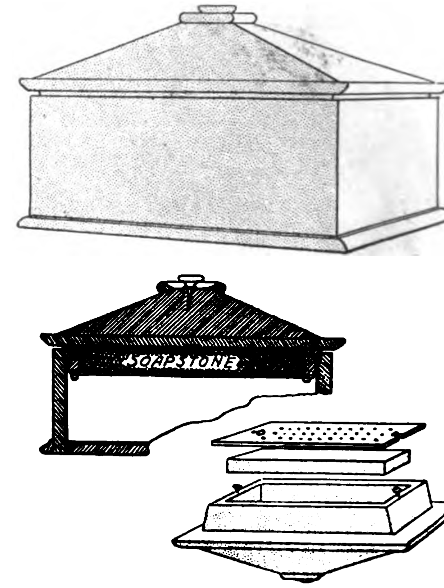
This Little Pipe and Tobacco Cabinet is Just the Thing for the Library or Smoking Room Table. It Provides a Humidor to Keep the Tobacco Moist, as Well as a Dust-proof Rack to Support Several Pipes.

COMBINATION PIPE CASE AND TOBACCO BOX

A pipe case and tobacco box in combination, which will be an ornament to the library table, cannot be considered an objectionable item for the attention of the home mechanic. The pipe-rack and tobacco jar are old friends in a separated form; let us combine them and have something new, particularly as the combination brings us attractiveness and efficiency. Our design can be carried thru endless editions or variations, quite as the older rack and jar was developed. It consists of a box having two compartments, one for the pipes and one for the tobacco. A soapstone slab ½-inch thick is used in the tobacco compartment to keep the tobacco moist. In order that this slab may be removed for the purpose of wetting with water, four adjustable clips are attached to the cover in the manner shown. The stone thoroly soaked once a day, will keep the tobacco in prime condition. This compartment is lined top and bottom with zinc, tin or copper. The pipe compartment is designed to hold six pipes, and these are held on racks about as shown.

CIGAR HUMIDOR

The average humidor for cigars or cigarettes has the disadvantage of drying out too easily; the design which is shown here is prepared with the hope of overcoming the above fault. It is provided with a cover, that contains a ¾-inch soapstone slab, that acts in a two-fold capacity, in one capacity to moisten the contents of the humidor, and in the other to form a weight to force the cover firmly down into the bevelled sides of the container. To make this joint air-tight we suggest that a large rubber band be stretched over the outer sides on the lip of the cover and shellacked permanently in this position—this will do the trick. The inside of the container and the reservoir for the soapstone should both be lined with zinc or copper. The stone is held in place within its reservoir by a perforated zinc or copper sheet with slotted openings that slide over screws in the lower edges of the cover as shown. The stone is thus made removable

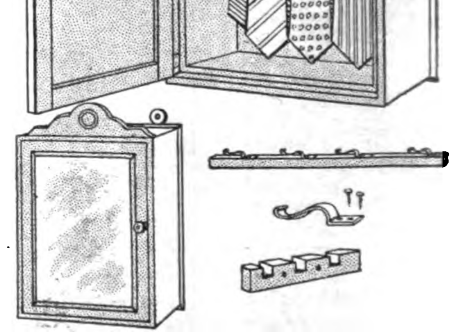


Cigar Humidors Like that Shown Above are Rather Expensive, and Many Smokers Never Waste Money on One, but Prefer to Buy More Smokes Instead. The details Here Given Show How to Build One at Slight Cost.

so that it may be soaked in water—the water penetrating the porous stone; every two or three days should be sufficient.

NECKTIE CABINET

A necktie cabinet, with a mirror on the front door, designed to hold a dozen ties is here illustrated. The ties are suspended from hangers and are held firmly in place by spring clips attached four to each hanger. The clips are made of spring brass of the sheet variety ¼ inch wide and 1/32 inch thick.



Did You Ever Cuss Those Wire and Other So-called Tie Holders which Support Them on the Side of a Door or Window Frame, Where They Catch All the Dirt and Dust Imaginable? Here is a Better Way to Keep Them in Perfect Condition—in a Tie Cabinet.

IMPORTANT
TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly every month. If you are interested in receiving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

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To........................ Newsdealer

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Please reserve for me........copies of SCIENCE & INVENTION every month until I notify you otherwise, and greatly oblige,

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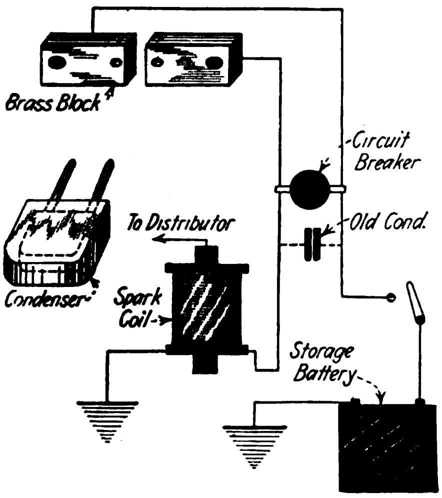
MOTOR HINTS

First Prize $25.00

REMOVABLE CONDENSER FOOLS THIEVES

In the illustration herewith is shown a scheme for preventing car thefts. Any competent mechanic can remove or destroy



Make the "Removable" Part of Your Ignition Circuit in the Form of a Condenser; it Can't Be Replaced in a Hurry, and Also the Car Cannot Be Started.

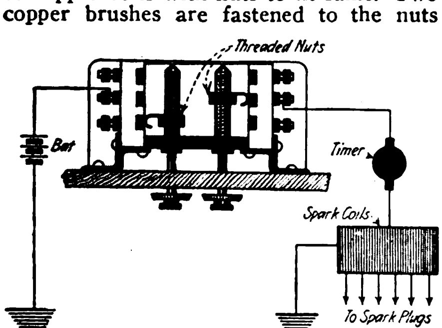
the condenser in ignition circuit, as assembled. Then place on dash panel two copper or brass blocks, having a small hole in each, in a handy place near the wheel, but not too conspicuous. The blocks must be insulated from each other. Ground one block, then lead a wire from ungrounded block to ignition terminal on switch; procure a suitable condenser and attach to it two plug terminals to be inserted in the holes in the copper blocks. The condenser is thus restored to use. With this condenser in your pocket the devil himself cannot start your engine without replacing it. The different systems will need different hitches, but a great deal depends on the mechanic. I have tried this stunt and it works very well.

Contributed by LEVI ALM.

Second Prize $15.00

THIEF-PROOF COMBINATION SWITCH

In the illustration is shown a novel protective switch of the combination type. The whole apparatus is attached under the dashboard. The dials are on the face of the dash. When the marking on the dials is made there should be a point at O. In the illustration there are two brass or copper bolts with nuts to fit same. Two copper brushes are fastened to the nuts



A Combination Lock Switch That Can't Be "Guest" Very Easily. It Can Be Changed Frequently so as to Keep 'Em Guessing.

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.

and continue to be a part of it during its operation. The wiring may be changed so as to vary the combination. An extra lead wire is used to conduct the electric current from the battery to the ground. The wiring should be changed frequently.

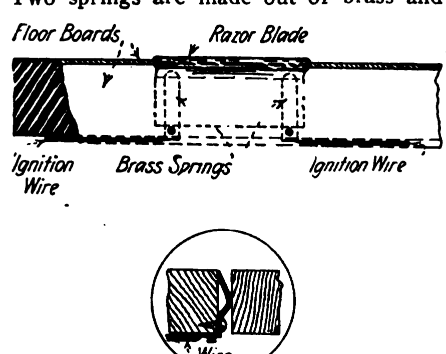
Contributed by JOHN E. BOSTON.

Third Prize $10.00

"RAZOR BLADE" IGNITION

The following is a clever ignition switch which is thief-proof. There is not the slightest chance for the thief to see it.

A break is made in the ignition wire under some space between the floor boards. Two springs are made out of brass and



Side View Showing Spring

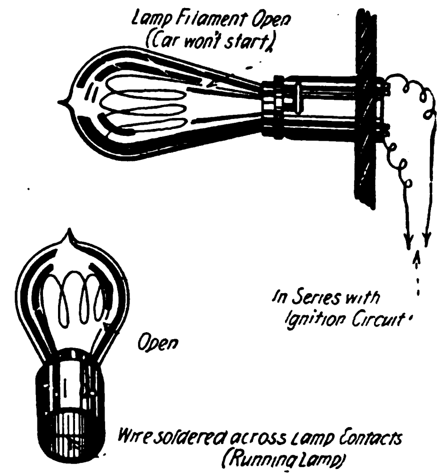
Third Prize Winner—a "Razor Blade" Secret Ignition Switch.

bent as shown. This spring is then screwed to the edge of the board, said spring pressing against the other. The wires run underneath the floor boards, so that it is impossible to see them. The two springs are placed less distance apart than the length of a razor blade. A razor blade is then shoved down in the crack and the contact is made.

Contributed by
L. ARNOLD ENGEL, JR.

"PHONEY" LAMP PROTECTS CAR

I provide an "open" in the ignition circuit in the form of an electric light socket which can be placed over the speedometer or other desired place. The socket may be obtained at any garage and two *burnt*



The Car Can Be Started Only When the Short-Circuited Lamp is Placed in the Socket Containing the "Open" Lamp.

out bulbs are needed. The contacts on one bulb are connected or shorted by a wire. To operate the switch, the person, when leaving the car, takes the bulb with the contacts connected, out of the socket, and replaces it with the other bulb. Hence the ignition circuit is broken, but the stranger doesn't know where.

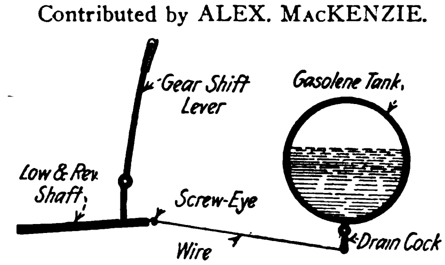
Contributed by LEONARD REXIN.

THIEF TRAP EMPTIES "GAS" TANK

In the illustration is shown sketch of how to prevent theft of certain types of cars which have gas tank under front seat. A hole is bored and tapt in the rear end of the shaft, which protrudes from the gear box when lever is in reverse, to take a screw or screw-eye. The latter is connected by a small wire to the arm of a valve in the bottom of the gasoline tank. Mr. Thief starts the car easily enough and shoves her into low. The valve opens, but he can't hear the gas trickling out. He gets into high—but he doesn't go far. The bigger the valve the less distance you will have to run after your car.

I would suggest that the concern which makes the auto spike lock for use on the car wheel, fix it so that it fits rigidly around one spoke. It could be done surely, tho it would cost a little more to make, but it would not be possible for the thief to deflate the tire and twist the spike around, as he now does.

Contributed by ALEX. MacKENZIE.



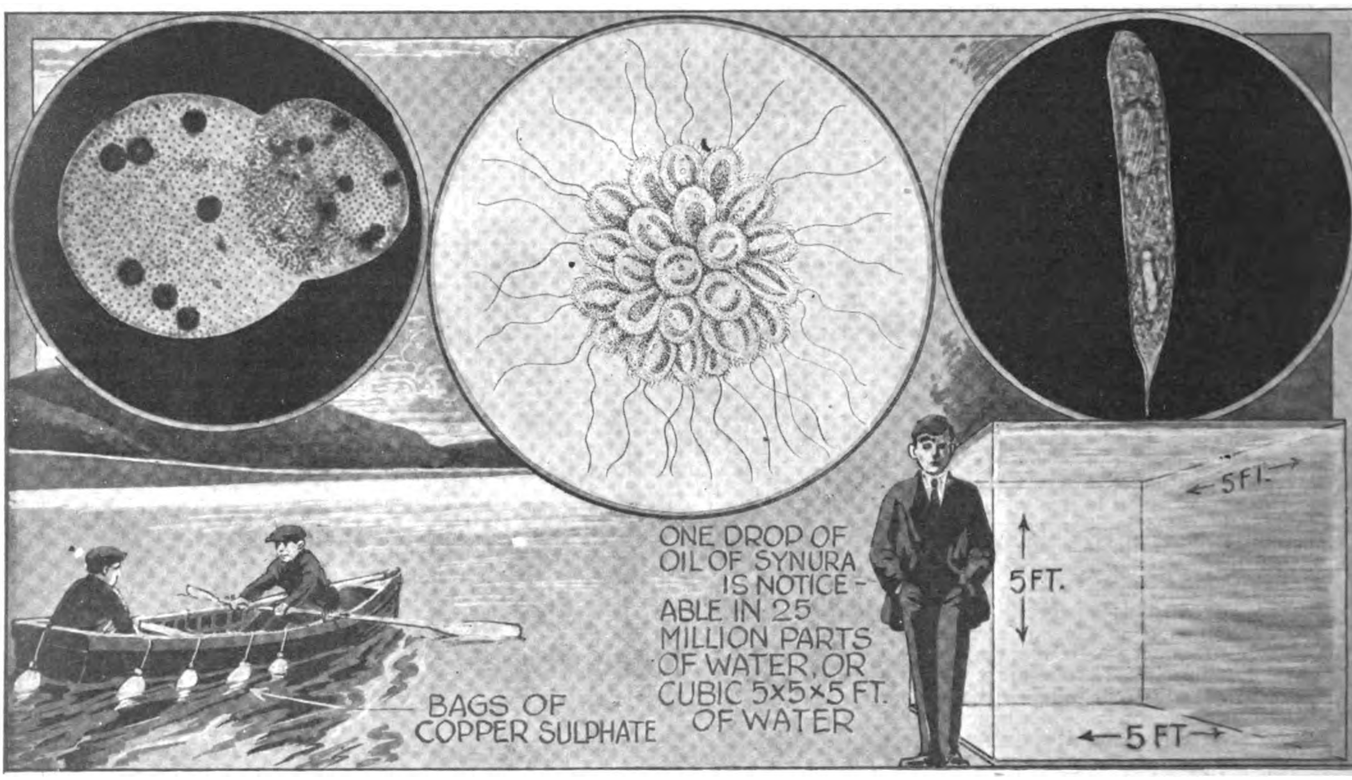
When Thief Starts Car Fitted With This Arrangement He Does Not Go Very Far Before the Gas Tank Runs Dry.

Synura Gives Oily Taste To Drinking Water

By DR. ERNEST BADE

IN the nethermost depth of the animal kingdom where plant and animals intermingle with each other to such an extent as to be indistinguishable, and where, at certain times, the plant becomes an animal and the animal a plant, tiny ciliated animals are found. These free swimming forms propel themselves forward with thread-like appendages which whip the waters. They are masters of motion when observed under the microscope. And these whip-like structures origin of the more complex structures can be found. The method of reproduction is primarily a division of the cell substance, and it occurs most profusely under favorable conditions. Colonies are produced when individual animals do not become separated from their parent. But then the colony would soon grow to enormous size, and the inner animals would soon be killed by the pressure exerted by the outer ones, if no limiting factors were present. Therefore such reproduction is *individual is 30 microns and the diameter of the colony is 60 microns; each micron is 1,000th part of a millimeter and the millimeter is .03937 part of an inch.*

Each cell-animal has two *chromatophores.* These are well defined plasma particles of slightly denser consistency, of a definite shape, and yellowish brown in color. Altho chlorophyll (green coloring matter in plants and algae) is present in Synura, it is masked by the yellow color. These chromatophores, which only



New York City's Drinking Water Recently Acquired a Disagreeable Oily Taste, Traced Directly to the Synurae—Little Oil Bugs, as We Might Call Them in Every Day Parlance. The Synurae Are Seen Under the Microscope in Colonies, as the Central Cut Herewith Shows. The Two Smaller Photos Show Similar Organisms Which Sometimes Cause Trouble in Drinking Water. The Reservoir in Which the Synura Happens to Thrive is Cut Off from the Main Pipe Line, and the Water Treated With Copper Sulfate; Bags Containing this Chemical Being Hung Over the Sides of a Boat, Which is Rowed Around on the Surface of the Water. The Amount of Oil Produced by Each Synura is Exceedingly Minute, but Can Be Detected in a Dilution of One Part in 25,000,000 Parts of Water. One Drop of Oil in 300 Gallons of Water is Quite Noticeable; This is Equivalent to a Drop of Water in a Cube 5 Feet on a Side, as Shown in the Illustration Above.

which appear to be nothing more than tiny strands of a contractile material are still a mystery to the naturalist, for he does not know how or whence they take their motion. It is a simple thread of plasma, which some observers say consists of lighter and darker parts, and therefore has some resemblance to cross-striped muscles of higher animals, whose "strength" one must assume. That this must originate in the nucleus, which is the center of energy in these tiny organisms, is undoubtedly true. But there is more than this. Where such a one-celled animal, or where a number of them have combined to form a colony and then possess a number of cilia as in Synura, it never happens that they become entangled nor do they beat the water indiscriminately, but always keep time so that they swim uniformly onward. Just like a ball do the colonies of Volvox, Synura, et cetera, roll away, rise and sink in this life-giving element, and are, in part, independent of the water currents.

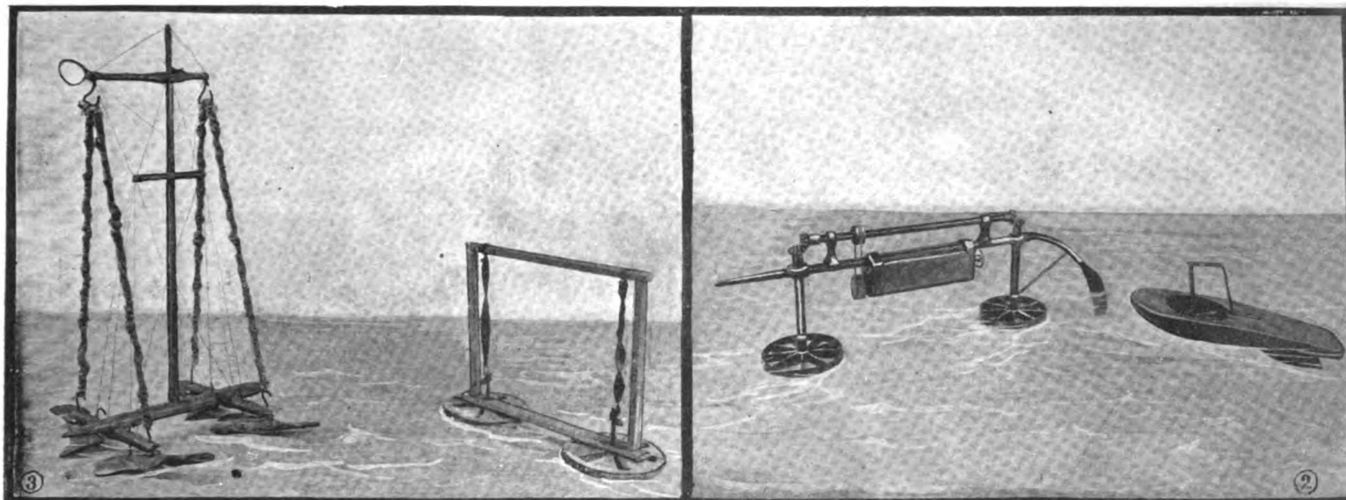
Where these one-celled animals unite to form a colony the first phases of the not at all suitable for any length of time, and for this reason only those ciliated animals unite which are male, female, or those which are not capable of copulating. So it can be said that this union is a stage in the division of labor. Reproduction thru division is only possible for a certain length of time. If for any reason this method is continued without cessation, then a gradual loss of vitality of the stock takes place. This decay and final death is prevented by conjugation. Reproduction and rejuvenation not only apply to the combining animals, but also to their progeny, while in the higher animals it only applies to the young.

The Synura is a pear-shaped individual, as the illustration shows, uniting with others to form a sphere which is surrounded by a skin-like covering. This covering can be likened to a vegetable membrane. Each individual cell of Synura is provided with two cilia, which are somewhat longer than the animal itself. The entire colony is yellowish in color and is capable of a rapid rolling movement in the water. *The length of each* multiply by division, give the animal its particular color. One or more *eye spots* are also present in each animal; their place can be taken by numerous scattered tiny bodies of a reddish color. But whether these eye spots can distinguish light or darkness has not as yet been definitely determined. In Euglenia, at any rate, the light distinguishing particles are found in the colorless protoplasm just before the red "eye" spot.

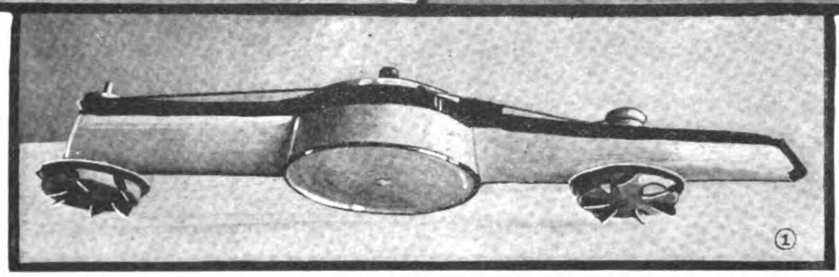
The life history of ciliated animals varies quite considerably with the different species. The majority of them eat solid food like other animals, some decompose carbon dioxid like green plants, while others absorb soluble organic substances like the chlorophyll-lacking plants. And since two of these mentioned methods of taking up their food is possible in one and the same form, these organisms are the boundary between the two great plant and animal kingdoms, and they cannot be definitely assigned to either kingdom.

The product *formed within the body* is a fatty oil whose composition is not at pres-

(*Continued on page* 1085)



A Few of the Models Entered in the Skipping Boat Contest are Here Shown. Above and to the Left is the Third Prize Winner, Constructed Entirely at Variance With Our Drawing, but Which Came Quite Close to Accomplishing the Sought-for Result. To the Right of This is the Second "Honorable Mention," very Simply Constructed. Further on, in Order, We Have the First "Honorable Mention," Which Follows the Construction Shown Originally.



At the Extreme Right in the Photo Above is the Second Prize Winner, Which Instead of Using Energy Stored Up in Rubber Bands, Depends Upon a Spinning Wheel for Its Action. This Was Rotated Forcefully by Cord Wound Around the Axle Much the Same as a Top Would Be Spun. At Lower Left is the Ingenious System Evolved by Mr. Ross, the First Prize Winner.

"Skipping Boat" Contest Winners

In the October issue of this magazine, we showed an idea about a boat that we thought might skip, the idea being taken from a skipping stone, as it skips over the water when given enough momentum. What we wanted to know was if a boat constructed on this principle was practical.

We are giving, herewith, the experiences of a number of constructors who have made models of boats on this principle, and we have the models in our possession. We have found, as the constructors have, that there is no immediate danger that the ships and boats of the world will become revolutionized, and we are much afraid that we will not soon travel across the ocean by the skipping boat method!

We have satisfied ourselves that the idea is impractical, and that a large boat constructed along these lines would never leave the water; that is, we do not think it could be made to skip. Nevertheless, there was much interest in the contest and many ingenious devices were submitted, including a score of models. We are publishing the prize winners, herewith. EDITOR.

First Prize $25.00

The photographs submitted show my choice of several attempts to skip the boat. A few tryouts and the difficulty of spinning a pontoon large enough to support one-half of the model became so apparent that I hit upon the idea of one pontoon with sufficient displacement to float the motor. The spring motor is of my own construction, consisting of the necessary clock work and a flat spring five-eighth inch wide by 12 feet long. The impulse of the spring is transmitted through a wooden pulley 4 inches in diameter, to the small pulleys on the propeller shafts. These small pulleys are about five-eighth inch in diameter at the bottom of the "V" belt groove and the belt is a waxed cord. The "V"-shaped tin-work in front and rear of the motor adds the displacement to carry the weight of the extra material.

The propellers are semi-pontoons 2½ inches in diameter. The propellers become pontoons when up to speed, and the body of the boat rises to the surface. With the propeller shafts perpendicular to the water the boat would rise to the surface and the pontoons would lash the water to a foam. There was no motion in any direction in the plane of the propellers. When the body of the boat was warped slightly, so that the left edge of the rear propeller was one-eighth inch low, and the right edge of the forward propeller correspondingly low, the boat would move foward or rather drift slightly forward after the motor had run down.

The rudder I fastened by a clip to the cross-brace on the stern. It was not used in any of my experiments and was overlooked when the photograph was made. I will add that I feel reasonably safe in saying that this method of propulsion will not be adopted universally by the builders of speed boats. MOWRY ROSS.

Second Prize $15.00

The model which I have submitted will skip for the very obvious reason that the excessive power which it is possible to deliver to the vaned disk is more than ample to lift its weight and move it in a forward direction, which forward direction of orientation is accomplished by the very simple method of placing the vaned disk, or lifting surfaces, at an angle suited to the forward motion. Please note that I do not employ any additional agent for the purpose of forward movement. WM. J. BEACH.

Third Prize $10.00

By my experiments and model I have proved to myself that the skipping boat idea is practical.

My model consists of four propellers each 4x1¾ inches, and 3¾ inches pitch, rigged in pairs fore and aft; the two starboard propellers turn in the same direction and opposite in direction to the port propellers. Thus any horizontal thrust that would tend to turn the craft about on a central axis is nullified. The shafts are not vertical, but inclined so that each pair have a common terminal thirteen inches above the propeller hull, twelve inches of each shaft is occupied by a rubber band motor, the motive power. All four motors are supported by a central mast rigged with a horizontal cross arm running fore and aft.

The helicopter principle of direct vertical lift is applied with difficulty in the air, but the density of water allows a vertical lift of healthy proportions, so much so that a craft of almost any design, partially or wholly devoid of buoyancy, can be lifted bodily to the surface under favorable conditions. To operate, set the motors, submerge the ship, and release all the propellers together. The vertical thrust of my model raises the craft high out of the water, so high that only the trailing edge of each blade touches the water. The tilted shaft permits but one blade to revolve in the water at one time. The other blade of each propeller meanwhile reciprocates or recovers in the air (a medium of lesser resistance), like the arm of a swimmer using the crawl stroke.

While the submerged blade is creating a nearly vertical lift, its drag or drift causes an active horizontal thrust in but one direction. This secondary thrust is created in the same direction by all four propellers. These two thrusts are what ye editor was fishing for and constitute the skipping boat theory. Perhaps a propeller could be designed, or the shaft made to jig or dance up and down, that would cause a craft of this kind to skip, but my model will not skip because it is dependent on propeller thrust for action. This thrust is produced by surface contact and to raise the propeller from the water deprives it of surface contact and diminishes its thrust. The density of water prevents the propeller from again entering it at its initial speed.

R. E. MULLIN.

First Honorable Mention

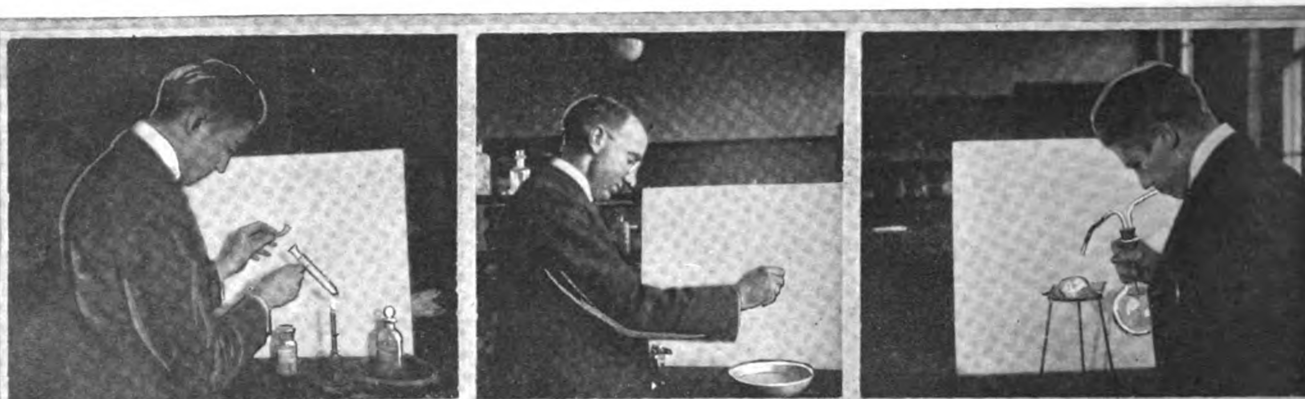
I am a reader of SCIENCE AND INVENTION, and in the December number I noticed that nobody seemed to want to take the chance of building one of the skipping boats. I have found that constructing one is quite a job. The first question is,

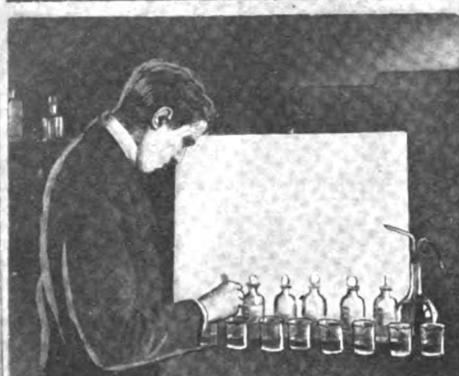
(*Continued on page* 1085)

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

CHEMICAL BASES





Top Left: Ammonia Evolved from an Ammonium Salt Turns Litmus Paper Blue.

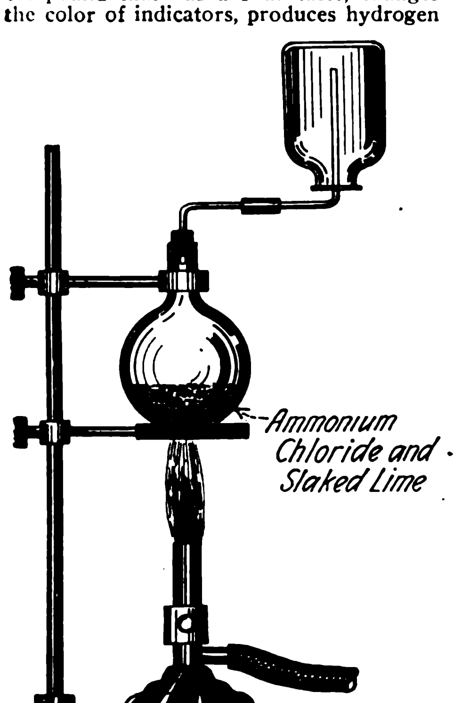
Center: The Reaction Between Potassium and Water, With Evolution of Hydrogen and Its Ignition.

Top Right: Calcium Hydroxid Prepared from Calcium Oxid Producing Evolution of Heat and Steam.

Lower Left: Various Indicators Tested With Alkalies and Acids to Show the Color Reactions.

Lower Right: Ammonia, Dissolved in Water Produces a Vacuum, Demonstrated by a Strong Jet or Fountain of Water.

IN the two articles immediately preceding this one we dealt with acids. As already stated the three fundamental types of inorganic chemical compounds are acids, bases and salts. Nearly all of the compounds with which we experiment in inorganic chemistry may be placed in one of these three classes. We have seen that an acid is a compound that has a sour taste, changes the color of indicators, produces hydrogen ions in solution and, as we shall now see, neutralizes bases to form salts.



This Illustration Shows Chemical Apparatus Set Up for the Preparation of Ammonia from Ammonium Chlorid and Slaked Lime.

But what is a base? What are its properties? Why is it as different from an acid as black is from white? These and other similar questions will best be answered by a series of practical experiments.

Bases and Indicators: Prepare 10 per cent. solutions of sodium hydroxid and potassium hydroxid by dissolving 50 grams of each in 500 cc. of water. Also have at hand ordinary household ammonia and a bottle of lime water. At the same time prepare fairly strong solutions of sulfuric, hydrochloric and nitric acids. These may be about 1 to 4 or 5. (*Always remember to pour sulfuric acid into water —not the reverse.*) In another bottle have strong acetic acid.

