March