For indicators we will use litmus, phenolphthalein, and methyl orange. To prepare the litmus solution boil a small number of litmus cubes in a beaker of water, allow the solution to cool and pour off the clear liquid. The phenolphthalein solution may be made by dissolving a little in alcohol. About 1 gram of the indicator to 100 cc. of denatured alcohol will be sufficient. For methyl orange dissolve 1 gram of the substance in a few cc. of alcohol and dilute with water to a volume of about a liter. A quarter of this quantity will be ample for your use.

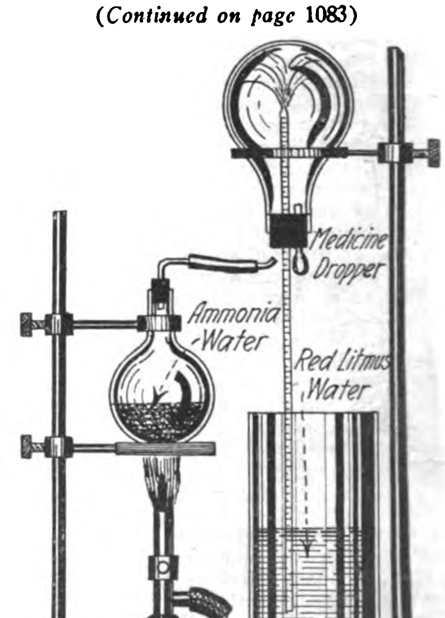
Now arrange a row of eight small beakers on your laboratory desk. In the first place a few cc. of sulfuric acid, in the second sodium hydroxid, in the third hydrochloric acid and so on, making every other beaker first an acid and then a base. Dilute the contents of each beaker with a little water and then add to each in succession litmus solution. The acids, as you will observe, give a red color and the bases a blue.

Dividing the beakers into four pairs mix the contents of each pair. Note and explain the color changes that occur.

Empty and rinse your beakers. Then repeat the above demonstration using phenolphthalein indicator. Note that the bases give a pink color while the acids give no color at all.

Again repeat using this time methyl orange indicator. By mixing the various acids and bases that you have, you will

(*Continued on page* 1083)



Here We See the Necessary Chemical Glassware to Produce the Interesting Effect of a Fountain in a Vacuum. The Tube Extending from the Ammonia Water Flask is First Used for Filling the Inverted Flask with Ammonia Gas and the Cork Subsequently Inserted.

Wood Phonograph Tone Arm and Reproducer

By PAUL M. WILHELM

FROM time to time we find descriptions and drawings of "To-be-made-by-the-amateur" reproducers, but to my knowledge there have been none which really bring about the desired results. They all give forth a certain metallic sound which is harsh and unyielding. The use of wood seems to offer the only remedy.

All that is needed to make the reproducer described in the following description are a few woodworking tools and a small bench wood lathe. A glue pot and a good quality of glue is also needed, for all parts that are joined should be glued. The work proceeds as follows:

The *sound box* is first turned from a piece of any close-grained solid wood, well seasoned. The outside dimensions may be changed slightly, but the cup or sound chamber must be kept close to size; also the small projection on the rear, as this must fit snugly into the recess turned into the *tone arm*. Sandpapering the outside will add to the appearance of this and all other wooden parts.

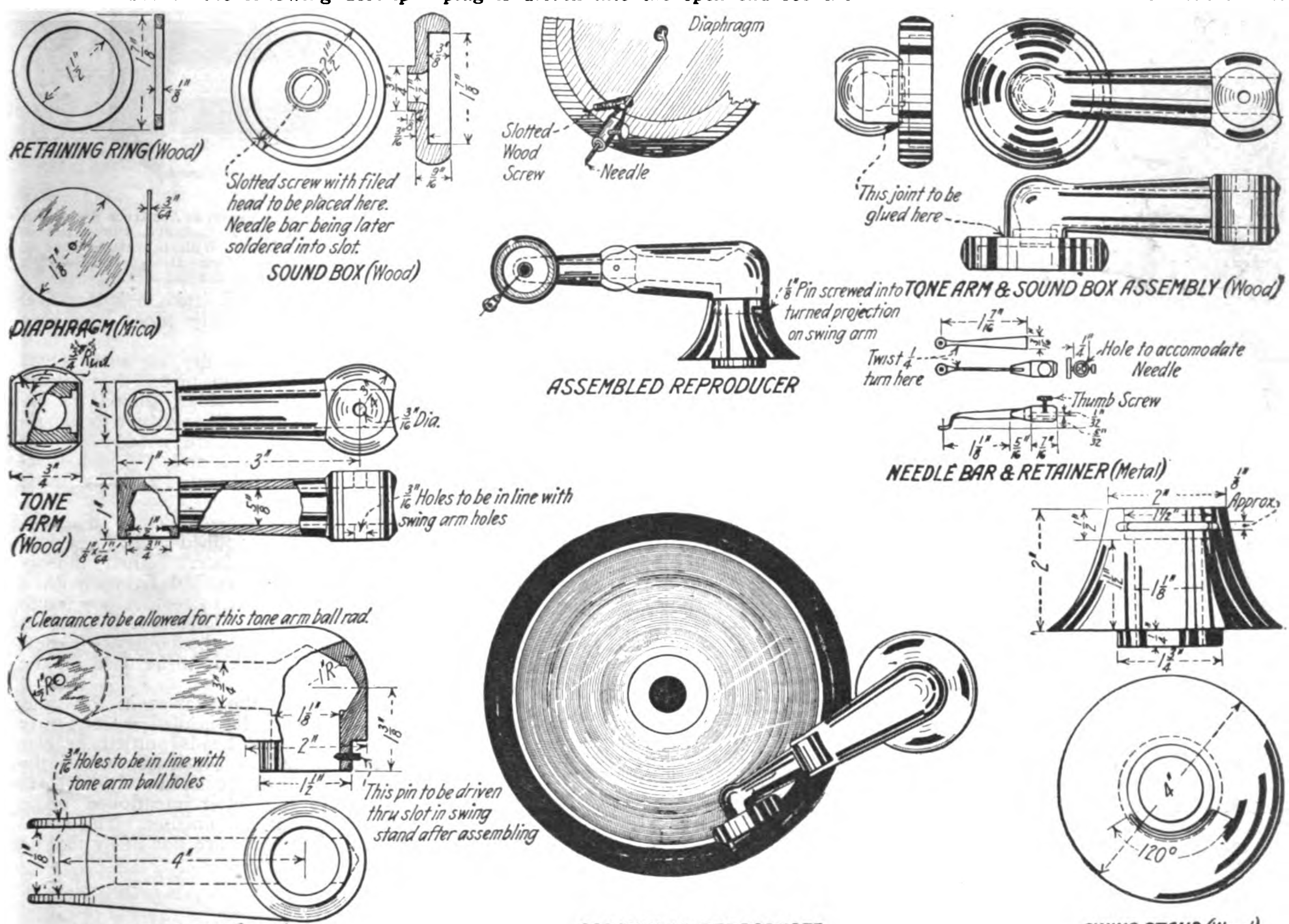
The sound box is turned from a piece of wood as closely resembling the other in quality as possible. Both the longitudinal and lateral holes are drilled in the rough piece. A surplus of stock is allowed to remain on the square end for centering one end in the lathe, while a plug is driven into the open end for the second center. This plug should have a slight shoulder on the outer end to expedite removal after the outside is finished, and the ball has been turned on the end. The square is now finished with hand tools.

The retaining ring is very simple, being turned from a piece fastened to the face plate, the outer end, inside and outside being turned first and the cutting off left until last. The outside diameter should be held to a close fit in the sound box. The cutting off is accomplished with a cutting-off chisel or hand sawed and filed.

The diafram is cut from a piece of sheet mica and filed or turned to dimensions. The hole in the center may be changed to fit any small rivet to be found. Handle the mica gently, so as not to shatter it.

A block of wood, two or three inches longer than the finished piece must be, is swung from the face plate or jaws of the lathe. The outside dimensions of this should agree with those of the *swing stand* on the drawing. The recess in the top is the most particular measurement as this latter accommodates the swing arm. The groove or slot is cut ¼ inch from the top and about one-third of the way around the piece.

For the swing arm a piece of wood 5½ by 2½ by 2⅛ inches is laid off as follows. One and three-quarter inches from the end and on the 2¼ in. face, a small mark is



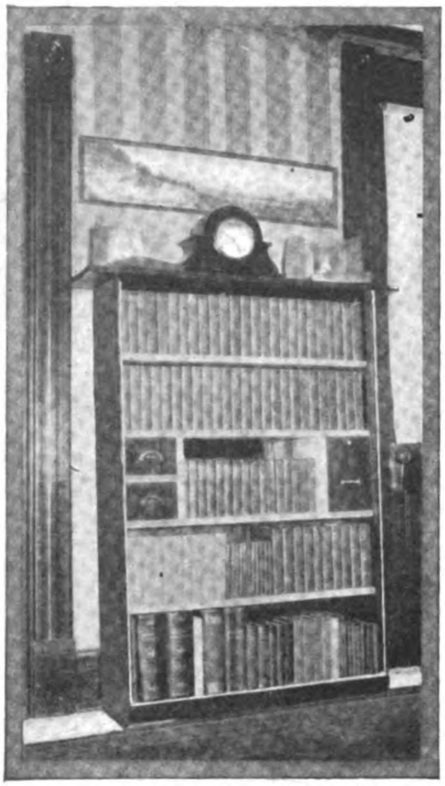
The Drawings Above Show a Very Practical and Interesting Phonograph Improvement Which Anyone Can Build Themselves, Even Without a Lathe, Simply By Boring the Necessary Holes With Wood Bits, including an Expansion Bit Perhaps, and the Judicious Use of Saw, Rasp and Penknife. Some of the Best Phonographs Today Are Fitted With Wooden Tone Arms; One Well-known Type Being Pivoted in a Ring of Ball Bearings at the Base. Mahogany, Such as Used in Making Patterns, is a Very Fine Stock to Build it From, as it is Close-Grained and Takes a Good Finish. Any Hard Wood is Preferable to Soft Stock.

(*Continued on page* 1052)

Making a Bookcase for the Home

By O. Stevens King

HERE is an ideal plan for a bookcase; and it is just the thing for the man about the house who wants to make a useful and attractive piece of furniture for the home. The one special feature of it



Actual Photograph of Home-made Bookcase of Novel Design. Three Drawers Are Provided and the Size of the Bookcase Can of Course Be Varied,

is, that it has three good sized drawers which always come in handy. It will also be found that this bookcase will find a place in the living room or the library, where no other piece of furniture seems to fit well. The bookcase is not difficult to construct and can be made during spare hours.

First in planning the bookcase comes the choice of the wood. Oak is always a good choice, but it is rather expensive and being a hard wood, is difficult to work with. A fine grained Georgia pine, that is well seasoned makes a nice wood to work with, and is inexpensive. The same can be said of cypress. If the bookcase is to be painted one solid color the choice of wood is not so important.

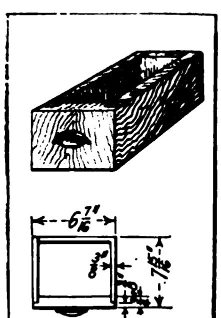
After the selection of the wood has been made, the sizes of the boards used are the next to be figured. Except in the drawers, ¾-inch boards are used thruout. About 28 feet of 8-inch width, and 4 feet of 10-inch width boards will be needed. The wood is to be finished up into the following sizes:

- 2 Side boards .... 8"x52"
- 1 Top shelf .... 10"x42"
- 5 Shelves .... 8"x33"
- 1 Bottom piece............ 2"x34½"
- 2 Vertical drawer supports 8"x 9¾"
- 1 Horizontal drawer support 8"x 6½"

When these pieces are sawed out, planed and sandpapered, the wood for the bookcase proper is completed. Then the two side boards are taken and ⅛-inch holes are bored according to the measurements given at left. In boring these holes it should be noted that the two holes for the smaller drawer support are only to be bored in one of the side boards.

In making the bookcase, the drawers are optional and if preferred it can be made without them. In this case the vertical and horizontal supports are not needed. In making the drawers, the front pieces are made of ¾ inch, and the sides, bottoms and ends of ⅜ inch stuff. The latter can generally be had from boxes, which the grocer will gladly give for the asking. The exact sizes of these pieces are given in the chart of measurements below. When making these, reference should be made to detail of the smaller drawer (see cut below), in order that the sides of the front pieces shall be properly sawed out and the general make-up of the drawer shall be understood. The drawers are just nailed, but they can be nailed and glued too, if it is preferred. If the case is to be all in white, glass knobs, instead of metal or wooden handles, make the case look more attractive, and a lock put on one of the drawers will prove handy on some occasions. The illustration shows the lock on the larger drawer.

When all the boards have been finished and the drawers have been made, the application of the stain will come in order. From experience the writer recommends

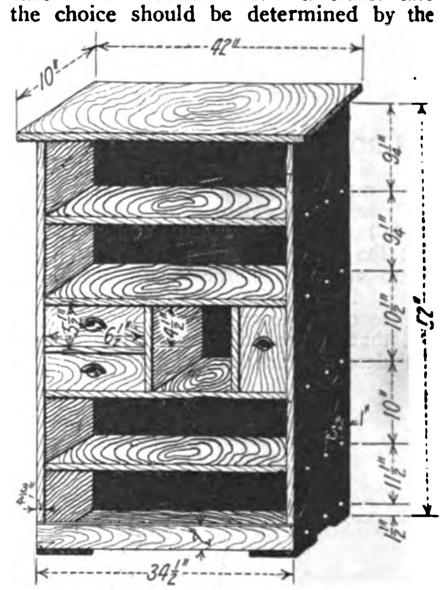


Smaller Drawers	
Front	6 7/16"x 4 7/16"
Sides	7 9/16"x4 7/16"
End	5 11/16"x 4 1/16"
Bottom	7 3/16"x 5 11/16"
Larger Drawer	
Front	9 11/16"x 6 7/16"
Sides	9 11/16"x 7 9/16"
End	9 5/16"x 5 11/16"
Bottom	7 3/16"x 5 11/16"

Chart of Measurements

The Drawing Above Gives Details for Building the Bookcase Drawers, as Well as Data for the Width and Length of the Front, Sides, etc.

a wood stain which is free from varnish for the best results. If the shelves are to be in white as shown in the photographic illustration herewith, they should be given two coats of flat white paint and then one coat of white enamel. They can be stained the same as the rest of the case if it is so desired. In either case the choice should be determined by the



All of the Principal Dimensions Are Here Shown for Building a Home-made Bookcase, Illustrated in the Photo at the Left. With the High Cost of Furniture Nowadays, This Design Will Prove Valuable to the Student.

furniture with which it is to harmonize. With the drawers only the front faces are stained.

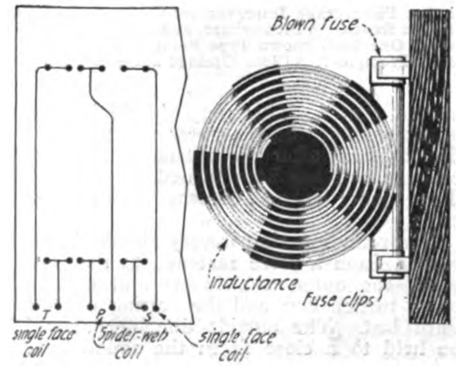
When the stain is dry the main parts of the case, the top piece, the bottom piece and the two sides, should be assembled, so that it will be easier to handle while finishing. Where needed ⅛-inch holes can be bored and 1½-inch flat-headed screws can be used and the heads puttied over.

After the case is assembled in this way, a coat of filler is applied and allowed to dry in a warm place. When thoroly dried it should be rubbed lightly with a fine sandpaper, so as to remove any rough spots on the wood. One coat of varnish is then applied and the bookcase is left to dry. No varnish is to be used on the white enamel.

When putting the shelves in the case, either 1½-inch flat-headed screws are used and then the heads puttied, or else the round headed blued screws of the same length can be used. Either are satisfactory, the latter mentioned being best with the darker finishes. The vertical drawer supports are put in by nailing them to the shelves.

Pancake Coil Mounting

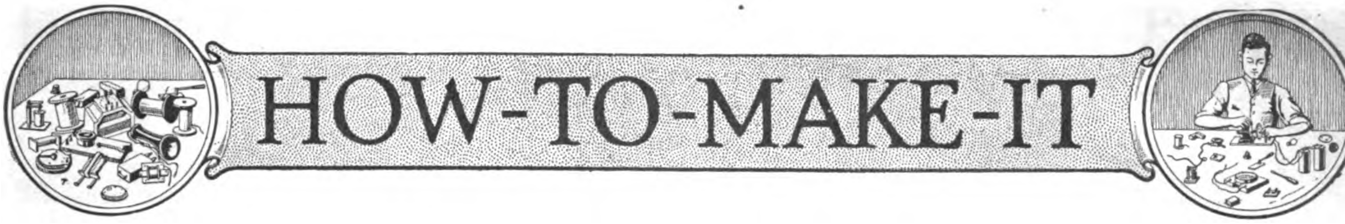
I have been comparing the honey-comb inductances and spider-web inductances; both are trimmed in the same manner, but they differ in two points: 1—winding; 2—selectivity of a set. The honey-comb coils are interchangeable, why not the spider-web? In illustrations herewith the apparatus is shown. This apparatus permits the now fixt inductances to be varied only by coupling. By loading a small inductance, the signals will be found to be very weak. The new apparatus, as I have designed it, permits large coils and smaller ones to be used on same stand. There is another point in construction that I have noticed. The wires on the primary have a face toward the secondary. The tickler and secondary



have also a double face. If the winding of the latter two coils might have the winding on only the face (nearest the primary), there is increased efficiency. Of course the

A Simple and Effective Mounting for Pancake Tuning Inductances, is Here Illustrated. Honey-comb and Spider Web Inductances Are Gaining More Favor Every Day, so That This Mounting Will Prove of Interest to "Radio-Bugs."

cardboard or frame of the coils, does not affect the induction appreciably, still attention to small details strengthens the signals. Contributed by FRANCIS McEVANEN.

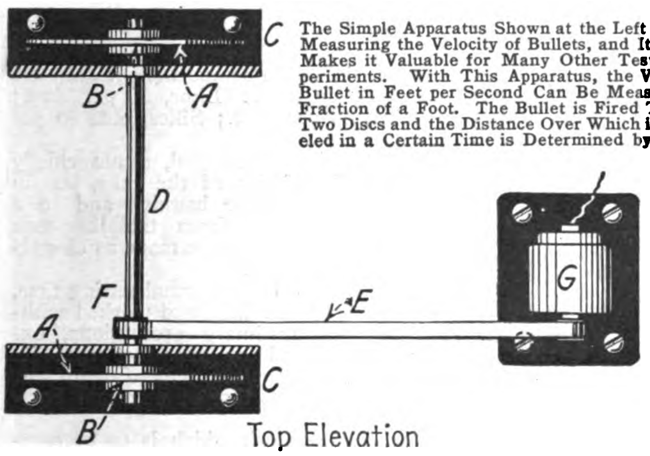


This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea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

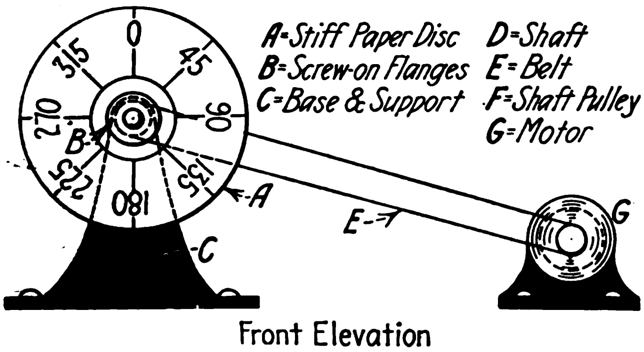
FIRST PRIZE, $15.00

MEASURING THE VELOCITY OF BULLETS.

Does it seem impossible to "time" a high-velocity bullet in flight, and not only that, but to tell, to the ten-thousandth part of second, how long it will take that bullet to travel ten feet? And this by actually timing the bullet for ten feet? By means of a device invented by Cleve Hallenbeck, of Roswell, New Mexico, this can be done, and the velocity of the bullet, in feet per second, can be measured to the fraction of a foot.



The Simple Apparatus Shown at the Left is Useful in Measuring the Velocity of Bullets, and Its Simplicity Makes it Valuable for Many Other Tests and Experiments. With This Apparatus, the Velocity of a Bullet in Feet per Second Can Be Measured to the Fraction of a Foot. The Bullet is Fired Through the Two Discs and the Distance Over Which it Has Traveled in a Certain Time is Determined by Noting the Velocity of the Discs, and Measuring the Angular Distance Between the Bullet Holes in the Front and Rear Discs.



The apparatus, like that used for measuring the length of light waves, is simplicity itself. The figure shows mechanical drafts of the front and top elevations of the device. It consists essentially of two circular discs of stiff paper, about three feet in diameter, mounted on a shaft, D, which is rotated rapidly by the small electric motor G, through the belt E. One disc is placed on each end of the shaft, and held in position by means of the screw-on flanges B.

Each disc is ruled with equally-spaced radii at suitable degree-intervals, and are placed on the shaft so that their lines are parallel to each other, or exactly "in line" with each other.

The rifle to be tested is held or fixed so that its barrel is parallel

(*Continued on page* 1065)

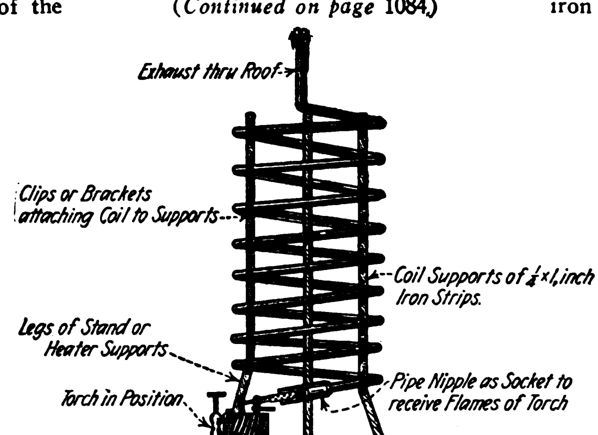
SECOND PRIZE, $10.00

BLOW TORCH AND PIPE COIL HEAT ROOM

The accompanying illustration shows how an ordinary gasoline blow torch and a coil or iron piping serve as an efficient heater for a cold room of the dwelling or office in winter.

A spiral coil of 1½ inch galvanized iron piping stands four feet from the floor of the room, as shown. The coil, whose diameter is two feet, is made by heating a few inches of the pipe at a time in the forge and bending around a circular body, eight complete convolutions being made. To provide a stand for the pipe heater, three pieces of ¼x1 inch strap-iron stand vertically

(*Continued on page* 1084.)

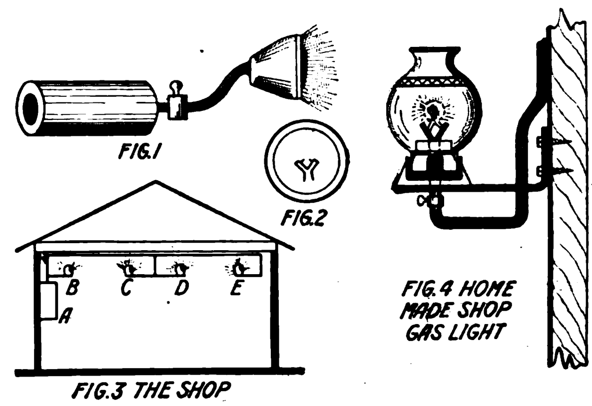


This Arrangement for Heating a Room or Laboratory, Comprises a Coil of Iron or Other Metal Pipe Supported on Light Iron Strips, Together With a Gasoline Torch, the Nozzle of Which is Placed in the Lower End of the Pipe Coil. This Gives a Large Superficial Radiating Surface for Heating.

THIRD PRIZE, $5.00

"HOME MADE LIGHTING PLANT"

Having much extra work in an all-around repair shop and having given trial many kinds of lighting for night work, the electric, oil and city gas, all had certain evils without counting the excessive expense attached for many lights. The brilliant lighting effect secured on auto trucks by the use of acetylene gas lights being noted and learning of their low operating cost, a second-hand pressure gas tank was secured together with tubing of metal and many burners such as is used in the truck head lights.

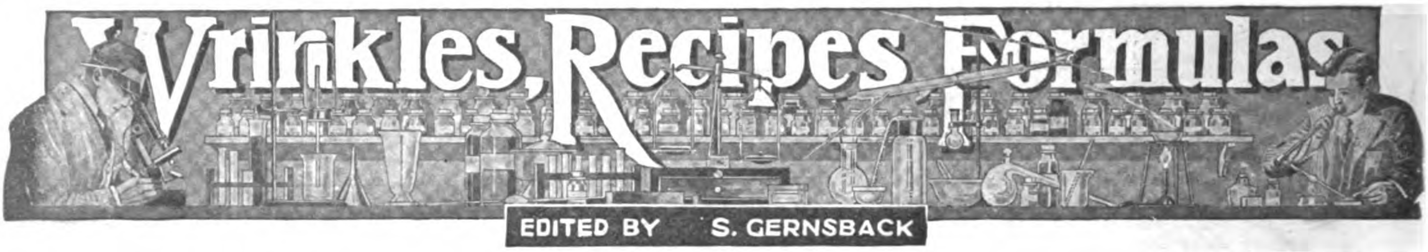


For the Home Shop and Laboratory, the Improvised Lighting Plant Here Illustrated and Described Will Be of Interest. The Author States That He was Greatly Imprest With the Brilliant Lighting Effect Secured on Auto Trucks by the Use of Acetylene Gas Lights, and With This Idea in Mind He Obtained a Second-hand Pressure Gas Tank Together With Some Metal Tubing and Burners of the Same Type as Those Used in Auto Head Lights.

Next, the tank, some 8x36 inches, was mounted in a corner of the shop and metal tubing was taken from it to all vantage points for lights. Next we procured several cheap kerosene lamp burners and large chimneys to fit same, by mounting these burners and holders on iron hangers, the latter made of scrap iron straps, and installing the gas burners in the tops of the oil burners and connecting the same beneath to the metal tubing by means of rubber connections, the gas burners were complete.

Fig. 1 of the drawing shows plainly the nature of the gas tanks and connections to head light as used on auto trucks. Fig. 2 shows face view of head lights and in the center will be seen the outline of the acetylene burner which is double fork with pin holes in each for directing its gas spray at angles and when lighted the impinging sprays produce a brilliant light. When the tank becomes exhausted, it is taken to a garage and exchanged for a a full one. Fig. 3 drawing shows the shop building outline and lighting system pertaining to same. Note tank on wall at A, and lamps at B, C, D and E.

Contributed by R. C. LIEBE.



Monthly Prize $5.00

A PHOTOGRAPHIC BAROMETER

Every cloud is a weather sign, even fog. Fog in the morning shows that it will be a nice day. To continue with the clouds—low clouds that move swiftly tell us that rain is on the way. Hard edge clouds indicate wind, clouds that look rolled or jagged, foretell a strong wind. Look out for rain when the sunset in the sky is yellow or greenish, also when the sunrise is red. When the evening sunset is red and the next morning is gray, the day will be fair.

Rain is foretold by a circle around the moon. If there is rain before seven o'clock, it will be fair before eleven o'clock. When it rains and an east wind is blowing, the rain will last for quite a while. A sudden shower is soon over, but one that is slow will last long.

In the morning if you see dew on the grass, it will not rain during the day; but if a dog eats grass it shows that rain is bound to come.

Winds from the east bring rain. Winds from the west bring clear, bright and cool weather. North winds bring cold weather, while south winds bring warm weather. There are many other ways to foretell the weather but they are difficult, so I have not attempted to describe them.

And now I shall tell you how to make a photographic barometer. Look among your negatives, select one which has 2 or 3 figures in the landscape. Make a good bromide print of it. Before we can proceed further, however, the print must be thoroly hardened in a 10% formalin bath. Then prepare the following:

Water .... 3½ ozs.
Gelatin .... 30 ozs

Dissolve with the aid of heat and add:

Cobalt Chlorid .... 30 gr.
Glycerin (water free) .... 20 drops

Coat the sky carefully with this mixture. If you have the water colors with which prints are colored, you may add further beauty to this barometer by coloring the foreground with the proper shade of green, or whatever colors are necessary. You may now mount it in any way that appeals to you, tho, of course, no glass should be put over it. Place it in a sheltered position on the porch, and in fine weather the sky will be blue, while in damp weather it will be red.

No doubt the change in the color of the sky will seem like a miracle, but a student of chemistry will tell you that it is due to the action of moisture on the cobalt salt.

Contributed by JOHN YURGIONAS.

CEMENT FOR CELLULOID

Celluloid may be cemented with acetone collodion. Among other adhesives suggested for this purpose are the following:

1.

Shellac .... 1 part
Camphor .... 1 part
Alcohol .... 4 parts

Dissolve the camphor in the alcohol, and in this solution dissolve the shellac.

2.

Celluloid Scrap and Filings .... 5 parts
Ether .... 3 parts
Amyl acetate .... 3 parts
Acetone .... 6 parts

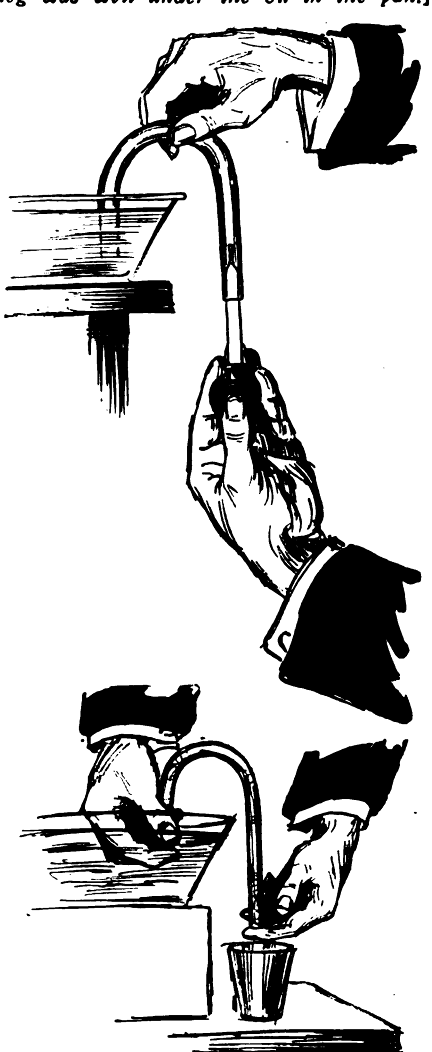
This preparation is very inflammable.

STARTING A SIPHON

The ordinary glass medicine dropper or pipette often comes to our rescue in experimental work. The illustration herewith shows a handy application of the pipette in starting a siphon. The pipette is placed in the lower end of the siphon and the rubber bulb contracted. When the bulb is released a partial vacuum will be produced in the siphon, and liquid will be drawn up into it and the regular siphon action thus started.

Contributed by THOMAS ELKINS.

[Editor's Note.—Several years ago we had occasion in the laboratory to empty several large pans of oil, and a very simple method of starting a siphon to empty the pans was evolved. The illustration shows how a piece of ⅛" iron gas pipe bent to the usual U-shape, with one leg a little longer than the other, was filled with oil before placing the shorter leg in the oil pan. Two fingers were held over the two open ends of the siphon after it was filled with oil from an oil can, and the siphon carefully put in place; then the fingers were removed, but not until the shorter leg was well under the oil in the pan.]



The Top Figure Shows How a Glass Pipette or Medicine Dropper May Be Inserted Into a Siphon Tube, and a Partial Vacuum Formed by Squeezing the Bulb and Then Releasing It. The Lower Figure Shows How Oil or Other Liquid May Be Siphoned in a Dish or Pan With a Piece of Gas Pipe or Rubber Tube, Bent to the Shape Shown. This Tube is Filled With Liquid and Then Inverted, Removing the Fingers From the Tube Ends When the Shorter Leg is Under the Liquid in the Pan.

QUICK HARDENING CEMENT

In the course of the Great War, a cement of a very remarkable type and properties was put into use by the French for special military purposes. Its high technical value, in certain limited fields, make it worth while to discuss its characteristics. It is a lime aluminate, differing from normal Portland cement in its small percentage of silica, and that it is almost white in color; and will harden with such rapidity as to support heavy guns within 24 hours. The cement, known as the LaFarge patent, is made in a small blast furnace, which is charged with coke, limestone and bauxite (impure aluminum oxide). When the furnace is in steady operation it turns out from ten to fifteen metric tons of fused slag or clinker. In composition it does not vary greatly from: Lime, 50 per cent.; Almina, 40 per cent.; Silica, etc., 10 per cent.

Silica, it is to be noted, comes chiefly from the impurities of the coke, but in lesser part from the bauxite, and to a very slight extent from the limestone used. The cement can be made as cheaply as Portland cement.

Fused cement has a normal setting time, can therefore be mixed and worked without any extraordinary precautions, except as entailed by the fact that its hardening takes place with far greater rapidity than does that of a normal Portland cement.

For marine work which is to be completed between two tides, it is a satisfactory material, and is also resistant to marine action.

Contributed by WM. R. REINICH.

PHOTOGRAPHING HIGHLY POLISHED SURFACES

The failure to photograph objects with highly polished surfaces cannot always be attributed to a lack of skill, but more often to a lack of knowledge of the manner in which to properly overcome these obstacles.

The first thing to do is to make a careful study of the object to be photographed. The use of dodges, such as putty, to overcome the violent reflections from polished surfaces, frequently changes the textural quality of the object; for instance, silver objects may appear to be made of wood in the photograph. The success or failure in effectively photographing polished objects is mainly a question of the proper illumination.

Because the angle of reflection equals the angle of incidence, the illumination should be arranged so that the reflection is away from the lens. Direct front light is impossible, and to safeguard against this a dark curtain should be hung not too far in front of the object, leaving a small aperture for the camera eye.

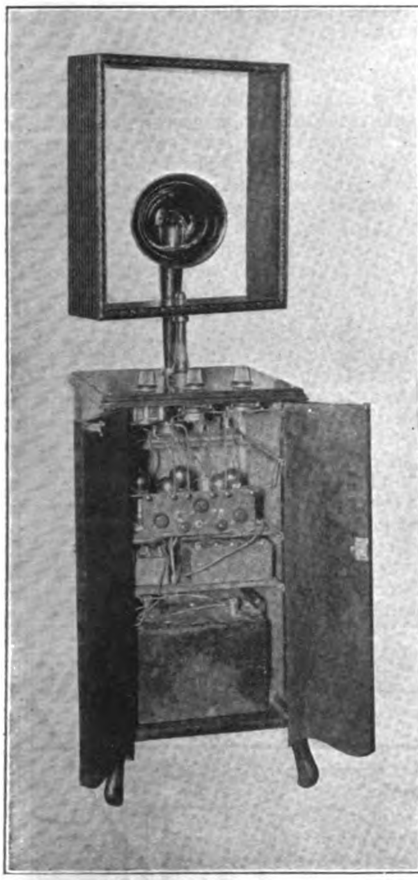
The light from one side and the top should be cut off, concentrating the light so that it comes from one direction, and is made to fall on the object at an angle of 45 degrees. Inspection in the ground glass will show the object with all the outline in fullest details; but the shadows will appear very dark because high glosses show up black when in shadow. Follow the old rule and expose amply for shadows and allow the high spots to take care of themselves.

Contributed by WM. R. REINICH.

How to Build a Radiotrola

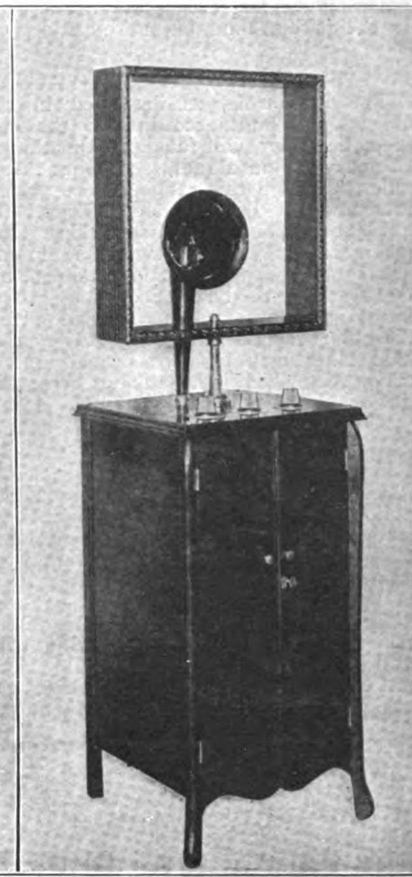
By H. GERNSBACK and R. E. LACAULT

The instrument that provides your home with free grand opera, lectures, sermons and jazz



View of the "Radiotrola" With Doors **Opened, Showing Storage Battery, Audion Control Panel, and a Magnavox in the Rear With Its Horn Projecting Thru the Top.**

This Photograph Shows the "Radictrola" in Our Offices, **Picking Up and Reproducing Thru the Magnavox Horn, Radiophone Music from W.J.Z. Broadcasting Station at Newark, N. J.**



Another View of the "Radiotrola" With Doors **Closed, Showing the Neat Appearance of the Instrument, Which Would Prove an Ornament in Any Parlor.**

IN a recent article in *Radio News* we made mention of the *Radiotrola*. Mr. Gernsback coined this word, the meaning being that the instrument was supposed to take the place of the present victrola phonograph, or at least make a good substitute for it. There is, of course, nothing fundamentally new about the *Radiotrola* with the exception of the novel designs used in this machine. The chief novelty is that no aerial and ground are used at all with the instrument, but the use of the loop is resorted to with good results.

The Radiotrola was designed and constructed by the authors for the private use of the editor, who desired to satisfy himself that it was practical. It is a well known fact, understood by all to-day, that radio is becoming more and more popular not only with the radio "bug" but with the man in the street, with the housewife, with the business man—as a matter of fact with everybody. It is realized that the average layman does not wish to be bothered with technical details. All he wants is a machine, which, placed in his house, will bring him music, concerts, opera, jazz, etc., without being asked to become a radio expert.

The *Radiotrola* as a matter of fact, can be used by anyone once a little instruction has been given him.

We do not think that the machine which we show here is the ultimate. It is simply the first of its kind, and for this reason naturally not the sort of machine which we shall see five or ten years hence. But it is a start, and works satisfactorily, bringing in at a distance of fifteen miles from W.J.Z. (Newark, N. J., Broadcasting Station) the music and concerts loud enough to be heard throughout a large loft.

The efficient range of this instrument with a loud talker is probably not more than fifteen to twenty miles, although it could be considerably increased with more stages of amplification, but the *Radiotrola* is provided with a set of phones that can be plugged in while the magnavox loud talker is cut out. In that case, the range is increased to fifty or seventy-five miles. The instrument was built with a view to do away with all unsightly wiring, aerial and ground, and to resemble the standard make phonograph as much as possible.

The cabinet used is by no means a regular phonograph casing, but is nothing but a record cabinet, and the style used by the authors is shown in Fig. 2. This cabinet of mahogany was bought in a retail store for $12. While a much larger cabinet could have been used, it was thought best not to do so for the reason that the loop would have extended up to an inconvenient height, and the instrument would have looked too cumbersome. While the instruments are somewhat cramped in the small space of the cabinet, it is also true that the apparatus is very compact and rather business-like, and above all it does work nicely.

It was found best to put the main switch right into the battery circuit, which switch when closed lights up all the filaments and connects the magnavox as well, all simultaneously. Thus if the adjustments have been made once, it is not necessary to make them again (except for very slight variations), as, for instance, when listening to a lecture. It was found that with the magnavox, music would come in very well, and with the same adjustment spoken words come through rather loud, but not so clear. By merely detuning the last circuit the words come in, not quite so loud, but more distinctly.

Construction of the Radiotrola

The Radiotrola, as described in this article, and built according to the data given hereafter, will function at maximum efficiency within a radius of about fifteen miles, although this range can be greatly increased; it depends chiefly upon the local conditions of installation. For longer ranges, another stage of radio frequency amplification should be added, but this was not used in the original instrument, which was to be employed within the radius mentioned above. Any type of loud taker may be used instead of the magnavox, which is installed at present in the original Radiotrola.

The Amplifier

In conjunction with the loop aerial, which acts as the tuner, a combination radio and audio-frequency amplifier is used. The circuit, Fig. 1, shows in detail the connections between the various elements which are numbered for reference. In this circuit, No. 1 is the loop aerial consisting of a wooden frame 20x18 inches and 4¾ inches wide, wound with ten turns of Litz wire, or small cable composed of several strands of fine copper wire, spaced ½ inch apart. No. 2 is the .001 mf. tuning condenser with a small fixed capacity of .0005 mf. in parallel, which may be connected by means of a small switch. With this capacity, the range of wave lengths which can be tuned is about 260 to 600 meters. No. 3 is a potentiometer used to vary the grid potential of the two first tubes acting as radio frequency amplifiers. No. 4 is the radio frequency transformer which is shown in detail in Fig. 3. The primary consists of 65 turns of No. 40 S. C. C. enameled copper wire, the secondary is wound with 75 turns of the same wire.

In order to tune the radio frequency amplifier, which is of the resonance type, two small variable condensers are shunted across the primary of the radio frequency transformer and the honeycomb coil L75, which gives a regenerative effect, since the plate circuit of the second tube may be tuned. It is important that the radio frequency transformer and the honeycomb coil be mounted at right-angles to prevent induction between these circuits and production of continuous oscillations causing whistling in the receivers. It should be noted that either AP or Myers RAC3 tubes must be used for the radio frequency amplifier, as these tubes, having less internal capacity than the others, give better results.

The detector tube may be of any make, although a non-critical one is better, not needing so much adjustment; the amplified oscillations are applied on the grid of the detector through a small fixed condenser, No. 8, of about .00025 mf. capacity, a grid leak No. 9 of suitable resistance, keeping the grid at the proper potential for best rectification. The audio frequency amplifier is of the ordinary type, the two stages being coupled by iron core transformers No. 10. A jack, No. 12, is provided for plugging in a pair of phones when it is desired to use the Radiotrola for long distance reception; when no phones are plugged in, the jack automatically connects the loud talker in the plate circuit of the last tube.

In the original instrument, a magnavox was used, the field of which was supplied by the amplifier "A" battery, a switch, No. 6, being provided to cut it off when not in use. For best results with this type of loud talker, a high plate voltage is necessary, and in the Radiotrola, 160 volts furnished by four 45-volt "B" batteries were applied on the two last stages of audio frequency amplification, only 90 volts being used on the radio frequency amplifier.

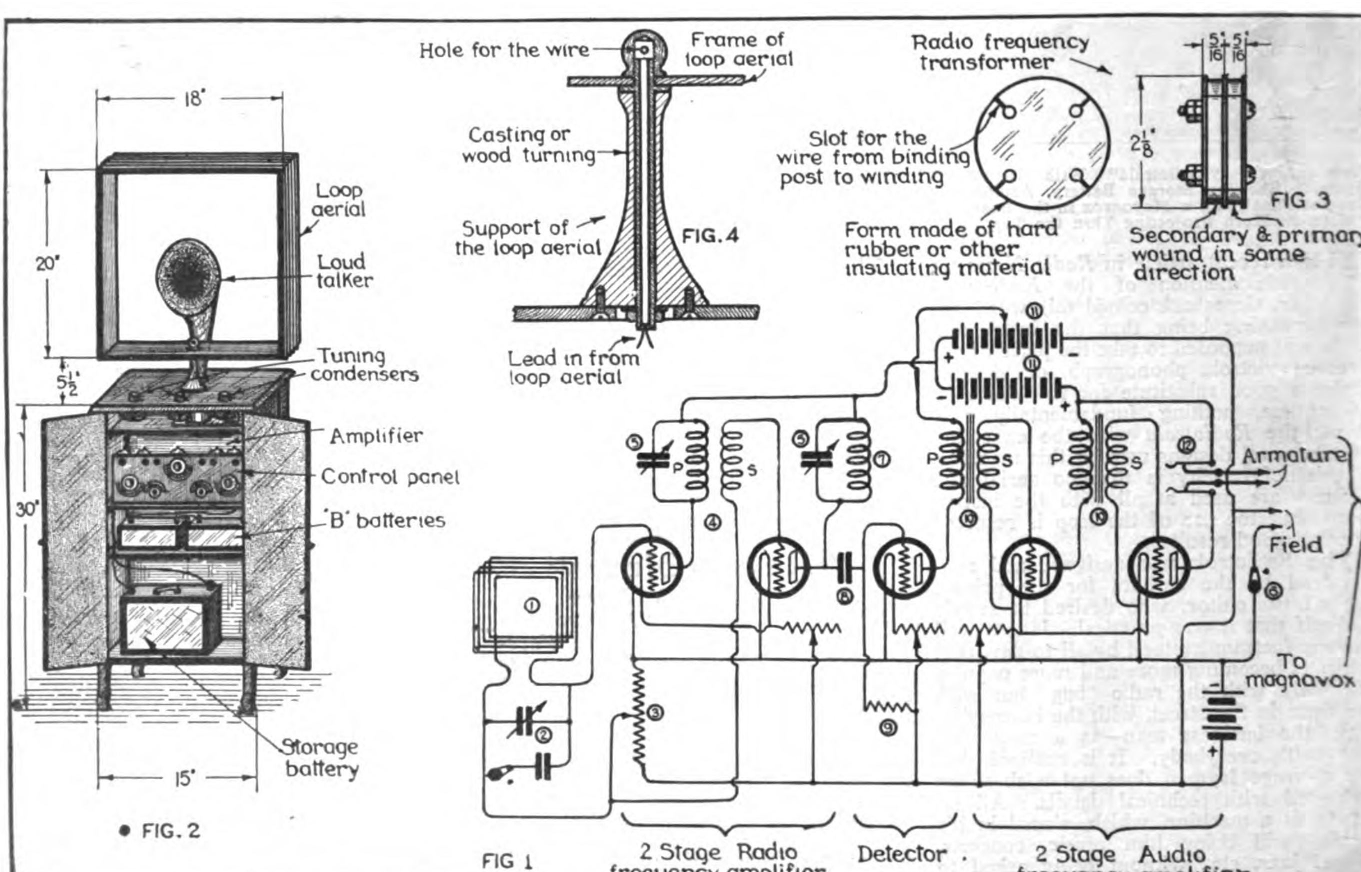
To simplify the adjustments, a single rheostat is used to control the radio and the audio amplifiers, as shown in Fig. 1; the rheostat used for this purpose is of the "power" type, in order to carry safely, without heating, the filament current of two tubes.

Assembling

Fig. 2 and the photograph showing the complete Radiotrola give a good idea of the arrangement of the various parts inside of the cabinet. The loop aerial, which can be turned in the direction of the station to be received, pivots on a support made of brass, as shown in Fig. 4, the two ends of the wire wound on the loop going through the support inside of the cabinet. This is mounted in the center of the top panel, which is of insulating material, such as bakelite and supports also the three condensers. Inside of the cabinet, mounted on shelves that can be pulled out, are the amplifier, the "B" batteries, and the 6-volt storage battery, furnishing the current to the vacuum tubes and the field coils of the magnavox.

The magnavox is mounted on a small shelf in the back of the cabinet so that the hole in which the horn fits is even with the bakelite panel on the top. The connections from the condensers and loud talker are attached to binding posts mounted on the control panel, enabling the complete amplifier mounted on the shelf to be pulled out for inspection, by simply removing the wire from these binding posts.

(*Continued on page* 1084)



This Design Shows All of the Constructional Details for Building a "Radiotrola," as Here Described by Mr. Gernsback and Mr. Lacault. Five Vacuum Tubes Are Employed With a Special Amplifying Circuit. A Common "A" Battery, as Well as a Common "B" Battery Are Employed for All the Vacuum Tubes.

Radiophoning To and From "L" Trains

IF the present plans of the Chicago Elevated Railroad do not miscarry, the patient straphangers will gladly pay the present fare of 8 cents without any murmur, and be willing to donate an extra dime or two for the privilege of riding on the *elevated*. The elevated system is figuring on installing a radio system on its cars and furnishing its passengers with songs, music, and even grand opera, on their way to and from work. Pretty soon it will be a privilege to work; not only will the passenger be entertained, but it will be possible for you to call your home while in transit and suggest what kind of meat you want for dinner.

Top Photo Shows Antenna Wires Strung Along Roofs of "L" Train.
Lower Left—Talking via Radiophone from Moving "L" Train in Chicago.
Lower Right—Dancing to "Jazz" Music Received by Radiophone on Moving "L" Train.

The first trial of the radio was made on a Chicago, North Shore & Milwaukee electric line recently. A dozen pretty girls from the offices of the line danced with the road officials to the strains of music transmitted from the radio station on top of the City Hall. They were also able to carry on conversation, i. e., talk to as well as hear, the chief of the fire alarm system in Chicago, and every test proved eminently successful.

One of the accompanying photos shows the girls on the Chicago elevated train enjoying a dance to the music being sent from the radio transmitting station in Chicago. Another photograph shows a passenger talking from the moving train to his home in the city via radiophone, while the third photo shows how the antenna wires are mounted on insulators along either side of the roofs of the "L" train.

The radiophone transmitting set used in this test was equipt with vacuum tubes for producing the necessary high frequency oscillatory current suitable for charging the antenna, together with a high voltage d. c. dynamo, the current from which is acted upon by the vacuum tubes in the production, as well as the voice modulation of the high frequency oscillations.

Radio Gives Telephone Secrecy

The *superphone,"* an apparently simple attachment for telephones, which is said to assure secrecy of communication and security from interruptions and to make possible multiplex telephony, was demonstrated recently in the office of the Chief Signal Officer of the army at Washington, D. C.

It was shown that one telephone line to which superphones were attached could be used for a number of conversations simultaneously and that no two speakers could hear or interrupt another two.

The superphone, it was explained, has been developed under the direction of R. D. Duncan, Jr., Chief Engineer of the Signal Corps research laboratory of the Bureau of Standards, assisted by S. Isler, assistant radio engineer. It is based on *wired wireless* or *line radio,* invented about ten years ago by Major Gen. George O. Squier, Chief Signal Officer of the army. The invention consists of a small, portable set of instruments, which may be installed in any office or residence in a few minutes and connected directly with existing telephone lines. High frequency alternating currents are employed.

Signal Corps officials said that the invention was of great value for military purposes, because of its assurance of secret communication. It would be of hardly less value, they said, to business men, bankers and others to whom it was desirable to have complete privacy in confidential channels of communication.

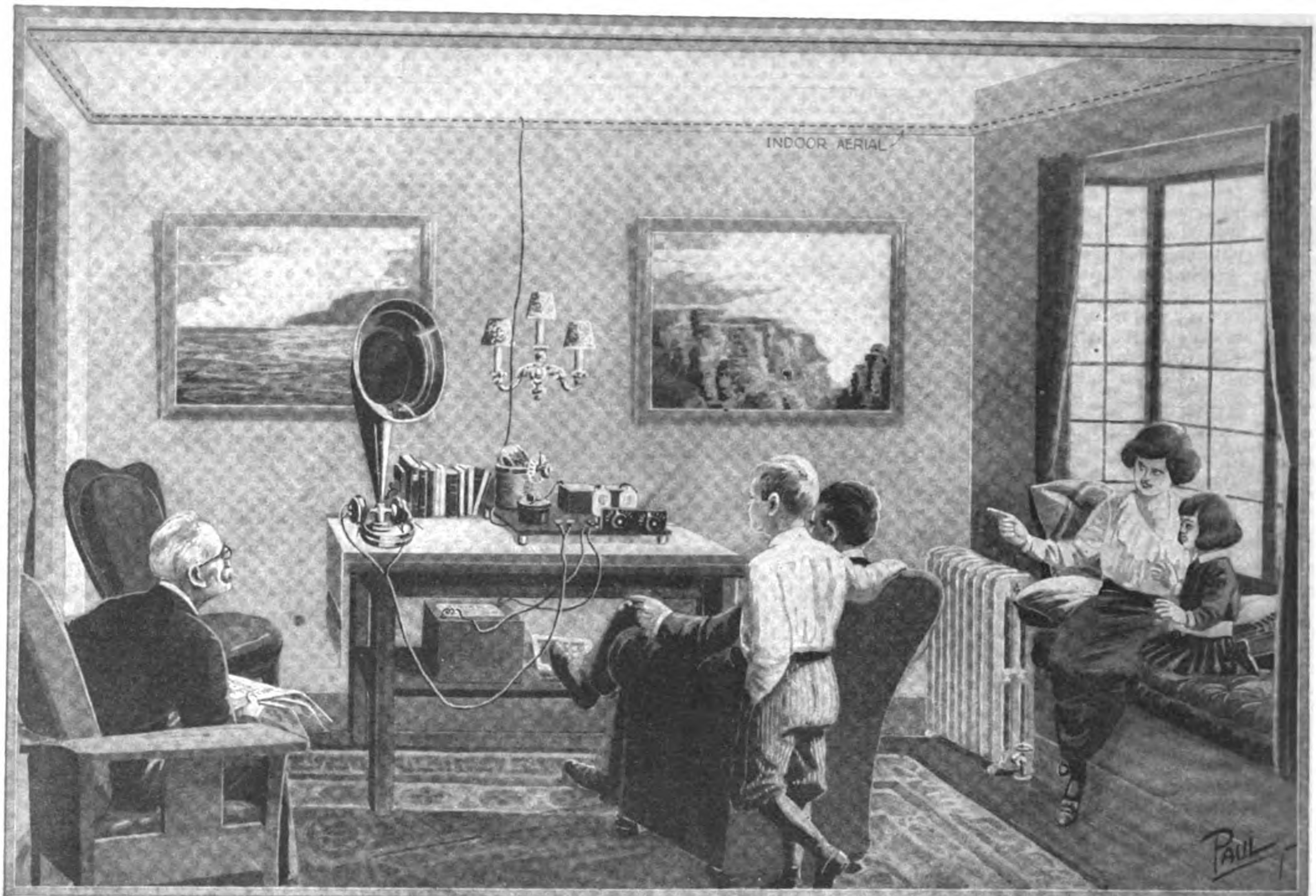
Sun Dust Bars Radio

SUN DUST BARS INTER-PLANET RADIO

Electrified dust thrown off by the sun forms an atmospheric envelope about the earth about 100 miles away which prevents wireless waves from escaping into infinite space, according to Prof. J. A. Fleming, University College, London, whose work in wireless research is known all over the world. The screen made by the dust, he says, acts as a sort of wireless speaking tube and enables waves used for long distance work — which are about ten miles in length — to travel 6,000 and 12,000 miles. If it were not for that screen, according to the professor's theory, the wireless energy thrown out by the big sending towers would not cling to the earth, but would pass away and be lost. When coming in contact with the screen the waves are deflected and guided between it and the earth's surface until they reach the receiving station for which they were intended.

The electrified dust is thrown off by the sun in immense quantities and the pressure of light — which exerts a total pressure of many tons on the whole surface of the earth — is strong enough to overcome the backward gravitational pull of the sun and so drive the dust particles on the long journey toward this globe.

The dust attains great velocity in the freedom of the empty spaces and generates enough energy so that a single handful would drive the biggest ocean liner for twenty-four hours. Each particle bears an electric charge from the sun and on reaching the outposts of our atmosphere friction slows it down, and thus floating, a layer or conducting screen is formed which is an unseen blessing to radio engineers. Prof. Fleming, altho he holds no positive views on interplanetary communication by wireless, says that the moon is unfit for long distance radio communication because it has no dust screen about its surface such as the earth has.



Radiophone Concerts Can Be Received Frequently, Especially in Cities Near the Broadcasting Stations, Using a Simple Antenna Made Up of a Single Bare or Insulated Copper Wire Running Around the Room in Back of the Picture Molding. Both Ends of the Loop Thus Formed Are Connected to a Lead Wire, as Shown in the Picture. The Ground Wire is Shown Connected to the Radiator, or it May Be Attached to Any Other Grounded Metal Body, Such as the Water Pipe.

Radio for the Beginner

By ARMSTRONG PERRY

1. How to Buy and Install a Receiver

WE are pleased to announce a series of twelve popular articles on Radio entitled, RADIO FOR THE BEGINNER, by Mr. Armstrong Perry. Mr. Perry is well known as a radio man and has the ability to see radio through the eyes of the layman. In these articles we are trying to show to the average layman, that is, the man in the street, who knows nothing about radio, just how to go about to receive the music that now abounds all around us.

There are, at present, five stations broadcasting radio music, lectures, stories, grand opera, vocal and instrumental music, the stations being as follows:

Westinghouse, Newark.....WJZ
Roselle Park, N. J.........WDY
Pittsburg, Penna..........KDKA
Springfield, Mass..........WBZ
Chicago, Ill...............KDY

Anyone within a radius of 100 miles of these stations by means of a simple apparatus can listen in.

We are quite certain that the articles are as clear as it is humanly possible to make them without straying into deep technicalities. If you should not understand anything, be good enough to address Mr. Armstrong Perry, enclosing stamped envelope for reply—Editor.

IF you were standing under a loaded apple tree it would not take you long to find a club and learn how to use it. Or if the apples had been converted into cider and barreled, I reckon you would find a straw. Then why stand around, now when the air about you is full of everything from prayers to grand opera, and not try to extract the religion, entertainment and instruction from the ether? It is simple.

If you want the hourly quotation on hogs from Chicago, an up-to-the-minute report on the weather and shipping conditions in the Port of New York, a bedtime story to put the kids to sleep, a bit of jazz, the day's stock market, or a sermon to help you face with fortitude the call for the first quarter's income tax, help yourself. You can get almost anything any time by radio. All you need is a little wire to intercept the radio waves that carry the messages and a little receiver to translate them into sound.

The news, the music, the stories, prayers and sermons, are put into the air by powerful transmitting stations where human voices and the notes of musical instruments are changed into radio waves that ripple away a thousand miles or more. If you want to know how it is done read magazines like RADIO NEWS, go to a radio school, take a correspondence course or write to the nearest Signal Corps Station of the United States Army for instruction by mail. But it is not necessary to know radio when using it, any more than it is necessary to know hydraulics in order to draw water from a faucet.

You go or write to a radio dealer and purchase a receiver. If you are within fifty miles of San Francisco, Los Angeles, Denver, Omaha, Kansas City, Wichita, Chicago, Cleveland, Buffalo, Boston, New York, Washington, or any of the larger cities, a receiver costing from $15 to $30 will be good enough to begin with. The dealer calls these "mineral detector sets." If you are farther away from a city where radio telephone transmitters are at work you will need a "vacuum tube" receiver. This costs from $75 up, including the necessary batteries, tubes and phones. In either case you will need to put up a wire—the aerial—so that the radio waves can trickle down from it to your listening ear.

A mineral detector set is less sensitive than a vacuum tube set. As compared with the "v. t." apparatus it is like a man who is somewhat deaf. It takes more energy to reach his ear drums. So for the cheaper receivers the wire needs to be comparatively long—say 100 feet—in order to pick up sufficient energy to penetrate the receiver and make sounds loud enough for your ear to hear.

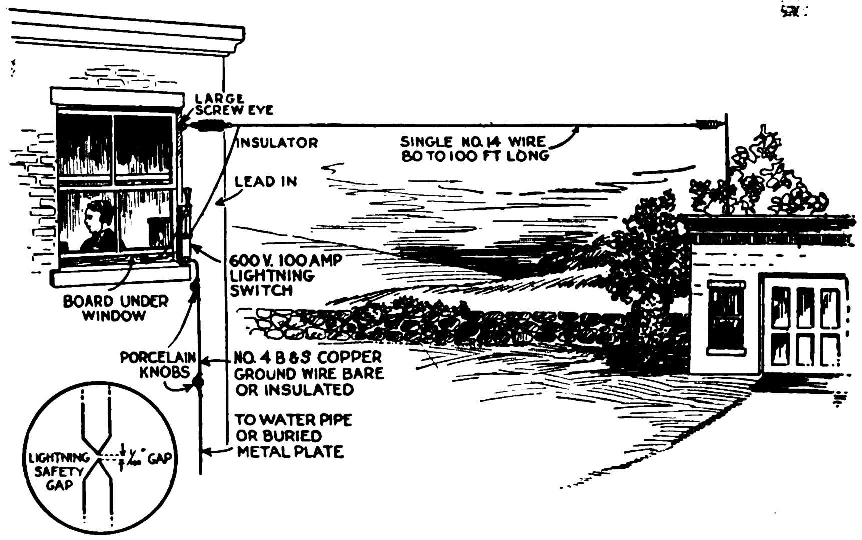
Copper or aluminum wire is best. Between these and wires made of iron or lead there is somewhat the same difference as between a very steep chute made of polished wood and one covered with sand paper. You might slide down the sand paper just as fast, but you would not be quite all there when you arrived at the bottom. Just so the electric current loses part of itself in coming down a poor conductor. In the language of the electrician, copper and aluminum have higher conductivity than most other metals. A wire made of strands gives better results than a solid wire of the same size.

Your wire had better be straight, tho it is not necessary to stretch it tightly. Usually it operates better if it is thirty feet or more above the ground. One that I use starts at a post twenty feet above the ground and runs up at an angle of 45 degrees to another post on a roof 75 feet high, whence it descends to my *radio cabin* on the fifth floor. Another starts at a barn, goes to an apple tree and then to a receiver in a ground floor room. Still another follows the picture molding around a second story room. They all pick up all kinds of messages.

One thing I am careful about is to keep these aerial wires from touching wood or metals. I fasten an old bottle or a composition insulator to the post, building or tree and then fasten the wire to that. Otherwise the radio waves, after being picked up by the wire, leak off into the tree, post or building as water spurts from a leaky pipe. As a certain oil magnate said to a superintendent, who proudly reported that he had been able to get 99½ per cent. of the gasoline out of crude oil: "That is not enough! We must have it *all!*"

When my radio wire passes from out-of-doors into a building I put in a lightning switch or a lightning arrester. Once I saw the lightning strike a wire just outside my window. It was very wonderful—magnificent, but ever since that day I have tried to make sure that the lightning remains out-of-doors. I hate to think of trying to confine within four walls any wild thing that needs so much room and air! Besides, I do not like the attitude of insurance companies toward lightning losses. They are as stubborn as the Lord was in the case of Lot's wife. If you invite destruction by disobeying orders, it is your own funeral and the undertaker's bill comes out of your estate.

Another little detail about putting up an aerial wire is that it should not run parallel with other wires in the neighborhood. Parallel wires are worse than one of those strings of neighbor's dogs where one begins to howl and sets them all howling. Electricians call it "induction." There is a shorter word that begins with "H" and expresses my feelings about it better. If your wire is at right angles with all others, or nearly so, you will not need to use either word.

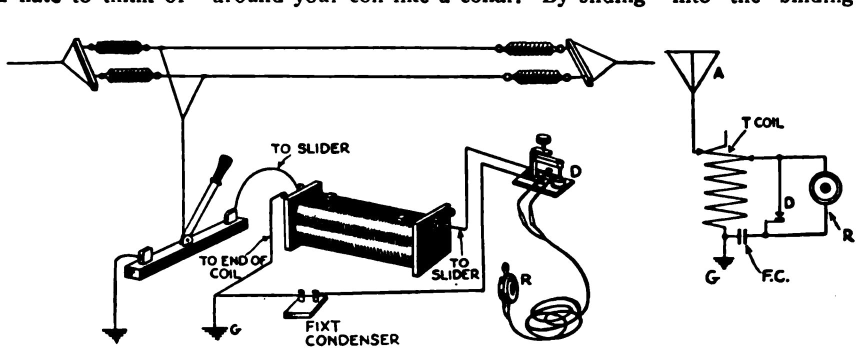


This Diagram Shows How a Single Wire Antenna May Be Strung Up Between Two Points, and Also How the Lightning Ground Switch is Mounted Just Outside the Window, in Conformity With the Fire Underwriter's Rules and Regulations. The Lead-in Wire, Passing Thru the Porcelain Tube in the Board Placed Under the Window, May Be No. 14 Wire; But the Ground Wire Running from the Lightning Switch to the Separate Ground Indicated, Must Be No. 4 B. & S. Copper Conductor or Its Equivalent. A Safety Gap, as Shown in the Circle at Left, is Sometimes Connected Across the Aerial and Ground Wires, Just Inside the Window or at the Grounding Switch, Heavy Static Discharges Leaping This Gap Easily Without Burning Out the Apparatus.

There is a knack to handling a coil of wire that I learned after spending several weeks of my life straightening out kinks. If the wire dealer is a desirable citizen he puts a single strand of rather stiff wire around your coil like a collar. By sliding this around and around your coil you can release one turn of wire at a time. If you take the collar off, sooner or later you lay your coil down or drop it accidentally and when you try to straighten it out you find it hopelessly tangled.

There are many kinds of aerials: Inverted "L's," "T's," "fans," "umbrellas," "wire mesh," "loops," and "cages." I prefer a single wire partly because I am naturally lazy, and partly because I am satisfied when I can hear what I want to hear. The more elaborate aerials require more time and money.

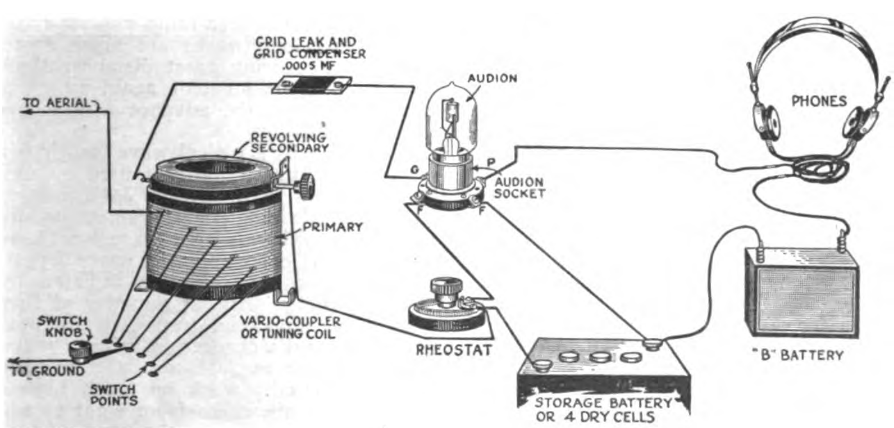
The inside end of your aerial wire goes into the binding post marked "A" or "Ant" on your receiver, and you turn the screw down tightly. Next to this binding post is one marked "G" or "Gnd." which is short for "Ground." To this you attach another piece of wire and run it to any convenient water pipe or steam radiator. If you have neither, solder the end to any old piece of metal and bury it in the ground. Soldering betters any connection. It is easy to do since the invention of the soldering paste that requires only the heat of a match.



This Diagram Shows Clearly Just How a Simple Wire Telephone and Telegraph Receiving Set is Connected. This Comprises a Crystal Detector, a 1,000 Ohm Telephone Receiver, a Fixt Condenser, and a Lightning Switch. The Telephone Receiver May be a 75 Ohm One, Such as Used on Regular Telephones, but a 1,000 or 2,000 Ohm Receiver of Good Make, Will Prove Much More Sensitive and Give Louder Signals. The Crystal Commonly Employed in the Detector is Galena, and is Procurable from Any Radio or Electrical Supply House.

Whatever kind of receiver you are using, when the wires are all connected and the knobs and things adjusted according to directions, you begin to hear things that your phonograph never thought of. It is a surprise party with unknown friends dropping in from all parts of the world.

(*Watch for the next instalment.*)



Simplified Picture Diagram of the Connections for an Audion or Vacuum Tube Detector. The 'Phones Used Should be of 2,000 Ohms Resistance for the Pair. The "B" Battery is a 22½ Volt Type and the Rheostat a 10 Ohm One. A Tuning Coil May Be Used in Place of the Vario-coupler. The Aerial and Ground Connections Are Made in the Same Way as in the Diagrams Above.

NEW RADIO APPARATUS FOR AIRCRAFT

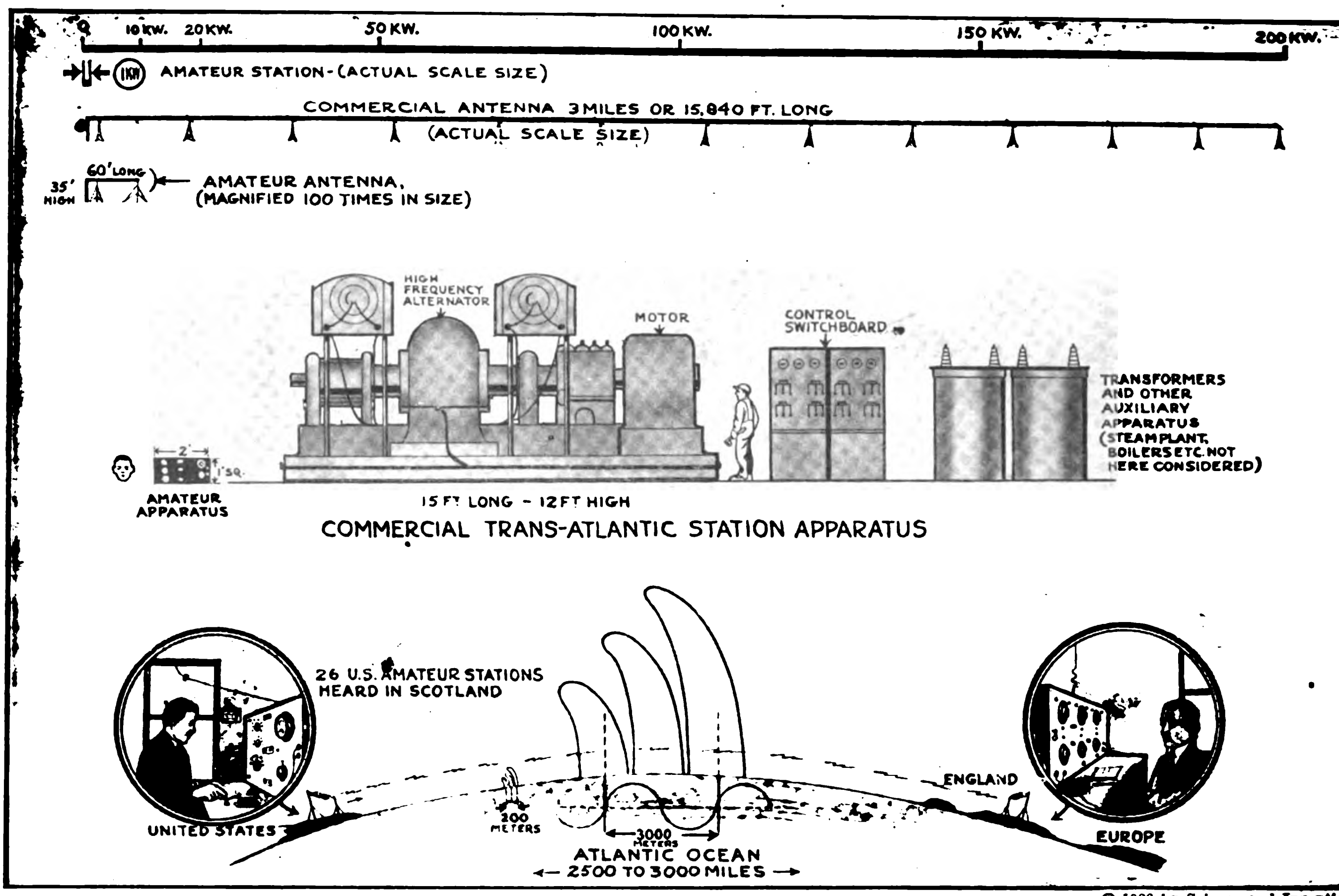
At Croydon, the London terminal aerodrome, on November 4th, very successful tests were carried out with a new wireless apparatus for guiding airplanes in foggy weather when near the aerodrome.

The aerodrome and surrounding district have been divided into sections and by means of the new apparatus the wireless operator on the ground is able to tell the pilot of the airplane which section he is over and the exact minute to turn.

The apparatus has been installed in a building known as the control tower on the aerodrome.

The tests were made with a Handley-Page airplane and the operator in the control tower guided the machine to various parts of the aerodrome.—*Lieut. G. H. Daly, D. S. M.*

American Amateurs Heard In Europe



The Every-Day "Radio Bug" is Greatly Interested No Doubt, in the Recent Announcement By Mr. Paul F. Godley, Well-Known American Radio Expert That He Had Heard 26 American Amateur Transmitting Stations When He "Listened In" in Scotland. The Distance Between the Transmitting Stations and Scotland Varied Between 2,500 and 3,000 Miles in Most Cases. The Greatest Amount of Energy an Amateur Station Can Legally Use is 1,000 Watts, and Only About 1-10th of This Wattage Was Used to Bridge the Atlantic. Compare This For a Moment With the 200 Kilowatt Radio Transmitting Set Used at Commercial Stations, as Shown in the Picture Above, When the Wonder of It All Will at Once Dawn Upon You. The Comparative Magnitude of the Amateur and Commercial Wave Lengths, as Well as the Relative Size of Antennae, Are Graphically Shown Above Also.

ABOUT a month ago it was reported in the daily press that twenty-six American radio amateurs were heard in Scotland by Mr. Paul F. Godley, an American radio expert, who installed a very sensitive receiving station at Glasgow, for the express purpose of listening in, to ascertain whether or not such small transmitting stations as those used by amateurs could be heard regularly in fair weather and under average static conditions over such a great distance as that existing between America and Europe.

Some of the amateur radio-telegraph transmitting stations in America are located far inland, and the maximum energy employed in transmitting the test signals over the 2,500 to 3,000-mile gap did not exceed a kilowatt, or 1,000 watts, whereas the commercial radio-telegraph stations employ from 100 to 200 kilowatts, or more, to bridge the same distance.

The accompanying chart shows graphically what a remarkable scientific achievement the trans-Atlantic amateur transmission really is. The upper scale line shows by comparison the small magnitude of the one-kilowatt amateur station as compared to the 200-kilowatt commercial, or government station, intended for regular trans-Atlantic communication.

In other words, the commercial station uses 200 times as much power as the usual amateur station, the only real difference being, of course, that the larger station is pretty sure to get the messages thru almost any sort of interference, or static.

Next, we may glance at the tremendous aerial wire system, or antenna, as it is usually called, employed by the professional station. An antenna of the type used at Radio Central on Long Island, for example, measures about 3 miles in length, or 15,840 feet, and the two dozen odd wires, each larger in diameter than a lead pencil, are supported 410 feet above the ground on latticed steel towers. The average amateur antenna will measure about 60 feet in length and will be about 35 feet above the ground, and comprises possibly 2 to 4 wires, each being as thick as an ordinary store string.

In other words, as the graphic chart shows, the amateur antenna, magnified 100 times in the picture in order to make it visible at all, as compared to the commercial antenna, is only 1/12 as high in the air as the big fellow, while the length is about 1/263 the length of the large aerial.

When it comes to the size of the *apparatus* or instruments employed, the amateur outfit looks like a "bunch of junk" compared to the formidable array which greets our eyes when we open the door of a typical trans-Atlantic radio station.

The amateur can place his apparatus (even for transmitting across the Atlantic and rated at far less than 1 kilowatt, when he is using, for example, the highly efficient continuous wave vacuum tube generator or oscillator) in a space measuring about 2 feet by 1 foot by 1 foot. Disregarding entirely the steam turbines, boilers and other machinery, the commercial radio station, rated at, say, 200 kilowatts, will require about 2,000 times the cubic feet of space, that the amateur occupies, to take care of the high frequency alternator of the type used at Radio Central, together with the control switchboard panels and the auxiliary condensers, transmitters, etc.

As a matter of fact, the professional station will occupy much more space than 4,000 cubic feet, even when the steam turbines, boilers, etc., are left entirely out of the calculation.

When it comes to the wave length used, and we must remember as extensive tests by Marconi and other radio experts have shown, that long waves are much more efficient in covering great distances than short waves, the amateur again scores a distinct mark in the advance of efficient radio transmission.

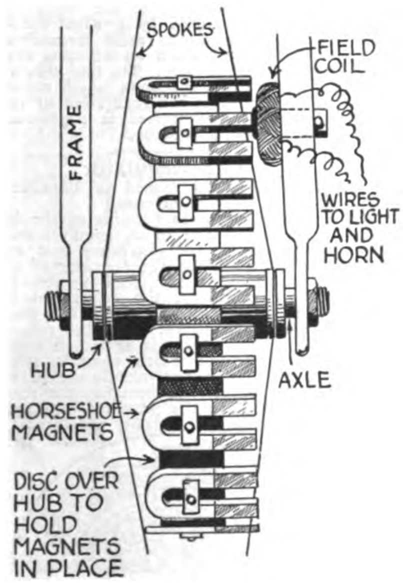
If we take as a typical wave length for a trans-Atlantic station that used by Arlington (N. A. A.), which is 3,000 meters, then the little amateur station, transmitting on a maximum legal wave length of 200 meters is operating on a wave length only 1/15th as long as that radiated by the big stations. And as a matter of fact very few commercial trans-Atlantic stations today take chances in using a wave length as low as 2,000 or 3,000 meters, and they actually work on much higher wave length, anywhere from eight to ten thousand up to twenty thousand meters (one meter being equal to 3.28 feet).

What to Invent

By JAY G. HOBSON

INGENIOUS BICYCLE GENERATOR

Attention! bicycle enthusiasts. Pin your optics to the following suggestion of our friend Maffet, from Opal, Colorado. No more burnt-out batteries, no mussy oil or carbide lamps and no accidents at night riding your rubber-shod steed with this needed improvement.



A Novel Idea in Electric Light Dynamo to Be Built on Bicycle Wheel.

DEAR MR. HOBSON:

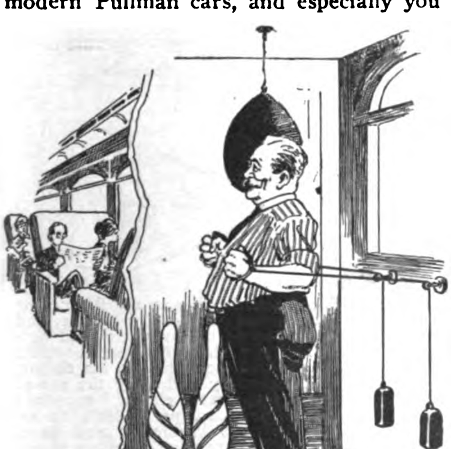
In response to your request for ideas in the August SCIENCE AND INVENTION, I am enclosing one of a generator for bicycle lights and horns. This one is very simple and sturdy, and should supersede the present unsatisfactory battery outfits. As the sketch shows it consists of a number of magnets mounted around the hub of one of the wheels. These could be either of the horseshoe or bar type. In the latter case two field coils could be used and thus make a stronger generator. The field coils are mounted on the frame of bicycle as shown and are arranged between the spokes and frame, in close proximity to the pole-pieces of the magnets.

THOMAS C. MAFFET.

PULLMAN EXERCISER

You who do considerable riding in the modern Pullman cars, and especially you who take those long, tiresome, muscle-stiffening trips over the steel threads, certainly will appreciate an addition to the coach that will enable a fellow to exercise, and work up an appetite during the extensive period of inactivity.

For instance, the Pullman company could easily afford to install a tread-mill for running, a bicycle arrangement for leg exercising, a punching bag for arm and shoulder practice and wall-weights for general limbering up. These devices undoubtedly would become very popular with the men folk, whose natural tendency is one of force and motion. With a small compartment of this description a fellow could slip off his coat and pitch into a frenzy of exercise that would make the old meal taste just like mother used to provide. And, finally, when one's destination was reached he wouldn't feel like a stoved-up elephant after an all-night ride in a small box car. I certainly hope some of you traveling readers suggest the above to the railroads so that they may provide this useful addition to their equipment.



Funny, Isn't it, Someone Hasn't Thought of Putting a Small Gymnasium in Pullman Cars?

MEN'S CRUMB CATCHER

Another mystery unsolved! Did you ever go to luncheon with some friends, all sit down on perfectly clean chairs, eat your hot, crispy rolls and butter, finish with pie, get up and with surprise find the seat of your chair all full of crumbs—the very seat that you have been sitting on? Well, the next time that you eat just notice this phenomenon and I am sure that you will agree that there is great need for an invention of a *men's crumb catcher* to assure better manners at the table, which now seem impossible of achievement.

Possibly one in the form of a cloth extension attachable to the table cloth and to one's coat would serve the purpose. Anyhow, to further the cause of neatness with our meals some thought along this line wouldn't be amiss.

Why Not a Crumb Catching Apron to Spread Between the Guest and the Table, to Eliminate Those Crumbs on the Chairs?"

LINTLESS NEWSPAPER

To those who read in dark-colored clothes a lintless newspaper would most assuredly be highly welcome. This suggestion was profoundly impressed upon me the other day after I had finished reading the Sunday papers. I approached some feminine and masculine friends in the corridor of a hotel, mentally at ease about my appearance. But to my surprise one of the ladies announced: "O, look, it's been snowing all over your clothes." The darned newspaper had shed its surplus dandruff all over me, and right there and then I decided newspapers were being cut with dull knives and somebody should invent one that keeps sharp and eliminates the bothersome lint.

And Why Doesn't Some Genius Take the "Lint" off of Newspapers Before They Cover us With a Miniature Snow Storm.

ACETYLENE AS MOTOR FUEL

Dr. Paul Weyland, President of the Association of German Natural Scientists, who is now in this country, says that owing to the poverty of the German people and their inability to get oil at the present prices, a substitute has been invented for their use in the form of acetylene gas, which is proving very successful for automobiles. He says that Germany is far behind this country in the use of electricity and that this means of motivation is looked upon with disfavor.

"Germany has no oil, and with her currency in its present condition she cannot afford to purchase what she needs," said Dr. Weyland. "This has led to a discovery which will revolutionize the automobile industry for Germany at least. Acetylene gas, generated by the action of water on calcium carbide, I believe, will be the coming motive power for automobiles in my country. The engine has been perfected. The gas is comprest and stored in cylinders. The user stops at a station and instead of having his gasoline tank filled exchanges his cylinder or gets it recharged. Stations for this purpose are already building.

"Germany is far behind the United States in the application of electricity as a motive power. It is not favored in my country. Even the electrically propelled locomotive for trains is in disfavor. Our use of electricity is negligible as compared with yours. But there is a real economic reason for this; labor in Germany is very highly organized and restless. To use electricity as freely as you do requires high control power stations. With labor in revolt, they place an enormous power in the hands of the working men, which we fear to give them.

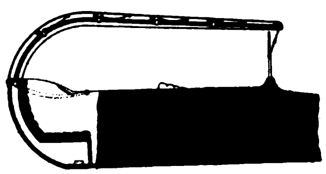
"But we are still making an excellent vegetable oil by gathering the fat from the soil and using it for lubricating purposes. One use we have made of electricity which is of great value is in increasing the growth of plants, an intensified cultivation."

LATEST PATENTS

Folding Automobile Top

(No. 1,390,554 Issued to Abraham D. Hedges.)

The framework which supports the flexible cover of the automobile top in this invention is composed of straight and of tubular sections

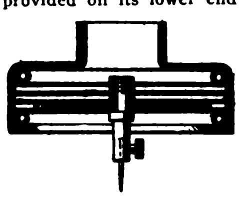


of steel. There are two of the latter rigidly connected at the rear seats with curved balancing arms which extend forward when the top is raised, as illustrated. These are attached to the sides of the automobile by bolts. The bottom ends of the curved arms communicate with levers, which levers have springs attached to them to assist in balancing the arms. The automobile is provided with curved openings or pockets to receive these arms. The cloth top folds down in back of the rear seat and is provided with a hooking device, for the purpose of holding it in the open position after the top has been extended.

Phonograph Reproducer

(No. 1,390,558 Issued to Alex Hoover.)

In this novel reproducer and seated in the upper and lower portions of its shell, are gaskets of leather or other material. Thru the center of an ordinary diafram and several auxiliary diaframs, an aluminum post is past, threaded on its upper end for the reception of a nut, and provided on its lower end with

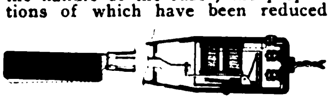


a socket adapted to receive the stylus or needle. Immediately above the main diafram is a four-legged spider, the arms of which terminate in depending fingers, superimposed upon the main diafram. This spider, it is claimed, serves the important purpose of adapting the receiver for use in conjunction with the lateral cut records. The reproducer will also give excellent results on hill and dale records without the necessity of changing the position of its needle, or any of its parts with relation to the record, the inventor claims.

Electric Razor

(No. 1,390,702 Issued to Joseph A. Hammond.)

In this razor the chopping stroke is changed to a swinging stroke. The operating means is found in the handle of the razor, the proportions of which have been reduced

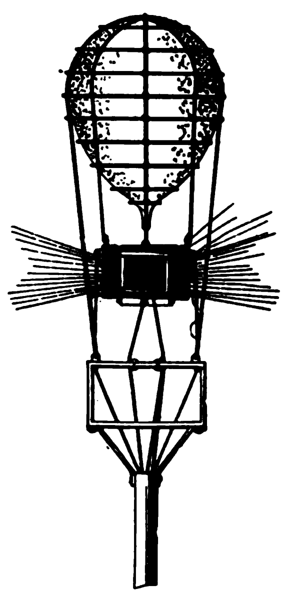


so that the instrument is graceful in appearance. Ordinarily one would consider it a straight edged razor blade attached to the armature of a buzzer. One might suppose that the razor blade would require a guard in order to prevent the user from injuring his face, but by actual experimentation, it has been demonstrated that even the inexperienced shaver will not cut his skin.

Balloon Searchlight

(No. 1,390,902 Issued to Columbus Grooms.)

Suspended from a lighter-than-air balloon is a powerful incandescent light suitably shielded by a square, box-like structure made of metal. This casing has in each of its vertical sides a bull's-eye, and also one on its lower horizontal side. Each bull's-eye is connected internally to a conical reflector, open near the source of light. On the outside of the box and situated over each bull's-eye is a curtain, connected at its free end with a cord.

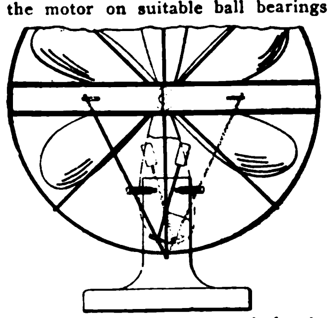


This cord passes down over a pulley in a frame suspended below the casing and thence thru a hollow pipe to the ground. From this place the light may be controlled, so that it will shine in any desired direction. For signaling or providing an aerial buoy, this system would undoubtedly be successful, but we fail to see its efficiency as a searchlight for training a beam on an aerial target.

Oscillating Fan

(No. 1,390,762 Issued to Philippe de Clamecy.)

An improvement over the ordinary oscillating fan is embodied in this construction. After mounting the motor on suitable ball bearings

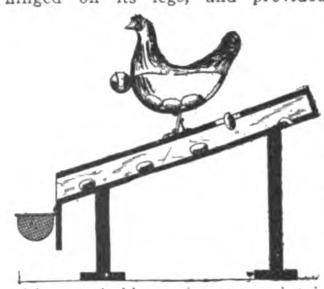


so that every movement made by the fan is free and absolutely silent, the inventor's attention is given to the fan blades. In the regular fans, the noise of the blades as they spin around in the air is somewhat distracting. In order to decrease this sound to a minimum and to increase the efficiency of the fan, the inventor has developed fan blades of a reverse curve, stream-line cross-sectional shape, having a rounded advancing or cutting edge, and gradually tapering therefrom to a thin rear edge, where the air leaves the blade. The inventor claims that this reversely curved stream-line shape of the fan blades results in a remarkably silent fan, having a substantially higher efficiency than is ordinarily obtained with the regular fans.

Amusement Device

(No. 1,390,789 Issued to St. Charles Jacobs.)

A hen, duck or other animal is hinged on its legs, and provided

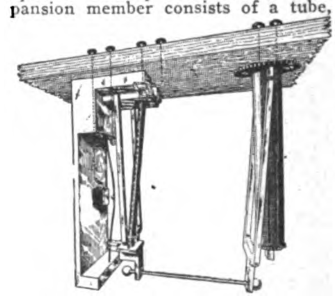


with a suitable spring to maintain its upright position. The representation is hollow, with an inlet at the top and also an outlet placed near a suitable hole on the game board. The hen now becomes the target of attack, and when a baseball hits it which is thrown by one of the prize seekers, the hen tips, laying an egg which slides thru a chute down to the front.

Electrothermo Relay

(No. 1,399,226 Issued to William A. Rhodes.)

This is a very novel relay, in which a member capable of expansion in response to electric current, operates a snap contact. The expansion member consists of a tube,

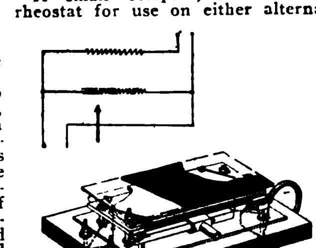


thru which passes the filament for heating the tube, and thus causing its elongation. This tube being combined with a device whereby its expansion movement is amplified, causes a contacting device comprising a spring, bowed in one direction and arranged to snap into a position of reverse flexture, to snap into a closed position. The spring may be returned to its first position by means of a restoring electro-magnet, or the device may be so adjusted that the tube when contracting because of its cooling, will bring the spring back to its original place.

Current Controlled Device

(No. 1,390,317 Issued to Charles Wagner.)

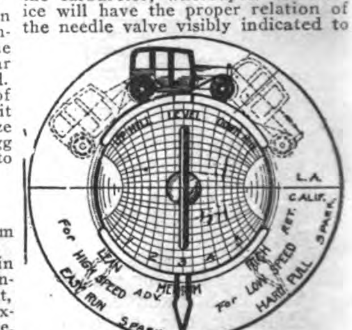
A small compact, self-contained rheostat for use on either alternating or direct current is the subject of this invention. Substantially the device consists of two long square asbestos covered pieces of wood, upon which is wound the resistance material. The top of the entire device is protected by a sheet metal covering, and the coils themselves are mounted upon an asbestos covered wooden plate. On one side of the plate is a bar upon which moves a slide contact for regulation of the current. The device is ingenious, especially its hook-up.



Gas Regulator

(No. 1,390,759 Issued to Bernhard G. Carlsson.)

In many cases because of the ignorance of the exact requirements of a motor for obtaining best results, or because the operator of an automobile is not well versed in motor efficiency, the regulation of the fuel supply is more or less haphazard guess-work. For that reason the inventor of this system has designed a dial which communicates directly with the needle valve of the carburetor, whereupon the novice will have the proper relation of the needle valve visibly indicated to

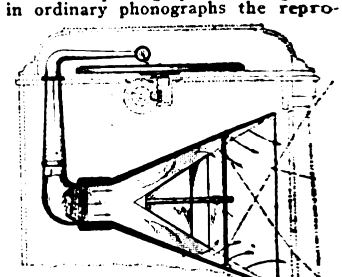


him. A small automobile on this indicator and a dial will be seen in the accompanying diagram, upon which there is also a representation of the globe with its meridians and parallels. The markings uphill, level and downhill, lean, high speed, easy run, etc., give the inexperienced driver all the indications necessary for proper regulation. The needle valve is set by turning a thumb-nut.

Amplifying System for Phonographs

(No. 1,398,965 issued to Lorren M. Hart.)

In order to preserve the beauty, timber and tonic qualities of phonographic reproductions, the inventor of this amplifying system has provided for a deflection of the air vibrations from the sound conduit or horn of a phonograph, claiming that in ordinary phonographs the repro-



duced sounds, due to the flaring air column, are harsh and blastlike, and that many of the overtones and harmonics are made impossible. This is remedied, according to his claims, by deliberately deflecting the sound waves against elastic sounding boards designed particularly to be responsive to harmonics and overtones, which require generous amplification. He then focuses the amplified overtones, so that they will be sent out from the horn together with the amplified vibrations primarily created by the air column of the horn.

Scientific Humor

This One Sounds Logical. — FIRST PROF: "Everything I tell that boy goes in one ear and out the other."

SECOND PROF: "You're wrong. Sound can't cross a vacuum."—*Ab. Jackson.*

This Joke Belongs In Purgatory.—Physics Prof. during Quiz:—"And now what are the physics of the ice cream freezer?"

Student—"Salt."—*Ralph F. Beilstein.*

We'll Say It Is.—PROFESSOR — "Mr. Stevins, please give the composition of air."

STEVINS—"Oxygen, carbon dioxide, argon, vapor and dust particles."

PROFESSOR—"Which one is most prominent?"

STEVINS—"Dust particles."—*D. Johnson.*

Correct.—JIMMY — "Pop, what makes that generator shake so?"

POP—"It's only being excited, son."—*T. R. Davis.*

And Makes a Monkey of Himself with Old Jokes.—Further proof that man is a descendant of some sort of animal is established by the following facts: Man has calves in his legs, frogs in his throat, swallows in his neck, hare on his head and bull right on the end of his tongue.—*Celia Freeman.*

The Teasing Point—FRANK—"If 32 is the freezing point, what is the squeezing point?"

FURTER—"Two in the shade."—*Edward L. Friedman.*

We Hope This Is Your Last One!—CONTRIBUTOR—"What did you think of my last joke?"

EDITOR—"I'm glad to hear you call it your last."—*Edward L. Friedman.*

Did the Bill Turn Her Hair Gray? — Several doctors were jollying one of the bunch about a long gray hair that had been found on his coat sleeve.

"If you must fall in love, why don't you pick out a young one?" they asked.

"That hair came from one of my patients," explained the accused.

"You can't put that over on us," returned the wit of the party.

"You know very well that your patients never live to have gray hairs."—*J. J. O'Connell.*

Are We Slipping?—NEGRO PREACHER—"Brethren, today the people are monkeying into God's business. This must stop. When God made the world he put it on an axis so that it could turn. If everybody drills for oil, and lets all the axle grease run out, some day this old world will stop dead still, and there will be no day or night."—*No name.*

An Operatic Family—CRISCO—"Have you seen Carmen?"

KATTIE—"Sure, my two brothers are conductors."—*Edward L. Friedman.*

First Prize $3.00

Did the Shock Kill Father—Then? FLOSSIE—"Yes, father lived longer than we thought he would — the power plant broke down."—*Edward L. Friedman.*

Did the Spark Coil?—CAR OWNER, ENTERING GARAGE—"One of my cylinders has been missing all day."

MECHANIC—"I expect the carburetor."—*J. Edwin Wilson.*

A Genius.—CRABSHAW—"How did you gain the reputation of being the big man out here, who knows everything?"

SUBURBS—"I managed to put up one of those portable houses without having to ask the manufacturer to send over one of their experts."—*J. J. O'Connell.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

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

It Always Works That Way—Two inventors made up their minds not to experiment any further upon a certain invention. One of them came into a room and found the second continuing his experiments on the said invention. The second inventor, much ashamed, said, "I just had a new idea about this; would you mind watching the unexpected results which I obtain?"

The first inventor approached to see the results and answered, "In the first place, I could say that I think we agreed to give this up, and secondly, I may truly mention that I just came from experimenting on it, and I obtained far better results."

—*Luce Kogan.*

What Did Ma Raise?—MOTHER—"Johnny, why in the world are you feeding the baby yeast?"

JOHNNY—"Boohoo! She swallowed my nickel, and I'm trying to raise the dough!"

—*Fred Sauer.*

In the Fall They Wire-less.—WILLIE—"Ma, teacher said the wires on the telegraph poles are educated."

MA—"She couldn't have said that. What did she mean?"

WILLIE—"Well, she said the wires expand in summer and get saggy, while in winter they contract and become taut!"

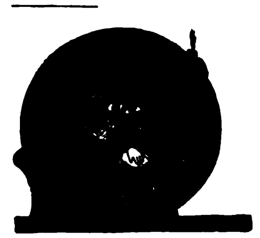
—*Raymond I. Long.*

Soon She'll Use the Wireless.—OLDTIMER—"I wish we could bring back the good old days."

SINGLETON—"Why, man, there were no good old days."

OLDTIMER—"Yes, there were for me. When I came home late nights then my wife beaned me with the broom; but when I come home late now she lands on me with the vacuum cleaner."

—*Raymond I. Long.*



He Should Have Refused to Fuse.—TOM—"Say, you didn't know that I was an electrician?"

JERRY—"Since when?"

TOM—"Why last night over at Jane's the electric light fuse burnt out. Guess who fixt it? Me—I—myself."

JERRY—"Huh! You're no electrician—you're an idiot."—*Edward L. Friedman.*

Not By a Darn Sight.—PROFESSOR IN PHYSIOLOGY—"A ball and socket joint allows movement to progress in any direction. Now, Jimmie, name a ball and socket joint of the human body."

JIMMIE, WITH COURAGE—"The eye sight."—*Emil S. Christilles.*

In Dry U. S. A.?—FIRST STUDENT—"Teacher, if two parts of hydrogen and one part of oxygen form water, why isn't water inflammable?"

SECOND STUDENT—"Because it's wet."

—*Frank Ralinger, Jr.*

A Short Circuit. — HE—"Why did you offer so much resistance to that last kiss?"

SHE — "Well, doesn't Ohm's law state that the greater the resistance the more current and force will be required to overcome it?"—*J. K. Smith.*

Without an Anaesthetic. — TOM — "Why are telephone girls called operators?"

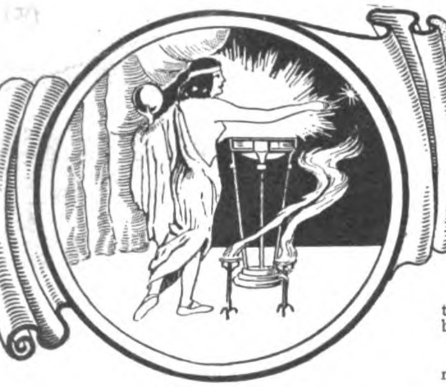
BOB—"Because they usually cut you off in the midst of conversation."

—*Harold Byner.*

Probably Killed Time.—A clock and a watch could not agree as to the time, so after arguing a while the clock laid off two of its hands and struck. The watch getting a big head from winning the argument, lost its balance, and fell on its face.

The main spring being so suddenly unloaded of its propriety went broke, and a bolt in the excitement lost its head.

—*Otto Thrower.*



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 publisht. 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 addrest 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.

Building 1/16 H. P. Induction Motor

(1183) G. C. M., Cleveland, Ohio, writes the Oracle:

Q. Asking for additional data concerning 1/16 H. P. induction motor.

A. Would advise as follows in regard to building the 1/16th H. P. alternating current induction motor, described by H. W. Secor in the October issue of SCIENCE AND INVENTION.

The field coils as well as the copper shading plates are secured to the stator poles by simply putting these in place over the pole, and then bending over either one or two lamination sheets with a screw driver, and then tapping them down with a hammer. A piece of oiled linen or fiber insulating paper should be placed over the coil where the bent down lamination will touch it, so as not to cut thru the tape with which the coil is wound, and cause grounding or other trouble. The rotor punchings are each complete, if that is what you mean by one piece.

The rotor punchings are keyed laterally to the shaft as you suggest, but there are many different ways by which the rotor may be secured to the shaft. All of the dimensions for the shading plates and the size of the shading poles, are governed by these dimensions and are given in the drawing accompanying the original article.

The thickness of sheet iron or transformer steel suitable for building this motor, is about 1/64 inch. If you purchase the sheet transformer steel used in building transformer cores, from companies supplying such material, this will be very good for the purpose.

8-Inch Spark Coil Core

(1184) Oscar Erpenstein, Lodi, Calif., writes:

Q. How is core of 8-inch spark coil built?

A. (1) With reference to building 8-inch spark coil, as described in the January issue of PRACTICAL ELECTRICS, would advise you as follows regarding iron wire core.

The iron wire should be as small as possible in diameter, and it is the best in any case to thoroly anneal it, by binding some wire around the bundle of core wire, and then to place this in a good hot fire until it just begins to turn red. At this juncture, the core is removed with a shovel or otherwise, and placed in the ashes beneath the fire and allowed to remain there for several hours or over night, so that it cools very slowly. You will be surprised how much better and more efficient the spark coil works when the core is softened or annealed in this fashion, as we have found from actual experience.

Q. (2) How do you join enameled wire?

A. (2) Enameled copper wire is joined in the same way as any other copper wire. The enamel may be removed by scraping with sand or emery paper or knife blade, the wires twisted together tightly and the joints thoroly soldered with a little non-corrosive or electricians' soldering flux. The joints, if on fine wire, such as used on spark coil secondaries, may then be covered with a thin piece of silk, and the winding proceeded with.

Mechanical Engineering Course

(1185) Guy W. Mayes, Diamond, W. Va., asks this Department:

Q. Would you suggest following up a mechanical drafting course with one in mechanical engineering?

A. From the Oracle Editor's experience he would say in general, that the mechanical engineering field offers just as many opportunities as does electrical engineering. There are just as many machines and devices to be perfected in the mechanical world as in the electrical, generally speaking, and so far as making money is concerned, some of the finest businesses of today have been started from some little mechanical device or machine.

The editor is quite a firm believer in following the line of work and study which you like best, as judging from observation, men usually seem to succeed best by following this plan. The electrical and mechanical engineers in practically all manufacturing and operating plants, work very closely together so far as the interchange of ideas is concerned, in their daily work. The editor found this so when he was connected some years ago with the engineering department of one of the large electric companies. There were seven men on the staff, including two E. E.'s, a Ph. D., three M. E.'s, and a draftsman. In this case the chief of the staff distributed the work pretty well, so that the purely mechanical jobs went to the M. E.'s in most cases.

We feel that it is almost impossible in any case to advise a person just what course is best, as this depends on so many different factors, and even then you might not like some other line of engineering as well as you did the mechanical engineering, and if you have a strong penchant for it, there is a very firm suspicion that you will do your best work in this line, whether you work for someone else or build up a business for yourself.

Platinum Plating

(1186) John K. Browne, Philadelphia, asks:

Q. 1. Please give me information concerning platinum plating.

A. 1. Platinum plating is not frequently done, but below is a very good formula for the solution to be used in plating copper and its alloys: Dissolve 17 parts platinic chlorid in 500 parts of distilled water. Dissolve 100 parts ammonium phosphate in 500 parts of distilled water. Mix the solutions. A precipitate will be formed. Little by little a solution of 500 parts sodium phosphate in 1,000 parts of water is added, and the whole is brought to boiling; water lost by evaporation being constantly replaced until, the ammonia being boiled away, the solution becomes acid and loses the yellow color it possest and becomes colorless.

This bath is used hot with a strong current, and its strength must be kept up by additions of the ammonium-platinum phosphate precipitate, obtained as above described.

Another formula is carried out by adding to a solution of platinum chlorid a sufficient excess of potassium cyanide to form a clear solution of potassium-platinum cyanide. A moderate current is required, or else a black powder will be deposited. The anode or positive electrode in platinum plating is always platinum.

Q. 2. How are steel electrotypes made?

A. 2. So-called steel electrotypes are used quite frequently owing to their greater wearing qualities, thus making it possible to print more impressions from a steel electrotype than from a copper one. A coating of iron is deposited on a copper electrotype of the engraving in order to harden the surface. The iron thus deposited is so hard and durable that it is sometimes termed steel, altho it is not steel at all, but pure iron. The bath may be thus prepared:

A solution of 1 part salammoniac (ammonium chlorid) in 5 parts of water is made. In it are suspended two plates of iron connected to the poles of a strong battery. After some hours the solution is ready, as some of the iron will be dissolved.

The electrotype which is to be steeled is put into the bath after thoro cleaning and washing with caustic potash solution. About 4 volts electromotive force are prescribed. After the steeling the plates are washed in cold water and rubbed with benzine. To preserve them from rusting they are covered with a film of beeswax. In storing them oil or beeswax must be used to prevent rusting.

Electric Heat for Garage

(1189) John Y. Hemion Harrisburg, Pa., writes:

Q. 1. I have a large garage measuring 45 feet wide by 70 feet long, the average height of the walls is 16 feet. The walls are made of corrugated iron. There are three windows measuring 3½ feet by 6 feet each, and two large sliding doors, each measuring 15 feet by 12 feet. There is also a skylight in the roof measuring 10 feet by 20 feet. The floors are made of 4-inch concrete filling on soil, there being no cellar. It is desired to keep this garage at a temperature no lower than 50 degrees F. when the outside temperature is at zero F. What boiler horsepower will be required to heat this garage as stipulated, and also how many kilowatts of electrical power will be required with suitably placed electric heaters?

A. 1. It has been computed that about 600,000 B.T.U. heat units will be required, including leakage and radiation thru doors, windows and walls, and the roof; as one boiler horsepower will give about 33,500 B.T.U. per hour, about 18 boiler horsepower will be necessary to steam heat this garage to suit your requirements. If electric heaters are employed, then about 13½ kilowatts of electrical energy will be required.

Nikola Tesla's Present Activities

(1190) Victor H. Tegge, Haddonfield, N. J., asks the following questions:

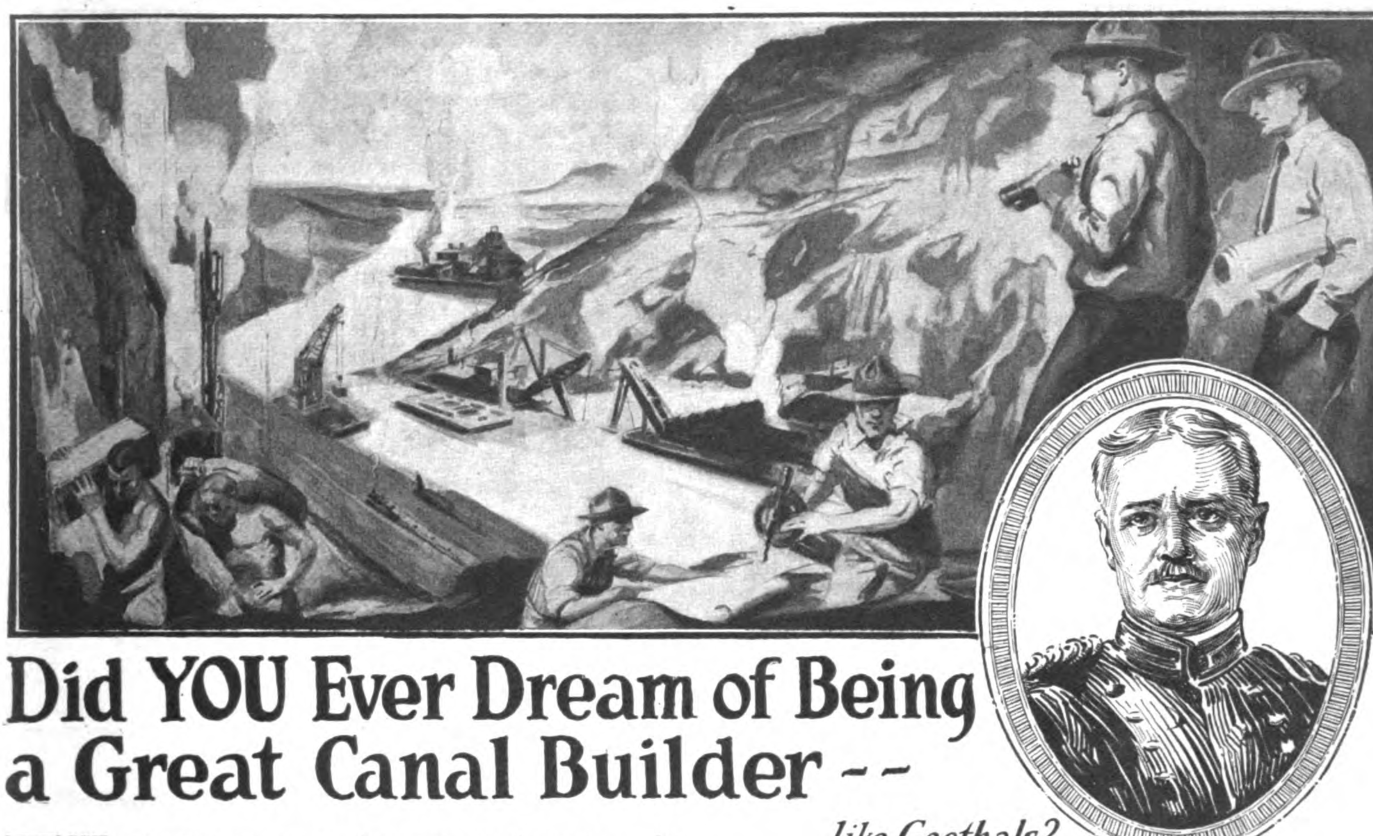
Q. 1. What is Dr. Nikola Tesla doing at the present time and how can I get in direct communication with him?

A. 1. Dr. Tesla maintains offices and a research laboratory in New York City, where he is constantly engaged on new inventions. His address will be found in the city directory or telephone book, or we can supply it on receipt of stamped and addrest envelope. One of the principal things he has been developing just now is his disk-type steam turbine. This turbine, as you probably know, consists merely of a series of thin steel plates, perfectly flat on both sides, the whole assembly resembling a group of phonograph records mounted on a spindle a short distance apart. Steam is injected or shot into the plates from a nozzle or series of nozzles, so that the friction of the steam jet on the flat surface of the disks causes the latter to revolve, and with it the shaft on which a pulley to transmit power is secured.

One of the recently marketed inventions of Dr. Tesla which the public knows little about, perhaps, is his new speed and revolution indicator, described in the December issue of SCIENCE AND INVENTION. This principle, which was recognized as one of wonderful novelty and originality in the realm of pure physics, has been adopted for commercial exploitation by one of the leading watch manufacturing concerns in America. There are only two flat disks in the Tesla speed indicator, the viscosity or friction of the air set up between one of the disks, driven by a shaft connected with the machine under test, and a second disk mounted on pivots and provided with a scale suitably calibrated in such a fashion that the second and freely movable disk turns thru part of a revolution and accurately indicates the speed in revolutions per minute without the use of any stop watch or any other timing device. We could go on detailing dozens of other interesting inventions which Dr. Tesla has been working on in the past few years, including phonographs, etc., and particularly improvements in wireless systems, including plants for the radio transmission of power, which, when perfected, will do away with all of the present extensive copper wire distribution systems.

Q. 2. Where can I find a biography of Dr. Nikola Tesla?

A. 2. We would suggest that you look this up in the files of your library, particularly the Astor Library, of New York, and the Engineering Societies Library, on 39th Street, New York City, where you will find, undoubtedly, the best collection of books and magazines describing in detail all of the motors and dynamos, etc., designed and invented by Dr. Tesla. One of the best books to consult, and which can be found in almost any library, is Dr. Tesla's famous lecture entitled "Experiments With Currents of High Potential and Frequency." This book has been out of print for a long time, but, as aforementioned, practically every library has a copy of it. He also wrote another book on high frequency currents and radio systems, which has been out of print for about ten years, but which you undoubtedly can consult at your local library or at one of the large New York libraries.



Did YOU Ever Dream of Being a Great Canal Builder--

like Goethals?

THE greatest men are the greatest dreamers. In youth they look years ahead and picture themselves doing the big things that later thrill the admiring world. As boys—they imagine themselves directing the boring of gigantic tunnels underneath towering mountain passes. They see mammoth transoceanic ships—like floating castles—Leviathans—all creatures of their own creative brain. They see great ship canals—channeling through trackless jungles in spite of a thousand obstacles that had threatened failure.

All this they see in their youthful dreams. But at last it comes—the great day in which the dream comes true.

What Happened Between Dream and Success?

Did these men sit back and dream *idly?* No. No. They had the good judgment to know they must *prepare themselves* for their great chance. They began by determinedly making the first step early in life.

The First Step to Success

One of the first steps to engineering success is DRAFTING—a knowledge of MECHANICAL DRAWING. Goethals—the builder of the Panama Canal—learned it. All great engineers and inventors learned it. Edison—John Hays Hammond—Steinmetz—McAdoo—*all* learned DRAFTING *early* in their careers.

But in their day no DRAFTING course existed that was not packed with theory and mathematical difficulties. It's different now. Today the Columbia School of Drafting can teach you DRAFTING in from six to ten months in your spare time at home. Think of it—only six to ten months on a study that can start you to success equal to that of Goethals. You may be the next Goethals. Destiny is *always* calling for such men, but remember this—destiny calls only men who are prepared.

Columbia Course Is Easy

Hundreds of Columbia graduates are already started, equipped with the first essential of DRAFTING success—expert draftsmanship. These men, without special education, became DRAFTING experts in less than a year and are today employed at salaries ranging

From $35 to $100 A Week

At one time during the construction of the Panama Canal it was thought that the project would have to be abandoned because of landslides in the Culebra cut. But Goethals, our greatest engineering genius, stuck to his task and WON.

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We put behind you our Students Employment Bureau in helping you secure a position that will pay well. We have helped hundreds of our graduates and are regularly receiving requests for *more* of our trained draftsmen from some of the country's biggest industrial plants.

Even though Destiny may never call upon you to do the work of a Goethals—yet substantial advancement is always open to you. As you forge ahead from Draftsman to Chief Draftsman and from that to Engineer, to Production and Plant Manager and so on—you keep going on up the salary ladder until your income nets you $15,000 a year and over. There's really *no* limit to what you can accomplish in this profession. The start is the thing that counts.

Don't say you haven't the education or the talent or the time. You have everything you need—as much and probably more than many of our most successful graduates had. Show that you have the determination to *start* on your career *today* by mailing the attached coupon right *now*.

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Wood Carving With a Pocket-Knife

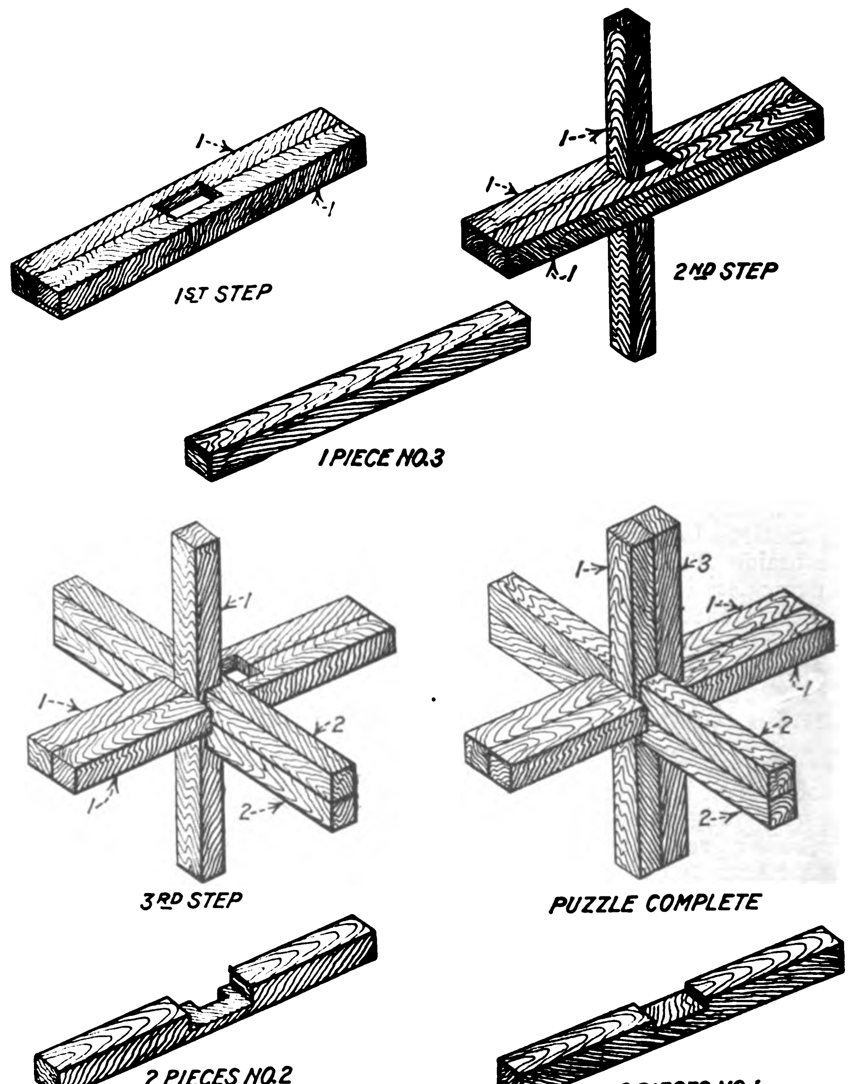
By G. E. WILLIAMSON

(*Continued from page* 1022)

and each one measuring about 3 inches in length. Locate and mark the center on each stick by a line all around; now cut out a center notch 13/16 inch long until you have exactly ¼ inch of wood left. Cut three sticks like this and label them No. 1.

Take two of the sticks and cut another piece out on one side and directly in the center, ⅜ inch wide, leaving the ¼ inch as in the other cut. The sixth piece is left uncut. In putting the puzzle together you will find some of the pieces will require a little extra fitting, but they should not be too loose.

inches, length of fan and shaft 7½ inches. All joints in the tower are exactly like the joints in the *Solomon's knot puzzle.* The outside corner posts lock the bottom, the posts being locked by the platform, which are in turn locked by the upright standard that carries the mill, the wheel of 16 pieces being locked together and also on the shaft by the short center piece running from the standard out thru the wheel, and cannot be removed until the fan has been taken off, the long upright piece at the back end being the only piece that can be taken out to start with. The mill contains no nails, screws, strings or glue, yet the



The Three Wooden Strips Used in Making the Solomon's Knot Puzzle. The Assembly of This Clever Joint is Seen By Studying the Drawings and Successive Stages Here Given.

As the illustration shows, to build up this puzzle first take two No. 1's, put them together so that the notches meet, hold between the thumb and first finger of the left hand, and with the right work the third number one stick into place with the notch up. Roll the thumb and finger slightly, which will bring the first pair parallel; now put the two No. 2's in place with small notch up, and, if properly fitted and adjusted, stick No. 3 will go into place easily.

No. 1—Model Windmill

This is a model windmill made of 72 pieces of basswood ¼-inch square. Base 5 inches square, top of tower 3¼ inches height 12 inches, diameter of wheel 5

wheel turns and the entire mill revolves on the tower.

No. 2—Wooden Chain

Next comes a chain made from a single piece of basswood, 2 inches square, length 32 inches. After getting the wood round and smooth, draw 16 lines the whole length of the stick, spaced equally all the way around, then draw another line parallel with each of them, the distance between them being the amount of wood to be left in the link. Next draw lines straight around the wood, one inch apart, the full length; this can be done by taking a piece of stiff paper with a straight edge and wrapping around so that the edges

(*Continued on page* 1054)

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PRACTICE

Muscle Control

and BE THE MAN YOU SHOULD BE!

ADMIRATION

always follows the robust, graceful and alert man. Pity trails behind the weakling, because his failing energy is not sufficient to carry him over the obstacles that obstruct every man's path to progress. Do you belong to the REAL MAN set—the dominant class of successful people; or are you among the sickly, flat-chested, weak-legged, nervous and always ailing—the insignificant class, that, instead of living just merely manage to breathe and exist?

NO MATTER what your position, environment, physical and mental development now is, *you* are being given a wonderful chance to get more satisfaction out of yourself and the world by this

Amazing Opportunity for Greater Strength

offered by Prof. Matysek, the man who, years ago, having resolved to become healthy and highly developed, has experimented and trained himself until he is ranked among the strongest men in the world. He, in order to accomplish this, has been secretly practicing on this

"Body Beautiful" Maker

Thousands of men who have tested this "Muscle Control Course" say it is the SUREST AND QUICKEST "MUSCLE BULGING OUT" STIMULANT, A CURATIVE SYSTEM OF EXERCISES THAT PRODUCE REALLY ATHLETIC MEN WITH GRACEFUL OUTLINES FULL OF STRONG PERSONALITY.

These Muscle Control exercises are the CHIEF SECRET of why I am growing despite my age, day after day, stronger and better developed, as well. Do you blame me for offering to acquaint you with such progress making exercises that will bring forth the maximum results you are after and NOW are within your easy reach?

Matysek's Muscle Control Course Consists of

Two handsomely finished charts containing twenty-one beautifully produced pictures showing every detail as to how to perform the movements with absolute correctness. The instructions are "straight from the shoulder," such as only an expert who went thru the mill himself could ever possibly produce. The following is but a part of what is embraced in the course.

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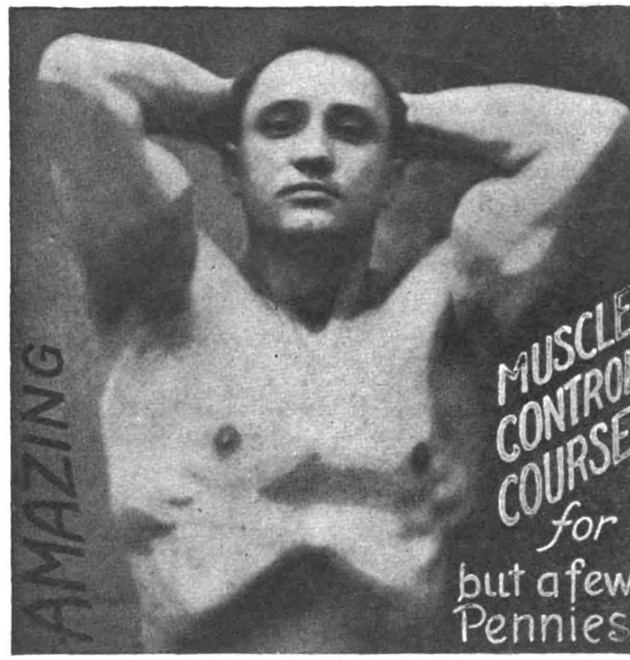
How To—easily correct the rounded shoulders.
How To—expel bothering gas out of the stomach.
How To—promptly chase away the staleness of the body.
How To—strengthen the nerves and internal organs.
How To—control every muscle of your body.
How To—store up energy for feats of strength.
How To—completely relax and contract.
How To—breathe effectively.
How To—arouse your inactive nerves.
How To—create better blood circulation.
How To—increase your chest circumference..
How To—learn the famous shoulder blade control.
How To—thicken the shoulders.
How To—make your shoulders supple.
How To—broaden your back.
How To—depress the abdominal muscles and wall.
How To—control the chest muscles, biceps, triceps, thighs, calt and all other muscles.
How To—assist in training the abdominal regions to be immune from rupture.
How To—master correct posture.
How To—overcome insomnia

and many other vital pointers you need every day, too numerous to mention.

The exercises in this course cause no strain on the heart and do not create nervousness.

Some time ago this course was sold only to my GRADUATE pupils of the regular Matysek Physique Exercise Course as an additional stimulant to the maintenance of Perfect Health. The gratifying results that these fortunate pupils have, and are still securing, brought about my decision to offer this marvelous "natural" nerve stimulant to the general public whereby every far seeing youth, man, even the aged, is given an opportunity to indulge and share in this miraculous muscle and brain instantaneous regenerator.



ANTONE MATYSEK

the muscular phenomenon, the man who is offering to place you on the energetic strong man map. When you find your place on this map you will always be full of pep, ambition and joy. You will be a REAL MAN.

Let My Muscle Control Exercises Mold Muscle on You Quickly and Solidly!

Only ten minutes a day, in the privacy of your own room, solves any case. From my own experience, as well as the very large number of pupils I have successfully aided, I know that in less than five days your efforts will be realized to a most surprising extent. If you are already training on some good "system" these Muscle Control exercises will force your progress to be 100% faster! If, however, you do not exercise, then for your own sake and own happiness, start building yourself up into a *real man*. Do not merely drag on.

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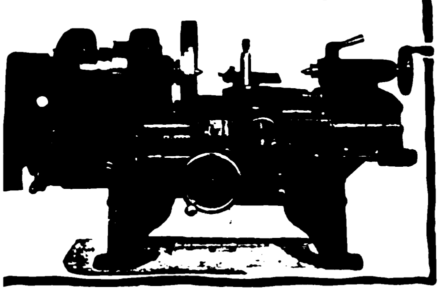
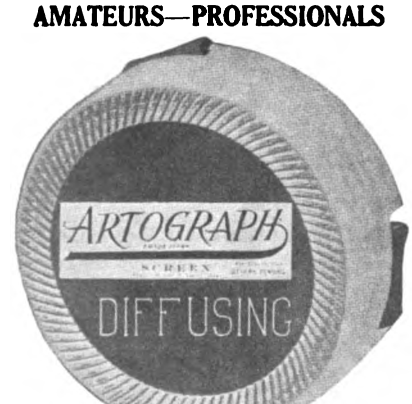
For this reason this Muscle Control Course is being offered you for a limited time at such a trifling price that **YOU CAN WELL AFFORD IT. COSTS BUT $2.00.** I guarantee quick results and absolute satisfaction or money back. Come then, my Friend, when I am reaching out to help you! I will place you on the real road: I will show you the main secret that helped me to get what I longed for and now certainly possess. In addition to this Course you have the privilege to ask any questions pertaining to your physical training; to these I will gladly reply, giving you personal attention. This favor alone is worth the **$2.00** I ask. Better avail yourself of this splendid offer *right now*, for in the future the charges may be *doubled*. Matysek's Muscle Control will do wonders for you. You will be the envy of your friends. Learn how to get the most out of yourself. It is [illegible] d YOU CAN DO IT! GET STARTED RIGHT—RIGHT [illegible] tear off the coupon below, mail with but $2.00 [illegible] gn orders, $2.20) and leave the rest to [illegible]





Wood Carving With a Pocket-Knife

(*Continued from page* 1052)

come in line. Make these lines heavy and draw others between them just plain enough to locate the center. Next cut out the wood in a "V" shaped groove between what is wanted for the links, cut about ½ inch deep, leaving about 1 inch on each end solid.

Cut a "V" shaped notch straight towards the center on the first heavy line away from the end, about ¾ inch deep, turn the stick and do the same exactly opposite, having 7 ribs between on each side, now round the corners of your notches, beginning at the light lines drawn last. Now take the next rib on the right and notch the same on the second heavy line, turn over and repeat. Take the third rib and cut on the third line and continue to the end.

Here is where you begin cutting out the wood not wanted in the links and about the only directions of any value that can be given are to keep your knife sharp and your patience well curbed.

No. 3—Wooden Chain From Match

In making the chain out of the match, the knife was so thin and sharp that it would cut entirely thru the links before any resistance to the blade could be felt and after many failures it was necessary to use a magnifying glass to succeed.

No. 4

These are three cages cut from a piece of basswood 3½ inches in diameter and 6½ long, diameter of ball 1¾ inches. The first job is to work the whole block into a perfect sphere with enough wood on the ends for the handles, then lay off the center rib ½ inch wide, as it is all cross-grained, then lay out the four ribs running lengthwise. Work out the three cornered pieces to the depth required, leaving the ribs the same thickness all the way in. Finish the ball before going any farther with the cages. Draw the guide lines in all of the openings at the exact place where you wish to separate the cages. Here is where the needle-pointed blade and an unlimited supply of patience is needed. Make the cut close around the small stem, just deep enough to connect with a cut between the inside cage and the second one just deep enough to meet it. The other end is cut in the form of a cone and if your blade is less than 2¼ inches long you should make a longer blade out of a dress stay. The next cut is far easier; on the small end cut the outer circle to meet the cut between the outside cage and the second; on the other end the cut is close around the stem.

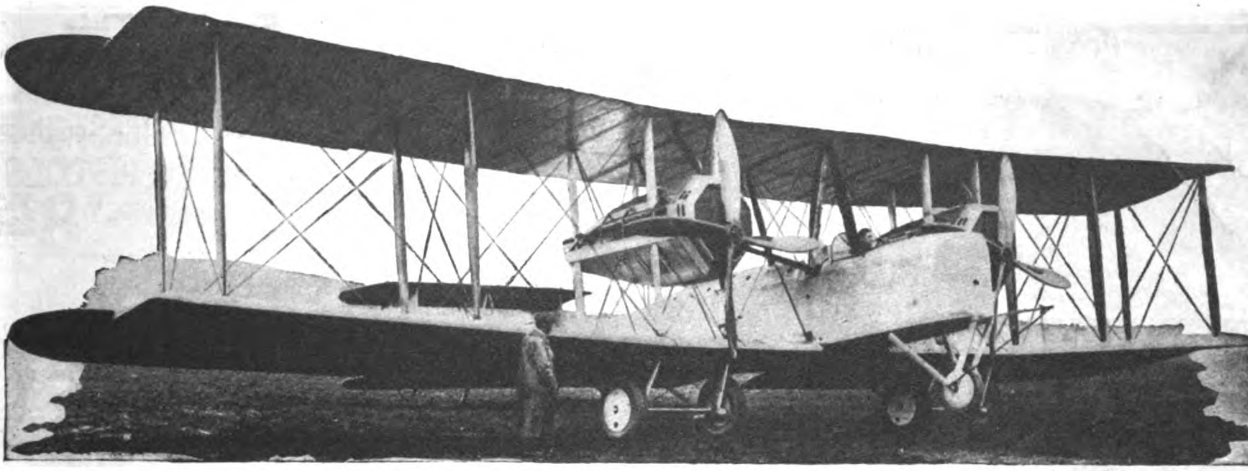
No. 5—Wooden Goblet

[illegible]s one piece of basswood 3 [illegible]ter and 6 inches high, hol[illegible]deep, with four loose rings [illegible]ch one passing thru the [illegible]ying out the stem of the [illegible]1 inch square cross-sec[illegible] for the rings.

[illegible]7—Bottle Puzzles

[illegible] 7 show respectively a [illegible]ing glass beads, strung [illegible]sired, upon a wooden [illegible]d thru a long wooden [illegible] second exhibit shows [illegible]ades opened, suspended [illegible] a wooden cross-arm [illegible] elongated stopper. [illegible] the details with the [illegible] in a little booklet, [illegible] publishing here.

[illegible]n *page* 1056)



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Delivering Newspaper "Extras" by Airplane

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Wood Carving With a Pocket-Knife

(Continued from page 1054)

No. 8—A Model Barrel

This barrel is composed of 16 staves, with 6 hoops, each fastened on with 4 nails, made of basswood, completed and assembled out of the bottle to make sure that it would fit properly, and all nails driven in their proper places, first insert the hoops and get them straightened out, the two larger ones having three threads tied to each of them, so that they can be hung from the neck of the bottle level and at the right height. Tools for placing the staves are two wires, one with a fine sharp point, which is stuck into the end of a stave just enough to hold while it is being lowered, the other wire to push it off, allowing the nail to hook over the edge of the hoop; the last stave should be one without any nails; after the staves are all in place, with hooked wires place the second hoop on the top end and carefully push it tight against the nails that will be above it when finished (the nails for the two bottom hoops and the top one should be driven in close before putting the staves in the bottle, each long enough to project inside of the bottle 1/8 inch). After the hoops are on they are pushed back from the inside, to get the second and fourth hoops in place. Drive the nails in by pushing the barrel against the glass. The bottom head is forced in from the inside. Each head is made of four pieces, the fourth piece in each head being beveled so that it can be forced in tightly. It will require several different kinds of crooked wires and hooks to do the job.

No. 9—A Hard Puzzle Within a Bottle

This is a Japanese puzzle of 21 pieces bought at a toy store. After learning to put the puzzle together with the hands, take two pointed wires long enough to reach the bottom of the bottle and learn to put it together with the wires. When you can do that you can put it into the bottle. The points of the star are matched like flooring and have holes drilled thru them sideways near the middle, the inside ends are cut off so as to leave a hole about 1/2 inch in diameter in the center, make a stopper with a 1/2 inch hole in the lower end about 1/2 inch deep and continue thru the length of the stopper with a hole just large enough to take a thread that is attached to the end of a plug for the lower end, but having a head about 1 inch in diameter. Put the star points on a thread like beads and juggle them into position a few times, then drop them into the bottle. Tie a thread to the small end of the plug and drop it in and get your points worked into position and tie the two strings together as tightly as possible, by means of wire tools. Thread the loose end of the thread attached to the plug, thru the stopper; place the stopper and gently pull the plug into place, where it will hold the star if the work has been properly fitted. Whittle a match stick into a long slim plug that will fill the hole where the thread comes out, put a little glue on it and force it in and cut off the thread.

No. 10—Clever Fan in a Flask

The illustration herewith shows how a wooden fan is whittled from one solid piece of wood, and then placed inside a small glass bottle. The fan is whittled and the leaves cut, so as to separate as the first step. The fan is then closed and put inside the bottle, where it is opened by means of two wires hammered flat and split for about 1/2 inch like fork tines.

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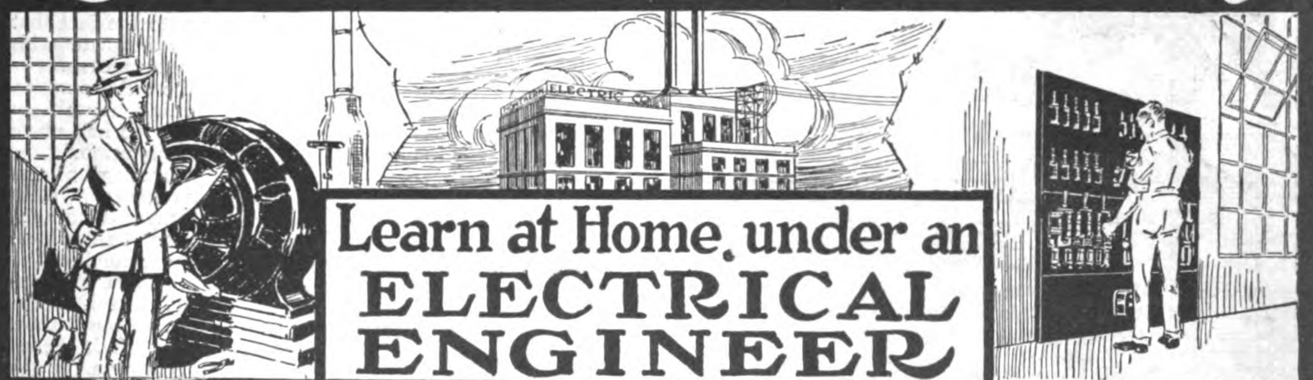

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The Ninth Spool

By CHARLES S. WOLFE

(*Continued from page* 1012)

quite awhile ago he got onto the fact that Mrs. Alvarez was unduly intimate with this Smithson chap. He took measures—strenuous ones—to end the little romance. Then just when he's patting himself on the back over the thorough job he's made of the bust-up, comes the explosion."

Fenner turned to Alvarez, who was showing signs of another outburst. "Keep your head, please," he warned, soothingly, "How long has it been since you first suspected your wife of improper conduct?"

Alvarez made a manful effort for control. "Two months, maybe," he said, brokenly, "Ten weeks. About that much time. I find, by accident, a letter. It is signed with the sign of Señor Smithson. I say nothing. I watch. I see them meet. They kiss," his fists clenched and unclenched spasmodically, "I follow this man to his lodgings. I take the pistols. I go to him and ask that he fight."

"Yes?" Fenner queried interestingly, as the swarthy little man paused, "And what happened?"

Alvarez choked. His face convulsed with rage, and I feared we were about to witness another outpouring. "He is no gentleman!" he cried, and tears of rage and humiliation sprang into his eyes, "He is—how you say it?—one big brute. He'sa take both pistols by force from my hands. He'sa spank me!"

I turned my head. Davidson leaned back in his chair, stared hard at the ceiling, and blew a big cloud of smoke aloft. Fenner gave no sign of amusement.

His sympathetic murmur carried the little man on. "For my name—for my honor—I make no complaint to the police. I tell this pig if I find him again in my house, I will shoot him. I go home. I tell my wife she is discover. She is very—very obstinate. My servant I can trust. Together we stop all her mail till I can read it. He follows wherever she go when I am away. There is no more between them. But this afternoon she give my man the knock-out drops. He sleep. She is gone!"

"So is the money," Davidson murmured.

"For the money," Alvarez screamed, "I care not one damn! It is her! I want her back. You will get her for me?" He looked appealingly around our little group.

"If it's possible under high Heaven," said Davidson, grimly "We will get her back. For me!"

Alvarez caught the significance of the Chief's remark. "Not for prison!" he screeched, "Not——"

Fenner stemmed the rising tide swiftly. "You are talking to the most merciful Chief of Police in these United States, Mr. Alvarez," he said, laughingly, "He spends half his time catching criminals and the other half getting them out of their troubles. I suggest that you take us over to your residence and give us a chance to pick up any loose ends that the señorita may have left dangling."

The Chief's car whisked us in no time to Alvarez's desolated abode. On request the little South American produced a bundle of letters which he said comprised the mail received by his wife, since the discovery of her intrigue. Swiftly Fenner subjected each to heat, an effort that proved fruitless. From his pockets he produced several bottles, bathing the suspected paper in one solution after another. As the last letter came dripping from the last bath, Davidson grunted his disappointment. "No sympathetic inks, eh?" he growled.

"Seems not," Fenner admitted, cheerfully, "So we'll turn our attention to Madam's chambers."

As we entered the boudoir we were confronted by ample evidence of hasty departure. Heaps of discarded garments littered the floor, while open cases on the dressing table told of the missing gems. Conspicuously arrayed, four dry cells lay scattered over the table top. Fenner paused in his tracks.

"What are they doing here?" he demanded, pointing to the Columbias.

"It is for the vibrator," Alvarez explained, "That, it seems, she has also taken."

"The vibrator?" Fenner questioned.

"*Si!* She got it several weeks ago. For her face. For her beauty. A box—little lamps inside. Something goes over the face—like this." He illustrated with a gesture.

Fenner glanced up at the glowing lights over our heads. "Why these cells with the house circuit so handy, Mr. Alvarez?"

Alvarez shrugged. "I don't know," he replied, "I know nothing about electricity. She say that she need the battery. I get it."

A little desk yawned open at our left and on it Fenner's searching gaze fell and focused. A topsy-turvy mess of paper debris spoke eloquently of the looting, but it was not to these remnants that Fenner turned his attention.

"For Heavens sake, Alvarez!" he exclaimed, wonderingly, "What did she do with all the wire?"

Following the point of his finger, we saw the spools. They were scattered heedlessly over the desk top, some standing erect on their ends, others lying flat on their sides, held by the chance barriers of paper heaps. I counted nine of them, nine full spools of glittering wire.

Alvarez stared blankly at Fenner. "For the picture, of course," he replied, "He is picture wire."

Fenner picked up a spool, found the free end, and idly unreeled a couple of feet. "Steel wire," he said, testing its strength with a little pull, "What did she have—an art gallery?"

Alvarez shrugged. "Not the gallery," he answered, indifferently, "But quite a few. See." He waved his arm toward the walls, which were, really, over full of paintings, hung without any particularly pleasing effect.

Fenner regarded the array on the walls speculatively, carelessly rewinding the wire on the spool meanwhile.

"Well," he said, after an interval of silence, "This doesn't get us anything. Let us look farther."

We looked, but without result. We ransacked the rooms, finishing thoroughly the work that Madam had so well begun, but we failed to bring to light anything to furnish a clue to the missing lady's whereabouts or her intentions.

Finally Fenner straightened up. "We've done all that we can do here," he said, quietly, "The gathering is adjourned. I'm going home and think the thing over." He picked up the nine spools of wire and dropped them into his pocket. "Chief, will you have Mr. Alvarez at my house to-morrow afternoon at three? We'll resume operations then."

Alvarez squealed in protest. "To-morrow at three?" he shrieked, "Amigo, you do not understand! My wife—she is fleeing—she gets farther——"

Davidson cut in curtly. "You don't know this young man as I do, Mr. Alvarez," he said, with finality, "I realize that every minute is eternity itself to you. But if Fenner says three to-morrow, three it is. I've had to put up with a delay countless times, and you'll have to make the best of it this time. There is always a method in Fenner's madness."

While he was running us around to our diggings, leaving Alvarez on his violated hearth, the Chief propounded a theory to account for the presence of the spools of wire. "Know what I think she wanted with 'em?" he asked, "A ladder! It's my opinion that before she got the idea of drugging the servant she had intended to twist up strong lines out of wire and make a wire ladder. See? She could have slid down from her window while Alvarez's man was watching the regular exits. Then she got the dope some place, and didn't need the wire."

"You never can tell," Fenner commented, non-committally.

"No," the Chief replied, "And it don't matter much what she wanted with it anyway. It don't help to locate her. Just the same, I think that was the big idea."

Later, wooing slumber in our room, I heard a chuckle from the bed across the room in the darkness. "What's the joke?" I demanded, listlessly.

Fenner's voice came, mirth-wracked, out of the blackness. "I was thinking of Davidson's wire ladder," he choked, "Great Heaven!"

"Sounds reasonable to me," I returned. "She never intended to use all that wire on pictures."

"But there was no guitar!" Fenner protested.

"No guitar!" I echoed, blankly. "Why should there be?"

"That sort of thing is never done without a guitar strumming as the lady descends from her boudoir," he explained, mockingly patient. "Davidson has been patronizing the movies."

The following forenoon found me exceedingly busy. Remembering the appointment at three, I hung doggedly to my task straight thru the lunch hour, dashing into our rooms five minutes ahead of that time as a consequence. To my amazement I found Fenner seated in a deep arm chair, clad in a dressing gown. It's pattern, for lack of stronger adjectives, I must call atrocious. He had evidently purchased it for the occasion, for I had never beheld it before. Around his head was neatly wound a turban, contrived from a piece of cloth that was making a noble effort to outshriek his robe. Before him on the table was a large crystal gazing ball. Cross legged, he regarded me with the utmost gravity as I entered.

"For the love of Tesla!" I began, taking in the details of the bizarre scene dazedly, "What——"

"Do not wax profane, Bill," he said, with cold disapproval, "You behold Fenner, the seer."

"What——" I began again, to be interrupted.

"I am seeing Davidson's wire ladder and raising him one," he grinned. "That gem deserved retaliation."

Before I could question more, Fenner's quickly stiffening face and the rattle of the knob announced our callers. I had the satisfaction of seeing the open-mouthed amazement of Davidson and the bewilderment of Alvarez.

"The Señor——makes the trance?" the little South American stammered.

"I do not make the trance," denied Joe, with the greatest gravity, "I fathom the mysteries of the sphere. Let no one disturb the conditions." He gazed with great directness at the fidgeting Chief.

"That means me!" the police head murmured, "Go on with the show. I'll be good."

Fenner gazed fixedly at the ball. So did all the rest of us. I saw no change of any kind in its surface, but presently Fenner began to speak, dreamily.

"You will find the Señor's wife," he intoned, monotonously. "In the town of Murray, twenty miles south of this city. You will go to number 509 Water Street, where you will find those that you seek. But you will find her not as Señorita Alvarez, nor yet as Mrs. Smithson. She will be called Mrs. Patton."

Alvarez was ready to burst with excited questions, but Davidson was already pushing him before him toward the door. "Go," he rumbled to the little man, "It's up to us now. We'll find her there if he says so. That sphere nonsense has nothing to do with it. I'll find out later how he picked up the scent."

The roar of his racing engine told of Davidson's hasty departure. I turned to Fenner, who had thrown off his turban and was demurely lighting a cigarette. "Cards on the table, please," I demanded, bluntly.

"It was the ninth spool that gave me city, street, and number," he said, slowly. He had wandered over to the wireless table, and on it he arranged the nine spools of wire, taken from the pocket of his dressing gown.

"Be it known to all and sundry," he continued, in the fantastic vein which he often affected, "Be it shouted from the house tops and announced from the church spires that this bird Smithson was not born on a raft. Whatever may be his shortcomings morally, he is no untutored savage. Not by a darned sight!"

"The spools!" I urged, impatiently.

"You will observe," he went on, unhurriedly, "That I have numbered them from one to nine with indelible pencil." He indicated his markings on the edges of the spools. "That is the order, I believe, in which they should be considered. Now, Smithsons stunt was flawless. He is absolved from all blame in bringing about their downfall. Señora Alvarez showed the ivory and pulled thè boner. She should have taken with her either the spools or the dry cells. Without either the chances are it would have gone by me clean.

"It struck me as odd that she should buy a vibrator, as Alvarez called the contraption, that required dry cells when she had the house current at hand. It sounded still more strange that a massage outfit should have two little lights, to again quote His Excited Honor. True, they might—they might have been Tungar rectifiers, but—if so, why the batteries?

"Then I picked up a spool, you may recall, and started to unwrap it. Then and there I felt that I had the Señorita by the heels, but I kept up the search to hoodwink Davidson, a weakness that I have. Look here!"

He picked up a spool, found the free end, and passed it to me. Feeling a thickness at its end, I examined it closely and found —— a tiny loop, very neatly made. I stared at it blankly.

"Looks suspicious," I ventured. "But what's it for?"

"Let me show you," he cooed. Swiftly he cut out of our set the two bulbs and transformer that comprised the one step amplifier. Quickly he connected the amplifier to our loud-speaking horn. Then diving under the table, he rummaged amid discarded apparatus, to emerge suddenly with a compact little outfit in his hands. He laid it before me triumphantly. "Remember building that?" he demanded.

"Good God!" I cried, in stunned enlightenment. I did, indeed, remember building that particular piece of apparatus.

Without comment he picked up the spool, numbered one, and placed it on the spindle. Deftly he threaded the wire thru the guides, dropping the little loop over the hook on the empty spool of the machine. With a flick of his finger he started the little motor and the wire fed evenly off of its containing spool. From the horn came the strong, vibrant voice of a man. And what an outpouring of endearing terms, what a wealth of romance and feeling came to us on that pleading voice. Dumbfounded, I listened.

"The missing clue," said Fenner, calmly, as the ghostly voice pleaded on. "The unsuspected love letters of the mail-barred Señorita Alvarez. Right under her cocksure lord and master's nose, Bill, and your two little lights become the obliging vacuum valves! Full instructions, counsels, warnings, the countless details of the flight together with the rendezvous on the ninth spool. *The telegraphone,* Bill! *In Hoc Signo,* slip one over!"

I stared. The voice ran monotonously on as the wire passed evenly between the magnet poles. Fenner arose, ran a hand thru his mop of hair, thrust both hands deep into the pockets of his robe and stared out of the window.

"A ladder of wire!" he said, softly, "Ye Gods!"

Snow Crystals

(*Continued from page* 1021)

common, but it is seldom that they are regular in their aggregation, as are the snowflakes.

The Weather Bureau of the United States Government has taken many photos of snowflakes, and it is said that every great snowstorm has supplied from five to thirty-four new crystals. Attempts have even been made by the Weather Bureau to determine the conditions of a storm in which the formation of any particular variety of crystals is brought about.

Mr. Wilson Alwyn Bentley, well known meteorologist of Jericho, Vt., has accumulated a world famous collection of snow, frost and ice crystal photographs, and it would certainly seem as if the makers of lace and ornamental fabrics could obtain many valuable hints from his 4,000 odd photographs to guide them in making their designs. A garnet, a rock-crystal, calcite and fluorite and many other minerals may supply absolutely symmetrical and beautiful crystals, sometimes colored, sometimes colorless, and perfectly transparent —but curiously enough, to find an aggregation of many crystals in numberless forms, and each group perfectly symmetrical, we have to go to the short-lived, almost microscopic snowflake.

SUN DIAL SHADOW MOVES BACKWARD

In the twentieth chapter of II Kings, at the eleventh verse, we read that "Isaiah the prophet cried unto the Lord, and He brought the shadow ten degrees backward, by which it had gone down in the dial of Ahaz."

It is a curious fact, first pointed out by Nonez, the famous cosmographer and mathematician of the sixteenth century, but not generally known, that by tilting a sun dial through the proper angle the shadows, at certain periods of the year, can be made, for a short time, to move backwards. This was used by the French encyclopedists as a rationalistic explanation of the miracle which is related at the opening of this article.

Contributed by WM. R. REINICKE.

The Amateur Magician

By JOSEPH H. KRAUS

(*Continued from page* 1030)

down, turn over the card at the number thought of, thus." He picked up the cards preserving their same order, saying, "I have thought of number fifteen — thirteen, fourteen, fifteen. I turned them over and note that the deuce of diamonds is the fifteenth card.

"Do you follow me?" I nodded in assent. "You do likewise," he continued. "Choose any card and remember its name and position in the deck." I did so. He picked up the deck, turned it face upward, and started to examine the cards, transferring them rather rapidly from his left hand to his right. He hesitated now and then and came dangerously near the card I had chosen, but past it by. "No, I think you fooled me this time." With the cards face upward on the table, he requested that I remove just as many cards from the top as the position of my card in the pack indicated. I did so. Then picking up the cards, he removed three more from the face end, and placed them face downward upon the table, stating as he did so, "One of those three cards is yours." I doubted him, and he asked me to turn up the cards and look at them. Again I carried out instructions. And then added, "Well, I fooled you that time, it's not there," but the smile on my face quickly changed. He seemed surprised at first, "Fooled me, that's impossible, it must be there! What was the name of your card?" I told him. "Tray of hearts?" he continued, "Impossible, why that card has been reposing in my pocket for quite a while. Here, put your hand in and take it out for yourself." Placing my hand in the side pocket of his smoking jacket, I extracted my card. Thinking perhaps that he had a duplicate, I checked thru the pack, but the tray of hearts was gone. Yet I was positive that was the card I had originally chosen, which fact I tried to impress upon his mind. He saw that I was astounded, so before I could ask for an explanation he started.

"You're so easily fooled I think I'll sell you the Public Library to-morrow. The trick is simple in the extreme, and is undoubtedly one of the most easily mastered of all card tricks, nearly impossible of detection, and requires no practise at all. The cards are, as you undoubtedly know, shuffled by yourself or any other interested spectator. They are placed face downward on the table, and you select a card, counting of course from the back, to a certain position in the pack. You remember the position and also the name of the card. I then pick up the cards from the table, turn them face upward, and altho I seemingly hesitate and appear to be looking for the card, in reality I merely transfer the cards from the left to the right hand, reversing them in order, one at a time. I then take four other cards from what is now the bottom of the deck, and place them on top. Immediately thereafter I request you to remove the same number of cards from the face of the deck as the position of the card thought of indicated. Thus assume that you chose the ace of spades, which occupied the tenth position from the bottom of the deck. In reversing these cards, the ace of spades again occupies the tenth position, but this time from the *face* end of the deck, after the entire order of the cards has been reversed. Removing four of the cards from the bottom I place them on top. The ace of spades now occupies the fourteenth position from the top of the cards. I request that you remove the same number of cards thought of originally—ten—which brings the ace of spades to the fourth position in the deck. Removing the top three and placing them face downward upon the table, I make the assertion that your card is one of the three, knowing full well that it is not. This brings to the top the ace of spades which I place into my pocket. Savez?" Altho I didn't see him remove the four from the bottom and place them on the top, I could well understand how the trick worked, and on trying it subsequently, found that it was indeed very effective, and quite impossible of detection.

THE RINGS OF HINDUSTAN

As usual Hargrave never gave me a chance to discuss one trick before he started off with another one. Opening the drawer in the antique "trick" table he removed two rings which seemed to be of wood, altho he later informed me that they could be made out of metal, glass, rubber, or in fact anything. These rings were about 2 inches in diameter. He then procured a piece of plain white paper and placed this on top of the desk, gave me the rings to examine and also a card 2⅛ inches square, and then asked me for a coin. Past experience had taught me that a Chinese yen is the best coin to give Hargrave when he asks for one, but not having this currency in my pocket, I produced a genuine American cent. This may seem sort of cheap to the reader, but after he has seen quite a few coins disappear from his regular income, he can well appreciate my position. Magic and black art costs money.

Placing this cent on the paper, he picked up the card and covered one of the rings with it. He then picked up the second ring and placed it on top of the card and the first ring. Lifting the entire group he placed them over the coin. He now removed the top ring then the cardboard disk, and the coin had disappeared. On replacing the cardboard then the ring, moving the entire group, two rings and card, the coin again made its appearance. "You can only do that trick by making this mysterious pass," he exclaimed, on deplicating this stunt, "and saying *oxyben zylmethylenglycolanhydride*, which of course means bakelite." In view of the fact that I could not pronounce the word, I assured him, in a jocular manner, that I could not reproduce the trick, but when I saw how it was done——.

Originally he had two rings which were absolutely unfaked. I examined them of course and returned them, and while I was looking for a coin he had substituted another ring identical with the two I had seen, to the bottom of which was glued a sheet of paper, exactly similar to the white paper upon which the trick was being conducted. The edge of the paper was carefully trimmed, so that to all appearances I was looking right thru the ring at the white paper sheet on the table. The order of the trick then followed thusly: Cardboard piece was placed upon the paper ring, another ring on top of this and the three placed over the coin. Top ring removed, cardboard sheet removed. The paper on the bottom ring was covering the coin, which seemingly had disappeared. Cardboard replaced, ring replaced, the three removed at once, the ring then taken from the top and the cardboard pushed aside. Care is taken that at no time shall the bottom ring be moved without having first been covered with the cardboard and top ring. Changing the rings is so simple that I never noticed it, my attention being distracted for the moment while fishing for the coin. As I left Prof. Hargrave that evening, I felt like hanging a sign upon my back, "kick, please, and kick hard."

Measuring the Velocity of Bullets

(*Continued from page* 1039)

to the axis of the shaft, and it is aimed at a point on the front disc two or three inches from the circumference, and fired. If the two discs were at rest, the bullet would penetrate both at the same degree-interval. With the discs in rapid rotation, the second one will turn an appreciable distance while the bullet is traveling over the intervening space.

Assume, for example, that the discs are ten feet apart and rotating at the rate of ten revolutions per second, and that the bullet has a velocity of 3,000 feet per second. The bullet will, therefore, consume 1/300 second in traveling the ten feet between the discs. They are rotating at the rate of 3600°, (360°x10) per second, therefore in 1/300 second they will rotate 3600°/300, or 12°. That is, the perforation made by the bullet in the first disc will be 12° in advance of that in the second disc. If the hole in the nearer disc is, say 27° from the 0° line, angular measurement, the hole in the further disc will be 39° from the 0° line.

Conversely, assume that after firing a bullet with unknown velocity, the two holes are found to be 16° apart; find the velocity of the bullet. Since the discs are rotating at the rate of 3600° per second, and are 10 feet apart, the bullet is traveling at the rate of 10 feet in 16/3600 second, which, by a very simple arithmetical computation, gives 2250 feet per second as the velocity of the bullet. In fact, for any given speed of rotation, numerical tables could be constructed, showing the actual velocity of a bullet for all angular distances between the perforations. Using the rotational velocity of 10 per second which we have assumed, 18°=2000 feet per second, 20°=1800 feet, 22°=1638 feet, etc.

No radii are really essential on the discs except the 0° line, which is used both as a guide for setting the discs and as the starting-point for measuring the angular divergence of the perforations made by the bullets. One pair of discs can be used for a number of shots, just as one target is used for repeated shots, until it becomes so full of holes that it is no longer serviceable.

Also, it will readily be seen that the distance between the discs and their speed of rotation, within certain limits, need not be of any fixed numerical value, so long as these two factors are known.

The device can be used at almost any distance within which it can be hit, but beyond 150 or 200 yards larger discs would be necessary unless an unusually expert marksman be employed to do the firing. And, since the velocity of bullets at different distances from the firing point can be determined, the device is a valuable aid in determining experimentally the retarding effect of atmospheric resistance upon different types and weights of bullets.

It will be seen that it is not necessary for the bullet to penetrate the discs at any fixed distance from the circumference, there being, in a three-foot disc, about one foot vertical range in which the bullet can safely be placed.

For extreme accuracy, the discs are set with a plumb line and the position of the rifle fixed by means of a surveyor's theodolite.—By Cleve Hallenbeck.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page* 1011)

lion light years since it first became a star.

It is one of the most remarkable facts concerning the past history of the solar system that neither the sun nor any of the planets has met with any serious catastrophe since the earliest geological period of a billion years ago, and possibly for many billion years prior to that time, tho of this we cannot be so certain. In the past billion years we know that there has been no serious change in the amount of light and heat given forth by the sun, and no collisions of sun or planets with any other body in the universe of sufficient size to interfere with our journey or with the development of the life process on our planet. Some astronomers are inclined to attribute the glacial epochs and intervening tropical periods of the past to encounters of our solar system with stray wisps of nebulosity drifting in different parts of space, similar in their composition to the dark nebulas that are known to exist in the Milky Way. Such an encounter with a rare resisting medium might result in slight irregularities in the intensity of the sun's radiations from time to time, and this might account for alternately warm and cold periods that are known to have existed in the past and which may occur again in the future.

It is difficult for us to realize how extremely small a unit our solar system is in the universe to which it belongs and how slight are the chances that it will collide with another similar system.

It may be helpful in this connection to illustrate the size and importance of our solar system in the universe by adopting a reduced scale of measurement that will permit a comparison to be made with familiar objects. Let us take the distance from the earth to the sun as equal to one inch. With this scale of measurement the extent of the solar system across the diameter of Neptune's orbit is five feet. The sun on this scale would be about one-hundredth of an inch in diameter. A super-giant such as Betelgeuse would be about three inches in diameter. The light year, which is sixty-three thousand times the distance from the earth to the sun, would be almost exactly one mile. In our reduced sidereal system, then, light would travel *one mile* in a year while the solar system would travel *four inches* in a year.

Now it is known that within a radius of the earth of about sixteen light years there are nineteen stars. So within sixteen miles' radius of our five-foot solar system we would place nineteen stars. Of course we cannot say that there are no more than nineteen stars within this distance of the sun, for we do not know the proportion of dark stars in the heavens and there may be a few additional faint stars within this radius that have escaped observation, but they cannot be many in number. The nearest star, Alpha Centauri, four and a third light years from the earth, would be four and a third miles from our five-foot solar system. When we stop to consider that on this reduced scale the stars would be represented as ...ling along, we might say, at the rate ...nches a year in various direc... ...ey are separated from one ...stances of several miles, we ...t are the chances of colli... stars in the universe in ...tive distances are the same ...ed model of the system. ... of ninety-three million ...h, which we have chosen, ... universe, thru which our solar system five feet in diameter is advancing at the rate of four inches a year, is three hundred thousand miles, and light, which on this same scale would travel one mile a year, must take three hundred thousand years to cross it. Our little sun, one hundredth of an inch in diameter on the same scale, with its microscopic planets advancing four inches a year would take nearly five billion years to cross this miniature sidereal universe. How totally insignificant our solar system appears in the midst of such a universe! And yet how wonderful are the stars when we consider the nature of their radiant energy! The sun is faintly visible without the aid of a telescope at a distance of forty light years. In other words in the miniature universe which we have constructed a mere point one hundredth of an inch in diameter emits light so intense that it could be seen forty miles away against a black sky, and its store of energy is so inexhaustible that it would last undiminished for at least one hundred billion years! And there are stars in the globular clusters that can be seen with the aid of powerful telescopes at distances of thousands of light years, which is equivalent to saying that in our miniature system certain sun-giants—a few inches in diameter—have such an overwhelming intensity of light that they would be visible with the aid of a powerful telescope at a distance of many thousand miles!

In this wonderful universe of stars thru which we are traveling, how infinitesimal are the chances of collisions between individual stars and how endless, apparently, is the journey upon which we are embarked.

A Combination Airplane and Submarine

(*Continued from page* 1005)

or when riding on the surface, an ordinary submarine engine operates the screw that drives it. By the use of this screw, when the wings are left expanded the machine will ride smoothly on the surface ready to dive beneath the waves or climb into the air as the operator chooses.

The entire body of the machine is made of aluminum, allowing the maximum in strength with the least possible weight. Fully equipped, it weighs only 1,650 pounds. However, it carries two torpedo tubes, and for each torpedo carried an additional 1,000 pounds must be added. The position of the torpedo tubes beneath the submarine makes it possible for the operator to drop the torpedoes on warships or land fortifications from the air by merely tilting his machine nose downward and releasing them.

In addition to the torpedo tubes the machine also carries three machine guns, two in front and one in the rear. The Liberty motor is considered capable of carrying the machine at a possible speed of ninety miles an hour, while under water its highest speed is placed at twenty knots.

The machine is controlled by one operator, tho it is possible for as many as three to occupy it. The operator's seat is just back of the engine, exactly as in an ordinary plane, and the operation of shutting off the Liberty motor and starting the submarine engine is all controlled by the shifting of one lever. The opening and closing of the wings and propeller blades are likewise controlled from the operator's position.

Even the possibility of a shot striking the ports before the machine submerges and drowning the operator is guarded against by a protecting device which can be fitted over the outside of the glass.

Electric Desk and Auto Clock

(Continued from page 1019)

cell battery. The use of current is so slight as to be practically imperceptible. The battery is guaranteed to run the clock for twelve months.

There is no main spring. A (a spiral spring) pulls B (the armature) so that D (the driving pawl) drives E (a non-conductor ratchet wheel) in clockwise direction. D (the driving pawl) and F (the holding pawl) press downward on the ratchet wheel E.

When the ratchet wheel turns thru the length of one tooth the holding pawl F drops from the top of the tooth and makes contact (as shown in the drawing) with the driving pawl D, thus completing the circuit from the battery thru the magnet G.

The magnet G being energized by the connection attracts the armature B, pushing the driving pawl D over the top of the next tooth in the ratchet wheel. D then drops to the bottom of the tooth, F being held at the top of the tooth and the circuit is broken. The spiral spring A again pulls the armature B, and the process is repeated.

Making and breaking the circuit, with tension spring A, takes less than 1/50th of a second and occurs every 45 seconds, this interval giving the proper gear ratio to the watch movement.

The turning of the ratchet wheel E, explained above, drives the power shaft which is geared to the center wheel of the watch movement—and thus the running of the clock is made automatic.

ALL-METAL REVERSIBLE AIRPLANE PROPELLER

An all-metal propeller for aircraft, lending itself to a reversal of the blades, has been designed by the Engineering Division of the Air Service of the United States Army at McCook Flying Field, Dayton, Ohio. The mechanical details of construction were executed by a commercial enterprise in Pittsburgh, Pa., where preliminary tests were successful in reducing the distance, which an airplane travels after landing, from 700 to 280 feet. Subsequent modifications of the new blades, according to claims, will probably further curtail the distance to 100 feet or less once the machine returns to earth.

The blades of this all-metal propeller are built of steel tubing of tapering section and thickness. There is an absence of welding, save to close the extreme tip fitting over the two arms of the hub. The blades are secured in position by use of ball-bearing rollers. The latter, if we are to accept the claims of the designer, considerably reduce the friction of the rotation of the blades about their center axis. An angular development of 45 degrees is possible by means of a control lever which extends to the cockpit.

Contributed by S. R. WINTERS.

MODEL SHIP MADE OF STRAW

MODEL ships have been built from tin and wood for many years, but it has remained for this genius, Mr. N. J. Seraphine, an artist, of Venice, to build this beautiful model of the former *Kaiser Wilhelm der Grosse* (sunk during the war on the west coast of Africa), entirely from straw. The photograph shows the model ship, and also its builder; the vessel measures six feet in length, is eight inches wide, and weighs only 2¼ pounds. The straw ship is valued at $5,000. Great credit is due its builder as we have seldom, if ever, seen a model which has more wealth of detail than this one.

Wood Phonograph Tone Arm and Reproducer

By PAUL WILHELM

(*Continued from page* 1037)

made in the center. With the calipers describe a 2-inch circle and a 1½-inch circle. This piece is now placed with the back to the lathe, the center of the circles being in line with the lathe centers. After securing the block the two-inch circle is turned back five-eighths of an inch and the 1½-inch circle ½ inch. The hole is now drilled 2 inches deep. The piece is now taken from the lathe and the ¾-inch hole drilled in from the end. A plug in the open end, centered and a center placed in the end having a surplus of stock, is now swung again in the lathe, this time between centers. The outside is turned as much as possible, the rest being hand finished. The slot, cut in the end, should just be a slide fit over the flattened sides of the tone arm ball. A hole drilled thru both members takes a pin, which in turn allows the two members a vertical swing. The needle bar is made from any handy parts that are to be found. The small hole in the end of the thin metal should be an exact counterpart of the hole drilled in the diafram. These two are now riveted together.

For assembly: The glue is warmed over a water bath and applied when hot to the projection on the sound box. This is placed in the recess in the tone arm and kept under pressure until very hard. When the glue has set, two rubber rings (or more) are cut to fit in the tone chamber. Enough rubber must be cut to fill the space under slight pressure when the diafram and retaining ring are in place, the retaining ring being flush with the outside face of the sound box. Glue is applied to the outer edge of the ring, placed inside with a rubber ring between it and the diafram and another rubber back of the diafram. Pressure is applied and the whole laid aside to dry.

The needle bar is secured to the sound box by filing the head from a wood screw until it has the same diameter as the body of the screw. This is now screwed into the sound box on a 45 degree angle from the tone arm, care being taken not to split the edge. The slot is left with its angle pointed the same as the needle bar. The metal strip of the needle bar is dropt into the slot and soldered slightly.

By pinning the tone arm into the swing arm, placing the swing arm into the swing stand and putting a pin thru the slot into the body of the swing arm, the assembly is complete.

Motors of so many different types have appeared at different times, that it is unnecessary to describe them.

A cabinet may be made to house all the parts if desired, and if care is taken in making all the parts, the reproducer and accessories will add to the appearance. The wood when varnished and stained a natural color, lends a different aspect to the talking machine than is usually connected with this greatest of all entertainers. It adds the decorative touch that seems to be lacking. The tone of the machine is benefited too by this wooden tone member, removing the metallic vibrations and imparting a softness that is unbelievable. Like the violin it improves with age.

A Binocular Eye-piece for Telescopes

By DR. ALFRED GRADENWITZ

(*Continued from page* 1027)

whose new binocular eye-piece is readily screwed on any ordinary telescope in the place of the normal single eye-piece, and enables both eyes to be used for astronomical observation.

The attachment, as represented in Fig. 2, mainly comprises two sets of inverting prisms, arranged behind one another. The amount of light generating the telescopic picture is, in the interior of the front set, on a half-transparent layer subdivided into two equal portions, and is so controlled that the telescope is used by each eye only with half the available luminous intensity. The luminous sensation forming in the observer's mind, truth to say, is by no means the sum of the individual sensations produced on looking through each half of the double eye-piece, but tho the luminous intensity, as compared with a single eye-piece instrument, is thus reduced by about 50 per cent, this loss is not at all very noticeable, the loss of luminous intensity, in the astronomical scale, only corresponding to .8 class of magnitude. While, for example, the 300 mm. refractor of the Zeiss Observatory with a single eye-piece enables stars of the 13th magnitude to be readily seen, the use of the binocular eye-piece reduces visibility to the 12th class.

The two sets of prisms are so arranged as to be readily rotated with regard to one another, so that any observer is able, as in the case of an ordinary prism field-glass, to adjust the instrument to his individual eye distance. In order to vary magnification, astronomical eye-pieces of various focal distances (25-5 mms.) can be used in connection with a given instrument. In the case of the 300 mm. refractor just referred to, the objective of which has a focal distance of 5 meters, there can thus be made binocular observations with a magnification of 200 to 1,000 diameters. These medium and high magnifications, however, are just those for which the binocular eye-piece affords special advantages. In fact, the usefulness of double-eye observation is bound to be felt, especially in connection with the observation of extensive objects possessing considerable luminous intensity, such as the sun, moon and planets. In the case of observations such as these, it is of the greatest importance that the observer should be able to contemplate a given object for as long a period and with as little eye fatigue as possible, and these conditions, thanks to the binocular eye-piece, are developed in every respect. Observations which in the case of single eye-piece instruments would become a torture, are an actual pleasure with the binocular eye-piece, and the ease with which even the minutest details on the surface of planets or the moon are detected by binocular contemplation is bound to impress every thoughtful observer.

An additional advantage of the double eye-piece is that the prism sets will re-erect the inverted images of astronomical telescopes, so that these can now be used for terrestrial observations, in which connection they will even afford special advantages.

By combining the binocular eye-piece with the objective fitting represented in Fig. 3, a hand telescope is obtained which only requires an exchange of individual eye-pieces, corresponding to various magnifications, in order to be advantageously used at distances as short as, say, 1-2 meter, in observing insects or the like actually acting as a microscope.

Shall I Take Up Engineering?

By H. WINFIELD SECOR

(*Continued from page* 1023)

career, and after a year or a few years in this class of work "out in the field," as it is called, the civil engineer is frequently called into consultation with regard to design and development work in connection with water and sewage pumping and distribution systems, power plant location and a thousand and one other things of allied interest and importance.

The scope of the civil engineer's activities is, therefore, seen to be a large one, and one of the finest things about this profession is that it wonderfully broadens the mind, and if the student has the proper aptitude for this course there is a very brilliant future waiting for him. Civil engineers receive anywhere from $2,500 to $5,000 a year while they are assimilating the practical elements of their profession after leaving college, and beyond the first five years there is no limit to what the "C.E." may accomplish, depending of course in great part upon his interest in his work and the business or professional associations, which he may be able to establish.

Mining Engineer

The mining engineer is one of those professions not so very well known, and, like many other unknown things in life, we often find it the most precious when fully understood. Wonderful opportunities await the hard-thinking mining engineer, particularly in the western part of our country, where there are many gold. silver and copper deposits still to be discovered and dug from Mother Earth. Mining engineers have a fine opportunity to become interested financially in mine development, and several well-known mining engineers have grown wealthy from a very small beginning, simply by combining their engineering wisdom and foresight with a little of that gambling spirit which every successful business man must have. It would appear from the present aspects of the situation that this is one of the most desirable of the engineering professions to follow. The Mining Engineer, especially that man who so perfects his education as to make himself invaluable, is in demand everywhere—not only in his own country, but in other countries. He may be sent to other countries also by his home concern, and in any event he has exceptional opportunities to invest in mining properties which may, in his later days, make him independently wealthy.

The mining engineer covers in his course of study many branches of engineering, including subjects in civil, chemical, electrical and mechanical technics. He will need all of these at one time or another in practising his profession. He may have to sink shafts far into the earth; elevators electrically or steam operated have to be designed and installed; electrical power lines and generating plants may have to be designed and installed in mountainous and unpopulated sections, where his own resources and initiative will have to be depended upon. Then again he may have to make tests of mine gases and deposits, and here chemistry and metallurgy come into play, as well as geology or the study of the earth's strata.

The Chemical Engineer.

The chemical engineer is what we might call a glorified chemist. A good chemical engineer today is capable of obtaining a very good salary, especially if he has the faculty of unearthing new chemical processes or products. As may be surmised, the chemical engineer covers in his course of study all branches of chemistry in a very thoro manner, and also many allied and inter-related subjects, such as metallurgy, dyeing processes and the manufacture of perfumes, medicines, and hundreds of other preparations. The chemical engineer is the "man behind the gun" in all such plants as the great dye works, glass and pottery works, rubber factories, paint manufactories, gas plants, oil companies (with respect to the different grades of oils and greases manufactured), soap factories, etc. Some of the best paid chemical men today are chemical engineers, and it is one of the coming and most promising fields of engineering.

Radio Engineering.

The science of radio engineering is not so very old, and there are, roughly speaking, but few educational institutions which give a specialized course in this new branch of engineering. First and foremost, the man who aspires to become a good radio engineer should be an electrical engineer, and then follow this with a post graduate course covering radio technique.

Radio communication is growing at a rapid rate with the establishing of an ever-increasing number of high powered radio stations in different parts of the world, and one of the latest developments, which seems to bid fair to open up a new departure in the radio field in general, is the wireless telephone.

Up to a few years ago the experts could not accomplish a great deal with the radio telephone, but with the advent of the new vacuum tubes, which are now designed to transform quantities as great as ½ kilowatt or more of alternating current power at 60 cycles, into radio-frequency power, suitable for transmitting the human voice across many miles of space, a brand new era has been ushered in.

The radio profession is without a doubt gradually swinging into step with the older branches of engineering and beginning to find its stride. At the present time there is a very good opportunity for first-class radio-engineers, as there is a tremendous amount of new apparatus as well as systems to be worked out and perfected. It has been said that with the present perfection of tuning apparatus, as employed at the world's greatest wireless station—"Radio Central"—on Long Island, stations can operate within ½ of 1 per cent difference of wave length. This sounds wonderful it is true, compared to the difference in wave lengths necessary between two nearby stations operating simultaneously even 10 years ago, but think of tomorrow—when not only a few dozen or a few hundred stations will want to operate simultaneously, but thousands and tens of thousands of them! Here indeed is locked up one of the great secrets yet to be evolved by the coming geniuses in the radio engineering profession. Another sidelight on the opportunities for "R.E.'s" lies in the fact that the radio companies are slowly but surely expanding and erecting more stations, so that there is plenty of work to be done, and we are now only at the very threshhold of the vast realm of Radio Engineering, as we shall know it tomorrow.

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 addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht 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.

Bottle Opener

(555) Wm. F. Mitchell, Evanston, Ill., desires patent advice as to whether or not he can employ a bottle opener and bracket used by a certain well-known fire extinguisher concern on a bottle fire extinguisher of his own design, particularly in view of the fact that the holder for the extinguisher made by the older concern is stamped "patent applied for."

A. There is only one way to determine whether or not you can make the particular contrivance you have requested information on, and that is to have a patent search made. There are many styles of brackets which could be used, however, and which would not come under patents allowed to the other concern, regardless of how broad these claims may be.

Almost any form of bottle opener which could be made in solid form could be used, or a stopper having a wire fastened to it so that a pull upon the bottle dislodges the cork would answer the same purpose. Another system would be to employ a sort of knife cutter or cutting corkscrew, so that the raising of the bottle fire extinguisher would force the corkscrew thru a paraffin seal on top of the extinguisher.

We would advise that you use some other system for opening the bottles, if the concern you mentioned has patented its device.

Washing Machine

(556) Carl Pitz, New Holstein, Wis., has patented a novel wash tub washing machine, and asks whether he should drop the idea entirely.

A. 1. We certainly think that your invention is novel enough to be placed upon the market, and it would hardly be practical now that you have secured your patent to drop the matter entirely. By all means work upon it and try to get it placed.

We would advise that instead of employing an electric motor to operate it, that you also supply your customers with another machine operated by water power, by a small gas engine or by hand. This will make your device practical for country users, who have no available supply of electricity.

Demountable Tires

(557) R. J. H. Potts, Mount Sterling, Ky., submits an idea for demountable tires in which the tire rim is locked in place by eccentrically operating devices.

A. 1. Altho the system designed by you for the removable tire on automobiles deserves some merit, we do not believe that a patent upon the same would be profitable.

Many changes would have to be made before the system is ultimately placed upon the market. Two eccentrics are not enough in this system, and we believe that unless some means is provided for preventing the eccentrics from turning, due to excessive vibration on the part of the wheel, the tire will come loose. This device has a tendency to distort the tire rim and the wheel. For these reasons we do not advise a patent.

Power Multiplier

(558) Charles F. Bluske, no address, who characterizes himself as the "Wonder of the World," submits a drawing of a system of levers and says:

"I have applied for a patent on this machine; the manner in which it works and how power is gained is well known to the U. S. Patent Office, under a New Science."

A. Of course, applying power at one end of the lever system will raise more weight at the other end of the system, but also it will raise this weight to a shorter distance. You are not producing power; on the contrary, you are "losing" considerable horsepower.

A one-pound weight could lift a ton thru the same means, but the one-pound weight would travel just about 2,000 times further than the one-ton weight, this is provided that the levers are in the proper ratio with regard to the length, inasmuch as horsepower is, roughly, the product of the weight and its rate of movement, you can see the loss in the various changes. If "the device is well known to the patent authorities," what is their opinion of it?

Heat Regulator

(559) Harley Mays, Gearhart, Oregon, submits a sketch of a kerosene chicken incubator heated by kerosene oil in which a shutter is operated electro-magnetically. This shutter cuts off the heat and opens a ventilator.

A. Frankly, we do not believe that your chicken incubator is any improvement over any other chicken incubator now upon the market. Some of these do not require batteries and shutters to maintain an even temperature, but are entirely automatic and keep the temperature fairly constant.

Fish Box

(560) Miss Grace E. Metcalf, Winthrop, Mass., writes:

"My brother has invented a fish box, a drawing of which I am submitting. Would you advise patent? He has many other ideas."

A. Altho the idea which your brother has advanced is ingenious, we do not advise a patent upon the same, in that there is nothing really patentable to such a box.

We would advise that you submit some of the other diagrams, which may perhaps be of more value. You may expect our earnest cooperation.

Talking Pictures and Weevil Exterminator

(561) Edward McCabe, Cleveland, Ohio, submits two ideas. His first is a method of photographically inscribing voice on a film for "talking movie" purposes. The second is a boll weevil exterminator. He requests patent advice.

A. The idea which you have advanced is nothing new. As a matter of fact, Mr. Eugene Lauste has photographically inscribed voice on a film for the past twelve years or more. The boll weevil exterminator which you have suggested would cost entirely too much money, and would not be positive in its action, particularly in sections where this pest is established.

Water Cooler

(562) E. W. Monrose, Agent Consulaire de France, Tampa, Fla., requests patent advice on an icebox in which water is led to the icebox and is then cooled by the cooling agent, cold running water being thus possible.

A. The device which you have designed and arranged so as to be applicable to an ordinary icebox is quite ingenious, yet at the same time we do not advise a patent for the reason that in the ordinary households the icebox is generally remote from a source of water supply. In addition, those regulation iceboxes which are connected directly to a drain are also equipt with a coil of tin tubing placed in an advantageous position, so as to supply cold water continuously whenever desired.

We do not believe that even tho you did secure a patent upon the contrivance you would find a favorable market for the same.

Constant Temperature Sad-Iron

(563) Ernest W. Press, Bridgeburg, Ont., Canada, enters a drawing and description of an electric sad-iron in which a mercury thermostat operates a contact arm closing the circuit thru mercury in a trough. He requests our advice.

A. With regard to this electric heat regulator for irons, we would advise that there are several drawbacks to your idea.

The first is that eventually the mercury within the receptacle will evaporate. The second, and most important, is the fact that the contacts, if positive, will arc when the current is turned off, because in your particular case the contacts separate slowly. The third is that the total expansion of the mercury in bulk as described by you is so slight that we doubt whether it will operate the contacts.

We, therefore, advise that before patenting the device you have a model built and experiment with it thoroly. Such experimenting may save the cost of patent proceedings.

Radio Receiving and Transmitting Apparatus

(564) R. J. Oliphant, San Antonio, Texas, sends a description of a radio transmitter which punches holes in paper. The paper is kept for future reference. Holes punched in paper at the receiving end will pass in front of the "steno" who transcribes the message and decodes it.

A. We do not see anything new in your idea of transmitting with a key and thus punching holes in paper and then receiving and decoding and typing the message on tape. This necessitates entirely too many operations, and would never take the place of radio today. It would not be a radiophone, however, such as you call it, but a radio-telegraph device.

Have you seen our account of the Rogers printing telegraph system described in the September, 1920, issue of this journal?

Water Caterpillar Tractor

(565) O. W. Potts, Cincinnati, Ohio, enters a drawing of a water caterpillar tractor and asks us if the device will be financially valuable.

A. Altho your idea of a water caterpillar tractor is practical and will work, it is not a device suited to a large sale manufacture, nor do we believe that you could interest sufficient capital on an idea of this nature to place it upon the market.

Liquid Rubber Tire Cement

(566) William Johnson, Lincoln, Nebraska, writes: "I would like to know if I can patent a rubber tire patch. This is ordinary rubber dissolved in a solvent. If placed on a tire it leaves a thin layer of rubber on the surface.

A. Soluble rubber cement is not new, and if you will go to your local garage and ask them for rubber cement you will obtain exactly what you were trying to invent. The solvent in this rubber cement evaporates and leaves a soft and gummy patch of rubber. This is then covered by a thin piece of sheet rubber which has been coated as above, and the two are thus prest together. For inner tubes this is quite efficient, but tires must be vulcanized with heat for best results.

Starting Autos in Cold Weather

(*Continued from page* 1020)

The first thing to do in any event is to push the float button on top of the carburetor and flood it, until the gasoline runs out of the air pipe. For cold weather running a heater or stove pipe should be connected with the engine exhaust pipe and the air inlet on the carburetor, to warm the air constantly when the engine is running. A car having magneto ignition only is particularly hard to start because. when turned by hand or even by a self-starter, the magneto or dynamo is not revolved at sufficient speed to generate a high enough voltage to give the normal hot spark. This difficulty can be easily overcome by placing a battery on the car, particularly on Ford cars, so that when the switch is turned to "Bat," the engine can be started by simply turning over once or twice.

If the self-starter on your car locks, which may not happen very often, it is well to know how to release it. Place the gear shift lever in *high* and with the ignition switch off, get someone to help if necessary, and rock the car back and forth. You will hear a sharp click, which invariably indicates that the Bendix gear on the self-starter shaft has released from the engine fly wheel gear, when you can again close the ignition switch and try the self-starter or else crank the engine by hand. In cold weather, when engines are sometimes hard to start, the storage battery is often run down after 10 or 15 starting trials, so that the self-starter will not turn the engine any more. It is then necessary to crank the engine by hand; allow a second person to help you by throwing in the self-starter; this will save much elbow grease.

The writer rigged up at one time a 110 volt, 1/4 H. P. electric motor on the floor of the garage, together with a round belt which was arranged to fit on a pulley mounted on a piece of hollow shaft, made to fit in the place of the crank handle. In this way, the motor could be turned over without any trouble until it did start. By jacking up one rear wheel, and throwing the gear transmission in *high*, a stiff engine can be turned over easily by simply turning the rear wheel. This is often useful, especially if the crank handle pin on the engine shaft shears off. Of course where it is possible there is nothing like a warm garage to aid in starting the car on cold mornings, but it is not advisable to have the garage too hot if you value your car varnish, as the quick change in temperature experienced in coming out into the cold air will cause checks or cracks in the varnish.

How Gas Turbines Work

By Prof. T. O'CONOR SLOANE, Ph.D., LL.D.

(*Continued from page* 1018)

partly employed in generating steam, a great waste will be indicated there.

There are many modifications which have been tried and have met with various degrees of success—a rotary pump has been used to remove the burnt gases; steam or water have been used to dilute the explosive mixture to prevent the production of too high a temperature, while the mathematics of the subject have been pretty thoroly developed in the text books. But the invention of the real thing apparently yet remains to be done.

Fortunes From Little Things

By CHARLES FREDERICK CARTER

(*Continued from page* 1031)

United States, as nearly as can be ascertained, in 1861. There is a legend that I. W. Stewart began making safety pins in New York as early as 1841; but this legend lacks probability. So far as authoritative records go, Stewart was certainly making pins in 1861. Under various changes of ownership and name the concern founded by Stewart has continued uninterruptedly in business to the present day. The Consolidated Safety Pin Company is still making safety pins on a large scale at Bloomfield, New Jersey, and selling a part of its output under Stewart's name, altho that gentleman was long since gathered to his fathers.

The first patent was for a wonderful affair, including a tubular back, a spring bolt, a slotted tube, a slotted knob and pin with chains. If you forgot the combination you were up against it, for the thing was strong enough to hold a horse, apparently. Another ball and chain affair was patented in 1876. Yet another had a slotted sleeve nut and screw socket.

The first patent issued for a safety pin approximating the present form seems to have been granted to A. V. Sargent, of Newark, in 1875. But the original Stewart had been making safety pins at his little shop in New York then for at least fourteen years. A sample of his pins of the vintage of 1861 is still preserved at Bloomfield.

Joel Jenkins, of Brooklyn, deserves much credit for developing the safety pin, both as an inventor and as a business man in producing and marketing it. At first Jenkins' pins were distributed thru Pratt & Farmer, of New York. Two years later Jenkins and Farmer formed a partnership and bought out I. W. Stewart, Butler Brothers, and consolidated them with Jenkins' own business. By this time Jenkins had so popularized the safety pin that the new firm began business with fifty employees. At that time everything was done by hand. Pins were not sold by the dozen, but by the single pin at 3 to 4 cents each.

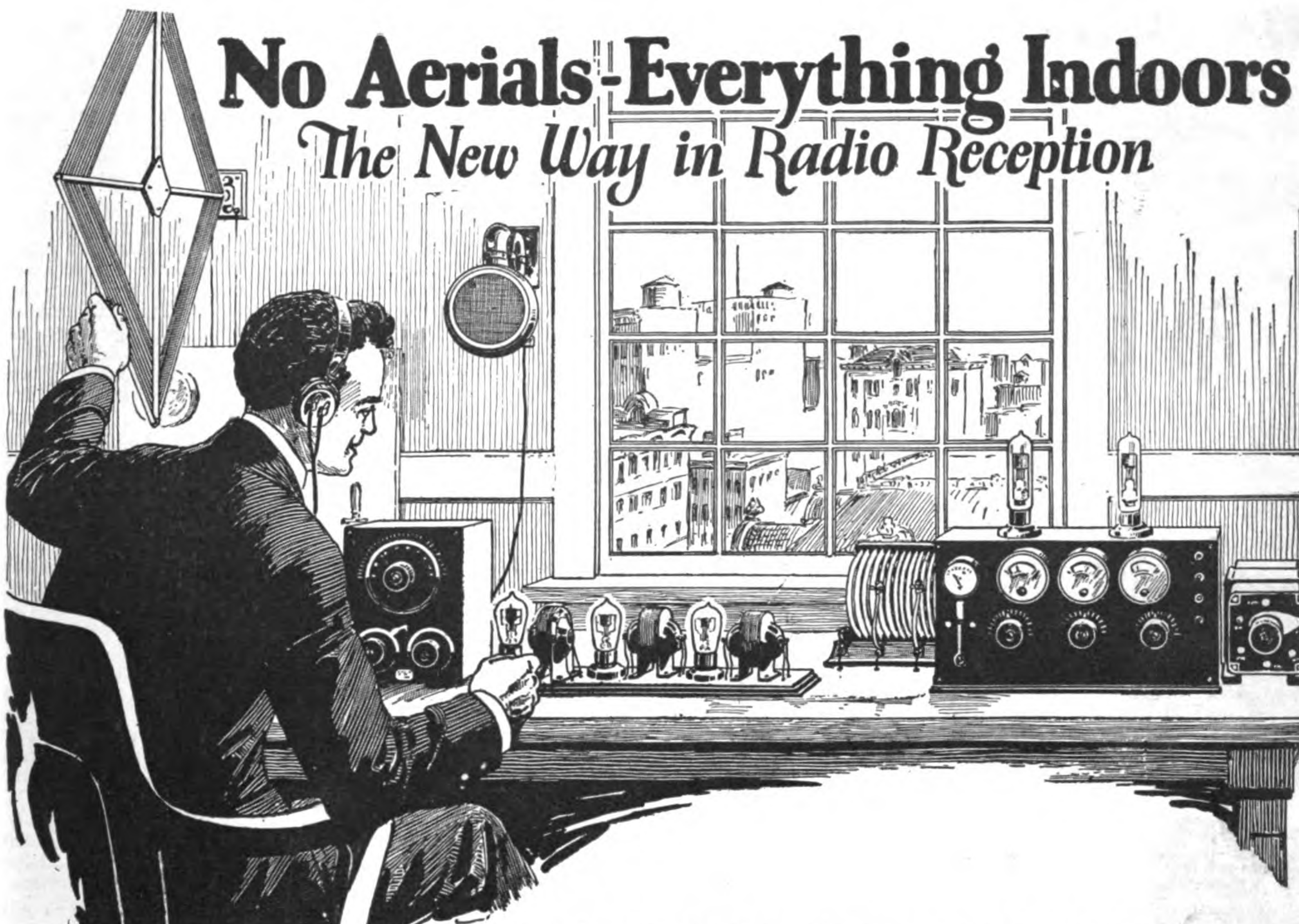
No fewer than seven patents were issued to Jenkins for safety pins and improvements thereon between 1875 and 1884. Some improvements were made by employees. George Hunt, an English mechanic, who was employed by the original concern and its successors for fifty years, is credited with much of the technical detail in perfecting the safety pin. By 1882 machines had been developed for winding the coil on the pins and for assembling the heads on the wires tho the original machines, of course, were not the marvelous automatons of to-day.

Improvements for making the pins have been continuous. To-day everything is done by automatic machinery. A battery of punch presses bites chunks of brass out of a strip running thru and forms it into a head or shield at a single stroke, the smaller sizes being turned out at the rate of one for each two ticks of a watch. Another machine is given a coil of wire which, without human assistance, bites it into lengths, sharpens one end to a point and twists the coil in the middle to form the spring. A third machine assembles the pin, head and guard, and drops the finished product into a pan.

It certainly does sound strange to hear the head of an up-to-the-minute manufacturing plant talk about "home work" in this year of grace, *but no man has yet been clever enough to invent a machine that will fasten safety pins on a card.* Hence this part of the job must still be laboriously performed by hand.

No Aerials—Everything Indoors

The New Way in Radio Reception



Aerials cannot always be conveniently set up—particularly on city apartment houses. With the new General Electric Company's Radio Frequency Amplifying Transformer, introduced by the Radio Corporation, receiving aerials can be dispensed with and indoor loops effectively used instead. At once the scope of radio is broadened.

Although the new Radio Frequency Amplifying Transformer makes it possible to receive with small indoor loops, it is more than a city-apartment convenience. Its introduction marks a great technical advance in the art of radio communication. For these reasons:

1. *Receiving ranges are doubled and tripled.*
2. *Tube noises are eliminated.*
3. *Signals are heard that cannot be received with other types of amplification circuits. Hence longer ranges are possible.*
4. *Selectivity is increased.*
5. *News and music broadcasted by distant stations are received with unprecedented distinctness.*
6. *Distortion in radio telephone reception is reduced.*

Radio Frequency Amplifying Transformer

Made in two models. UV-1714 has a range of 200-5000 meters; price, $6.25. UV-1716 has a range of 5000-25000 meters; price, $8.50. For radio-frequency broadcasting reception: one detector and two stages radio-frequency amplification. For general reception: one stage radio-frequency amplification, one detector, and one stage audio amplification. For extreme "DX" work: three stages radio-frequency amplification (using UV-1714) one detector, and one stage of audio amplification (with UV-712).

Distributors: Write to Sales Division Suite 1805

Radio Corporation of America

WORLD WIDE WIRELESS

Sales Division, Suite 1805
233 Broadway, New York City

Forecasting Earthquakes

(*Continued from page* 1008)

year. For all characters of earth's crust, however, it can be measured and measured accurately. When this movement of the earth's crust — *strain creep*, the scientists call it — has pulled this crust to a certain degree of tension, the *elastic rebound* sets in. That is to say, the crust of the earth can stand no more pulling or pushing, and at some point it gives way. Then and there an earthquake occurs. Sometimes this earthquake covers a large area, as that of 1906 in California, when it is estimated that an area of 15,000 square miles, 68 miles deep, moved varying distances from one foot to 20 or more feet. Sometimes it is local, as in the quake of 1903, which affected only the Mt. Hamilton region, and is believed to have moved appreciably that whole mountain, supposed to be a "fixt" object, if there is such a fixture on the surface of the globe.

Now, Dr. Lawson has discovered, in addition to these things, that the strain creep is antecedent to an earthquake, as well as consequence of it. As will be shown later, some points, mountains, known areas and other similar established factors, which had moved several feet by strain creep during a number of years prior to an earthquake, *moved backward, or to one side, nearly as many feet, during the few seconds of the earthquake*. This discovery proves that the crust of the globe, to a varying depth is on the move constantly, independently of the rotation of the earth on its axis or of its revolution around the sun. This alone was a discovery of stupendous interest to all scientific men, but wait!

Given the known rate of creep of the crust of the earth, the character of the component parts of that crust, and the limit of tension to which that crust can be subjected, it is not difficult for the man who deals with scientific figures to esti mate, very closely, the time and place at which that crust will reach the breaking point. When the crust reaches that breaking point, when it can endure no more *creeping* to the northward, there is a rupture at the weakest point of the crust, a ' we have what is known as an earthquak. But with the scientists watching the *cree* of the skin of the globe — a mere trifl of 65 to 70 miles in depth — the layman will know when and where to expect the earthquake. He will be able to remove himself and his family from the danger zone, and he will be able to prepare to combat successfully the fires which usually follow earthquakes in large centers of population.

It is evident that the main factor in the forecasting of earthquakes will be the close attention paid to observation of the *earth's creep*, the *tension* of the crust of the earth, and the *composition* of that crust; tho the latter, once ascertained for a given section, remains permanently reliable information; it is the creep which must be watched. Waves of earth generated at the *fault*, or breaking point of the earth's crust, travel thru the crust at the rate of 1.25 to 1.37 miles per se nd, far too fast for the human eye to r their movement. Yet those who ha ported seeing the earth moving lik waves on the sea have told the literal truth, but what they saw were slower and smaller waves, set in motion by the original earth waves, during and immediately after an earthquake. The passage of these waves frequently leaves the earth's surface in permanent waves, broken into furrows, as if some Titan had dragged his

(*Continued on page* 1080)

1—Points on opposite sides of the fault ›ved in opposite directions; those to e eastward of the fault in a southerly rection, those to the westward in a ›rtherly direction.

2—Displacements of all points were ap- oximately parallel to the fault.

3—The displacements on each side of e fault were less the greater the distance ' the displaced points from the fault.

4—For points on opposite sides of the ıult and the same distance from it, those n the western side were displaced on an verage about twice as much as those on ıe eastern side.

Going still further backward in their ıvestigations, the scientists learned that, ı the few seconds of the earthquake of 868, some 1,000 square miles of the earth's rust, of unknown depth, lying between the our points of Mt. Tamalpais, the Faral- ›ne Lighthouse, Ross Mountain and 'haparral, were *permanently* displaced to he northward about 5.2 feet. In other vords, the whole area moved as a block, vithout rotation or distortion. The dis- ınce between Mt. Tamalpais and Black Aountain, some 49 miles, was increased en feet by the combined efforts of the uakes of 1868 and 1906, and the Golden iate, lying between them, was widened.

The University of California, thru the ›ffice of the president, Dr. David P. Bar- ows, has issued a statement concerning he discoveries made by Dr. Lawson, vhich reads, in part, as follows:

"It is well known that on the occasion ›f the April, 1906, earthquake, there was relative displacement of the earth's sur- ce stratum on the two sides of the San ıdreas fault line, amounting in the .nas region, at one point, to *as much as* '4 feet, and at many points to about 17 eet. That this relative displacement in- luded areas lying several miles away rom the fault line was shown conclu- ›ively for several critical observing sta- ions by the work of the United States Coast and Geodetic Survey conducted shortly after the date of the earthquake. Intercomparisons of the results for the positions of these observing stations, made at different epochs, left no doubt that earth movements on a general scale were intimately connected with the earthquake phenomena of 1868 and 1906. In fact, re- searches of this nature made by A. C. Lawson, professor of geology at the Uni- versity of California, have shown that these earth movements are antecedents as well as consequences of earthquakes con- ›ected with the San Andreas fault.

"There is reason to believe that suit- able instruments located comparatively near the fault line would be capable of detecting the creeping of the earth's sur- face stratum from year to year, and that eventually such knowledge would be of high value in the prediction of future earthquakes. To how many miles from the fault line motions of this nature can be studied to advantage is uncertain, but the desirability of securing such observa- ions at critical and advantageous points s very great. Movements of the earth's surface of the nature described appar- ently can be best detected and measured by such programs of observations as those of the United States Coast and Geodetic Survey, and by observations for the deter- mination of geographic latitudes with ex- treme accuracy in the critical region."

Regarding the new instrument to be in- stalled at the Lick Observatory, Univer- sity of California, at Mt. Hamilton, Dr. Campbell, director of the observatory, says:

"The Ross photographic latitude tele- scope surpasses the international latitude instrument (visual) in accuracy as to the usual accidental errors, and it has the further immense advantage of eliminat- ing essentially the whole of the trouble- some systematic errors to which visual in- struments have been and still are liable."

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

(Continued from page 1036)

discover that bases reverse the color effects of acids and vice versa.

A Wine and Water Trick: Arrange three rows of glass tumblers on your demonstration table. In the bottom of each tumbler in the first row place two or three drops of phenolphthalein indicator. In the bottom of each tumbler in the second row pour two or three cubic centimeters of concentrated sulfuric acid. In the bottom of each tumbler in the third row put three or four cubic centimeters of strong sodium hydroxid solution.

Now fill a pitcher with water and add to it 10 cc. of strong household ammonia. Announce to your audience that you will pour wine from a pitcher of water and at the same time fill the first row of tumblers. As you do so the water apparently changes to wine, a deep pink color appearing in the tumblers. This of course is due to the fact that the ammonia is a base and gives the characteristic base color with phenolphthalein.

Then announcing to your audience that you suspect the presence of a government officer, immediately pour the contents of the first row of tumblers into the second row. The sulfuric acid neutralizes the ammonia and the pink wine color disappears. You have changed the wine back into water.

Presently you may state that the meddlesome officer has disappeared and that it will be in order to bring back the wine. Upon pouring the decolorized wine into the third row of tumblers, the wine immediately reappears. The sodium hydroxid, which is one of the strongest bases, neutralizes the sulfuric acid and with the phenolphthalein gives the characteristic pink color.

Since the quantity of liquid in the bottom of each tumbler is very small, to your audience the tumblers will seem to be empty. For rough measurements of volume it is convenient to have a standard test tube which contains about 25 cubic centimeters. If the colors do not change perfectly you will have to vary the concentrations or quantities of solutions used. But the demonstration will work beautifully.

Preparation of Bases: One of the simplest bases to prepare is sodium hydroxid. Cut a piece of metallic sodium about the size of a pea. As you doubtless know, sodium is kept under kerosene. If your piece of sodium has any yellow incrustation carefully cut this away. Dry the metal quickly with a piece of filter paper, do not touch it with the fingers, and place it upon the surface of 25 or 30 cc. of water in an evaporating dish. Immediately it will melt and with a sputtering and hissing noise will run about upon the water in a very lively manner. The gas that escapes is hydrogen. If you wish to collect it wrap the sodium in a piece of lead foil, leaving a corner exposed. Grasp this capsule with a pair of steel pincers and thrust it beneath the mouth of an inverted test tube of water held with the left hand in the dish of water. The test tube will fill with the gas, which may be ignited by holding it to a lighted Bunsen burner.

Now place a piece of red litmus paper on the desk and dipping a glass rod into the solution in your evaporating dish touch the end of it to the litmus paper. The characteristic blue color of a base will at once appear. Feel of the water and you will note a slippery soapy "feel." Place a few drops in a test tube, dilute with water and add a drop of phenolphthalein. Repeat using methyl orange.

(*To be concluded*)

How to Build a Radiotrola

By H. GERNSBACK and R. E. LACAULT

(*Continued from page* 1042)

Tuning

To tune in a transmission only three adjustments are necessary; these are the tuning of the loop aerial circuit, the tuning of the primary of the radio frequency transformer, which is not critical, and, last, the tuning of the plate circuits of the second step of radio frequency amplification, producing a regenerative effect, as in an ordinary regenerative receiver. This last adjustment is more critical, but may easily be made. In case continuous oscillations are produced by the tube, owing to too much coupling or feed back effect between the circuits, the rheostat of the radio frequency amplifier and the potentiometer, should be adjusted to the proper value, so as to prevent these oscillations. The adjustment of the detector depends upon the type of tube used, but it will be found that maximum audibility is obtained for a certain setting of the rheostat, once the other adjustments are made.

With the constructional details given in this article, it will be possible for the experimenter to duplicate the Radiotrola. Of course, it could be simplified so as to reduce the number of adjustments for tuning, but it has been found that better results were obtained over the complete range of wave length by using the tuned radio frequency amplifier, and since this set was designed not only to receive radio music, but also radio telegraph transmissions, this circuit was adopted. If only radio concerts are to be received, the windings could be designed so as to tune only the wave length used by the broadcasting stations with a means of varying it over only a short range; furthermore, by using some other type of radio frequency transformers, the only adjustment would be the tuning of the loop aerial by means of a variable condenser reducing the number of adjustments to one. With the Radiotrola, complete radio concerts, lasting for hours, have been received without having been interrupted by spark stations in the neighborhood, as the loop aerial has a directional effect, and the tuning of the circuit was sharp enough to prevent interference and statics.

Blow Torch and Pipe Coil Heat Room

(*Continued from page* 1039)

against the inner sides of the coil at intervals of one-third the distance around the coil.

At the lower terminal of the coil a nipple of 3 inch piping is attached to the end of the pipe by means of a pipe reducer and a sleeve union. The purpose of this attachment is to form a socket or receptacle to receive the flame of the torch, whose nozzle is inserted an inch or two into this nipple, which catches the entire volume of heat and conducts it into the coil. The torch is set on the floor, with its nozzle inserted in the nipple as shown, and it is obvious that very intense heat is thrust into the coil and circulates thruout it. The flames of the torch extend only a few inches into the coil, but heated air continues thru it. The upper terminal of the coil is led perpendicularly thru the roof of the room to exhaust the impure air from the room. The degree of temperature is readily varied at the torch.

Contributed by L. M. JORDAN.

Synura Gives Oily Taste to Drinking Water

By DR. ERNEST BADE

(*Continued from page* 1034)

ent known. It is believed to be related to the etherial oils. It is not volatile at the boiling point of water. It gives to the water a disagreeable, fishy, oily, and sometimes cucumber-like taste, which is transmitted to the water during growth and also after the death of the colony. When the animal begins to decay, the oil is set free, and wherever the most favorable condition for the propagation of the animals exists, they readily multiply in such countless numbers as they have done in the Kensico reservoir of New York City's drinking water supply system, so that the water becomes decidedly unpalatable. The quantity of oil produced by the animal is exceedingly minute, that produced by Synura can readily be detected in a dilution of *one part in 25 million parts of water.* This means that *one drop of oil* in about 300 *gallons of water* is quite noticeable, and this is equivalent to a drop of water in *a cube of water about five feet to a side.*

The destruction of the Synura in the water offers no difficulties, but it is a decidedly different problem with the oil. How it can be removed is still an open question, and this is far more important than the destruction of the animal. Copper sulfate in a concentration of *one part in* 1,000,000 *parts of water* kills the Synura and does not injure any other plants and animals. On the other hand, the Synura is a perfectly harmless creature which requires its content of oil in the body, in order to facilitate its swimming abilities, the oil, being lighter than water, causes the organism to partly float in the water. Other organisms will eventually destroy the Synura. One method employed in treating the oil-polluted water is to row a boat back and forth in the reservoir, allowing bags filled with copper sulfate to hang over the side into the water. Ozone should be good.

"Skipping Boat" Contest Winners

(*Continued from page* 1035)

will the boat run and skip? I can say that it will run, but I wouldn't say positively that it would skip; however, I believe it will.

BERT B. ANDERSON.

Second Honorable Mention

I am submitting a model of the skipping boat. The pontoons are driven by rubber bands. The boat will rise vertically about one-half inch when the pontoons are rotating in opposite directions. It will not move forward, however, due to the fact that two equal forces are continually counteracting each other. Forward movement is necessary to produce the skipping effect desired. As you object to a propeller, I would suggest a disk to be placed above the pontoon on the same shaft. This disk is to have paddles at the perifery and to be attached at an angle to the vertical of about twenty degrees; also this disk will run at the same angle, so that one side of the disk only will touch the water. Thus with the pontoon and its partner, the disk rotating in an opposite direction to the other pair, it should work.

SAMUEL HAGERMAN.

Household Science

By H. Winfield Secor

(*Continued from page* 1017)

reflector may be removed by covering over the wire guards, i. e., the whole opening in front of the heater, with copper or brass wire gauze, No. 24 gage.

Hot air heat in a garage is good, as is also hot water or steam, but don't have the boiler or furnace in the garage.

Speaking of automobile hints, one should never operate the engine in a closed garage, as the exhaust gases contain the deadly carbon monoxid which is liable to asphyxiate one. Never use a lighted match to read gasoline tank gages or when shooting trouble about the car—use a flashlight.

Extinguishing Fires

House or outbuilding fires happen now and then, and it is well to observe a few simple rules in regard to fighting them. Use carbon tetrachlorid solution to fight gasoline, kerosene or electric fires. Never throw water on any of these, as it will only spread the conflagration. Sand or dirt are very good to fight these and other fires with, or they may sometimes be smothered successfully with a blanket or carpet. If a person's clothes catch afire, endeavor to smother the flames by rolling them on the ground or carpet, or by wrapping a blanket around them and pounding on them. There are a number of dangerous situations that arise in connection with electrical transmission lines, and even in our household electric lighting systems. Never touch a fallen wire as it may be charged with a sufficient voltage to kill. Don't throw a wire or even a kite string over a transmission line; if the kite string is damp, a sufficient current might leak to prove fatal or give a severe shock. Never touch electric fixtures whether switches, chandeliers, heating or violet ray apparatus, etc., while standing on a hot air register, or while touching a radiator or any plumbing fixtures whatsoever. Never touch an electric light fixture or switch, while standing in a bathtub filled with water, as several deaths have resulted in this way.

Eyeglass Don'ts

A few practical hints with regard to eyeglasses, particularly nose-glasses, would seem of value from the appearance of some of the glasses we see people wearing every day. Fig. 11 shows some of the reasons why people complain of severe headaches before half the day's work is done. 1—Shows pupils too far apart for lenses; 2—Shows lenses too far apart for the pupils; 3—Shows glasses on slant or staggered—very bad; 4—Shows nose-glasses in correct position, while 5 shows the most comfortable glasses or specs, with ear hooks, which are preferable for reading, study or work, as they always hold the lenses in the correct position in both horizontal and vertical planes before the eyes, just as the oculist intended they should when he measured them in a similar frame.

In handling poisonous medicines, a few hints may not be amiss. Bichlorid of mercury (corrosive sublimate) solution should not be used for washing open wounds, and Fig. 12 shows how these may first be closed with *new skin* or collodion mixture to prevent the solution getting into the blood, and which might cause mercury poisoning. Instead of this antiseptic solution to kill infectious germs one may use chlorizine, lysol, carbolic acid or potassium permanganate; any of these may be used in water, the proper proportions being obtainable from your druggist.

The Psychic Lens

By CARL S. WALLACE

(*Continued from page* 1014)

miss it. The plate had been taken from a newly opened box. Both sides of the holder had been empty, and he had loaded them at the same time. It was impossible, therefore, that he had carelessly used a plate which had previously had a picture impressed on it. He was aware that imperfect washing of used plates at the factory sometimes leaves an image, which will print out, but the image in this case was too well defined, too clear, for that.

Unable to satisfactorily explain the presence of this mysterious stranger, he sprang up and set to work feverishly. Drawing the plate from the hypo, he gave it a brief, forced washing. Placing it in the draft from an electric fan to accomplish rapid drying, he prepared to make a print.

Impatient to get a better view of his unwelcome subject, he placed the plate in the printing frame while it was still dangerously damp, past it under the printing lamp, and ran the paper rapidly thru the baths. By the red light he saw that the figure was printing almost as clearly as Miss Meredith's own.

When he was able to turn the white light on he examined the dripping print eagerly. As he got a clear view of the features of the stranger his face went chalky white. The wet paper fluttered from his nerveless fingers. With a choking cry, he reeled drunkenly against his work table. Oh, it was unbelievable! Florence! Great God! Dead these twenty years!

Altho it was comfortably warm in the little darkroom, he went cold. Icy fingers seemed to pass rapidly along his spine, nervous tremors following in their wake shaking his whole body. His trembling fingers found a reading glass, and by its magnification he studied closely the figure and features of the apparition. Unmistakably it was Florence. The Florence he had wooed and lost long ago. Not a vague resemblance, not a tantalizing, reminding similarity, but sharp, clearly defined face and figure that could not be denied.

Dropping glass and print, he turned to a wall cabinet and drew forth an album. Turning its pages rapidly, he finally found and extracted the print he sought, a picture he himself had made of her when they had been sweethearts. Side by side he laid them, the fading print of years ago and the shining wet one of this evening. A glance was enough. They were identical, those figures. The only difference was that of dress.

Palsied, he sank into the chair. He had heard of spirit photographs, knew all the tricks of exposure and manipulation that were used in their making. Invariably they were frauds, frauds that the trained eye had no difficulty in unmasking. But here there had been no manipulation, no processing. He had loaded the plate holder himself, made the exposure himself, developed negative and print himself. It was impossible that Miss Meredith had tricked him. A stranger in the neighborhood, she had never known Florence, nor, to the best of his knowledge, did she know their story.

Only one hypothesis could satisfactorily account for this phenomenon. That Florence's personality surviving bodily death, and, most likely, wishing him to know it, by some law or process of nature not understood, had managed to project her image into the camera and register it. Unthinkable, incredible as it was, it was the only theory consistent with the facts.

Always sceptical in matters touching the supernormal, Lohr fought hard to avoid conviction. For hours he sat there, his mind in turmoil, seeking an answer that would dissipate his growing belief in the supernatural origin of the figure in the print.

He could find none. And eventually he locked up the darkroom and went to a restless bed to wrestle futilely throughout the night with the problem.

Ere twenty-four hours had passed the thing had become an obsession. Capitulating perforce to the spiritistic theory, he sought further and convincing proof of the reality of the phenomenon. If it could happen once, he argued, it could happen again, could be made to happen at will once the law governing its production was understood and applied. He reasoned that by accident all the conditions necessary had been fulfilled at the moment of exposure, and his negative, therefore, was not a freak, but proof that a definite result must follow definite procedure.

He began a series of exhaustive experiments. Unable to determine whether the secret lay in the mediumship of Miss Meredith or the peculiar virtue of the camera or some psychic condition of the location or possibly a combination of all three, he attempted a tedious process of elimination.

Plate after plate he exposed under every condition he could conceive. Sometimes Miss Meredith was posed, sometimes he shot mere landscape. He employed many cameras, tried many makes of plates. Fast ones, slow ones, medium speeds he worked; time, bulb, snapshot exposures. Interiors, flashlights, combinations of former experiments were used. Hour upon hour he passed in the darkroom, assisted by the indefatigable Miss Meredith, who was as determined as he to get at the truth. But they were futile hours. Not one plate, coming dripping from the bath, showed a visitor on its surface.

One thing only gave him hope that he was drawing close to the riddle's key. When he used the camera that he had employed on that memorable afternoon, almost always a faint fogging of the plate occurred, a tantalizing mistiness, sometimes a blurred, vague, provokingly suggestive outline. He became convinced that this particular lens had much to do with the miracle, altho he was unable to determine how, and eventually he came to call it his psychic lens. Thereafter he abandoned other cameras, and made all his exposures through that particular lens.

Lohr had not attempted to keep his experiments secret. He had allowed many to view the mysterious prints and plate, and had quite openly admitted his belief in the genuineness of the spirit figure. Consequently there was much gossip in the little community, much argument in the hotel lobby and at the general store. The credulous fell in with Lohr's view readily, the sceptical ridiculing stoutly what they deemed nonsense. And by the time Jimmy Morrison registered at the little hotel it was a regular evening topic with the lobby loungers.

Morrison, seizing a vacation from his strenuous duties as camera man for a big moving picture company, had chosen the little town at random, from among a number of "quiet" places, and arrived with the avowed intention of just resting. After months of intensified movement it seemed good to sit still. There was a thrill in the thought that he could do nothing and in being unable to find no good reason why he shouldn't.

Tilted back in a lobby chair, deliciously comfortable, he listened in contentment to the chatter of his neighbors. Lazily puffing his cigarette, he paid a listless attention to the thread of argument around him, mentally taking sides, applauding silently each well-taken stand, maintaining silence, lest he be drawn into active effort.

When his delight seemed to know no bounds, when the cup of contentment appeared ready to overflow, Lohr's experiments came on the carpet. At the mention of spirit photographs, Jimmy sighed. He rolled his eyes in the direction of the speaker and gave undivided attention. At the end of a half hour he had absorbed the details of the case. He sighed again. His chair legs thudded to the floor. Reluctantly he arose.

"Where does Mr. Lohr live?" he asked the man nearest him.

The villager obligingly gave directions. "Interested in the thing?" he inquired, with the air of one who would relish discussion.

Jimmy sidestept the offered issue. "Yeh," he replied, as he moved toward the door, "I'd like to see a spirit photograph. Just one!"

Jimmy found himself welcome in Lohr's darkroom. To Lohr the quiet little expert, who could follow understandingly his theories, who could appreciate the object of all his experiments, came as a Godsend. He talked freely and frankly, giving the little camera man a detailed account of the affair from the beginning, exhibiting his plates and prints, openly avowing his belief in the reality of the spirit picture, and stating clearly the arguments that forced that belief on him.

As he listened Jimmy became convinced of two things. There could be no doubt of Lohr's sincerity nor of his honesty. Morrison realized that there had been no trickery here, no manipulation. And he quickly found that the man was a clever and accomplished photographer, one whose views were to be respected.

Studying the print thru half closed eyes, he listened to Lohr's earnest dissertation. He could find no clew to the mystery in the print, nor, from Lohr's description of the exposure, could he account for the presence of the very clear figure. He had made many trick prints himself, had examined many more. But he was forced to admit that this was something different from anything he had so far encountered.

Finally, arising to go, he tucked the print into his pocket. "Look here, old man," he said, slowly, "do you mind my butting in?"

"You are not butting in," protested Lohr, warmly. "I would appreciate your assistance. I am more than anxious to have my theory definitely proved or disproved, and I am eager for competent help."

"Well, then," replied Jimmy, "I'll confess I'd like to take cards in the game. You seem positive that your psychic lens, as you call it, has a lot to do with this business, and I'm going to ask you to lend me that camera."

Lohr offered him the instrument. "Gladly," he said, "and I feel confident that you will come to agree with me."

"I don't know about that," rejoined Jimmy, dubiously. "I'm not strong for this spirit stuff. But I'll give it a fair try."

Two days later, late in the afternoon, Morrison ambled into Lohr's darkroom, the borrowed camera under his arm. Fishing into his coat pocket, he drew out a plate holder and dropt it on the table. Sinking into the chair, he mechanically rolled a cigarette, lighted it, and surveyed Lohr thru half closed eyes.

"If that plate," he remarked, laconically, waving his cigarette toward the holder on the table, "shows nothing but a darned old cow, I'm wrong and we start all over again."

"Have you found something?" cried Lohr, eagerly, picking up the holder with trembling hands.

"Don't know," Jimmy retorted, calmly. "Run it thru, and let's see what I've got."

Lohr switched on the red light, spun the plate into the bath, and rocked the growing outlines. Watching him, Jimmy saw him stiffen. There came a startled cry.

Jimmy rose, and came to his elbow.

"Another ghost?" he queried, interestedly.

"Florence!" cried Morrison, his voice quivering with excitement. "Again! I don't have to print it to make sure. It is she! Morrison, you have found it! What are the conditions? What is the law?"

Jimmy took him by the shoulder and shook him, almost roughly.

"Now look here, old man," he cried. "You want to get this spook business out of your head. That isn't a picture of Florence. But it is a picture of Florence's daughter. Remember those three girls that watched you make the exposure that afternoon? Well Florence's daughter was one of them. If you hadn't been so blamed busy with your posing you would have noticed the striking resemblance. I nosed around until I found those three girls. I found that Florence's husband is living on a farm down there with his second wife. And as soon as I clapt eyes on that girl I knew that you had somehow got her into your picture.

"Now let me tell you what you really did do that afternoon. You fust around posing Miss Meredith until finally you got her just to your liking. Then you went over to the camera, put the plate holder in, and—pulled out the slide. At the last moment you saw something you didn't like and went over to her to change it. Of course, the shutter was closed. But remember, the slide was off of that plate."

"Yes," admitted Lohr, "I seem to recall doing that, but the shutter was shut. Of that I'm positive."

"Sure!" agreed Jimmy. "It was shut all right, but just the same it was right then that your psychic lens got busy and did its dirty work. Those girls were well out of focus of your regular lens, but by pure blamed luck Florence's daughter was absolutely and almost unbelievably in the focus of your psychic lens. You were away from your camera say thirty seconds. Maybe it was a little more, maybe a little less. In the nice light you had it was ample time for a peach of an exposure with that psychic lens."

"The psychic lens?" murmured Lohr, questioningly.

"Yes," cries Jimmy. "The psychic lens! Your spook producer. Look!"

He ript open the back of Lohr's camera, snapping wide the shutter. Pressing the open back end against Lohr's face, he threw the focusing cloth over his head, shutting out the light.

"What do you see?" he demanded.

For awhile Lohr was silent, as his eyes accustomed themselves to the darkness. Finally he spoke.

"A leak," he said, slowly. "A small leak."

"Yes, a leak," echoed Jimmy. "A pinhole! That accounts for the mysterious fog on your plates when you use this camera, and it betrays the secret of your psychic lens. You didn't get a spook picture, Lohr, but you did get one darned fine PINHOLE PHOTOGRAPH."

FINDS "KICK" IN CIGARETTES

At last the harmful element in cigarettes has been discovered by Lucy Page Gaston, famous anti-nicotine crusader. The harmful element is furfural, described as a "colorless, aromatic, volatile, oily compound, gradually darkening, which is formed by distilling bran, starch, sugar, etc., with sulphuric acid."

Miss Gaston says the furfural in one cigarette provides the equivalent in *kick* to two ounces of whisky.

Talking Over a Trolley Wire

(*Continued from page* 1024)

One of the advantages of the system as shown during the demonstration is that the energy required is practically negligible, as it is *guided by the transmission lines instead of being radiated in all directions thru the ether,* as in wireless telephony. The system is free from inductive interference and atmospheric disturbances such as static. It does not of itself produce inductive interference to a degree that would cause disturbances in other communicating systems. No elaborate antenna is required, and, finally, even tho the transmission line may be broken, the system will work satisfactorily.

The system thus constituted, we might say, *wired wireless.* The trolley or other electric wire acts as a guide to the etheric waves, which thus follow and surround the wire for a considerable radius. The message is received at the station or signal tower by means of a loop antenna, connected with a suitable vacuum tube detector and amplifier apparatus.

Commenting on the tests, W. B. Potter, engineer of the Railway and Traction Department of the General Electric Company, said:

"These tests at Schenectady and on the C. M. & St. P. Railway, indicate the early perfection of a practical telephone system utilizing the power wires as a conductor, which will provide for the usual call and telephone communication between different locomotives in the same train, between the locomotive at the head and the caboose at the rear of the train, or for communication between different trains. This system is equally applicable to communication between the train dispatcher and the trains in operation under his direction. This is an important development which we feel sure will contribute materially to the facility and safety of railway operation.

"The locomotive engineer on the head locomotive of a long freight train will be able to tell the engineer of the pusher at the rear when he is ready to start without resorting to bumping the rear locomotive thru the long train, as is sometimes necessary when the present whistle signals are not audible. The train conductor can communicate with his engineer in case of anything happening to his own train, which the engineer is not in a position to observe. The engineers of different trains, on the same track, can communicate with each other, which would greatly lessen the liability of train collision. While train orders will continue to be issued as a matter of record, they will not be beyond countermand by the train dispatcher in case of an emergency. The train dispatcher could, in fact, stop every train on his division, should occasion arise requiring it."

RADIUM FOR DENTAL ABSCESSES

Recent observations upon the use of radium emanation indicate that there is a possibility of employing this substance in the treatment of chronic dental abscesses according to Dr. J. A. Marshall, as[sociate] professor of biochemistry and de[ntal] pathology at the University of Califor[nia].

Experiments employing the radio-ac[tive] liquid in the treatment of root canals h[ave] been conducted at the George Willi[ams] Hooper Foundation for Medical Resear[ch] and at the College of Dentistry of t[he] University of California. With one possible exception, there has been no evidence of succeeding soreness or pain.

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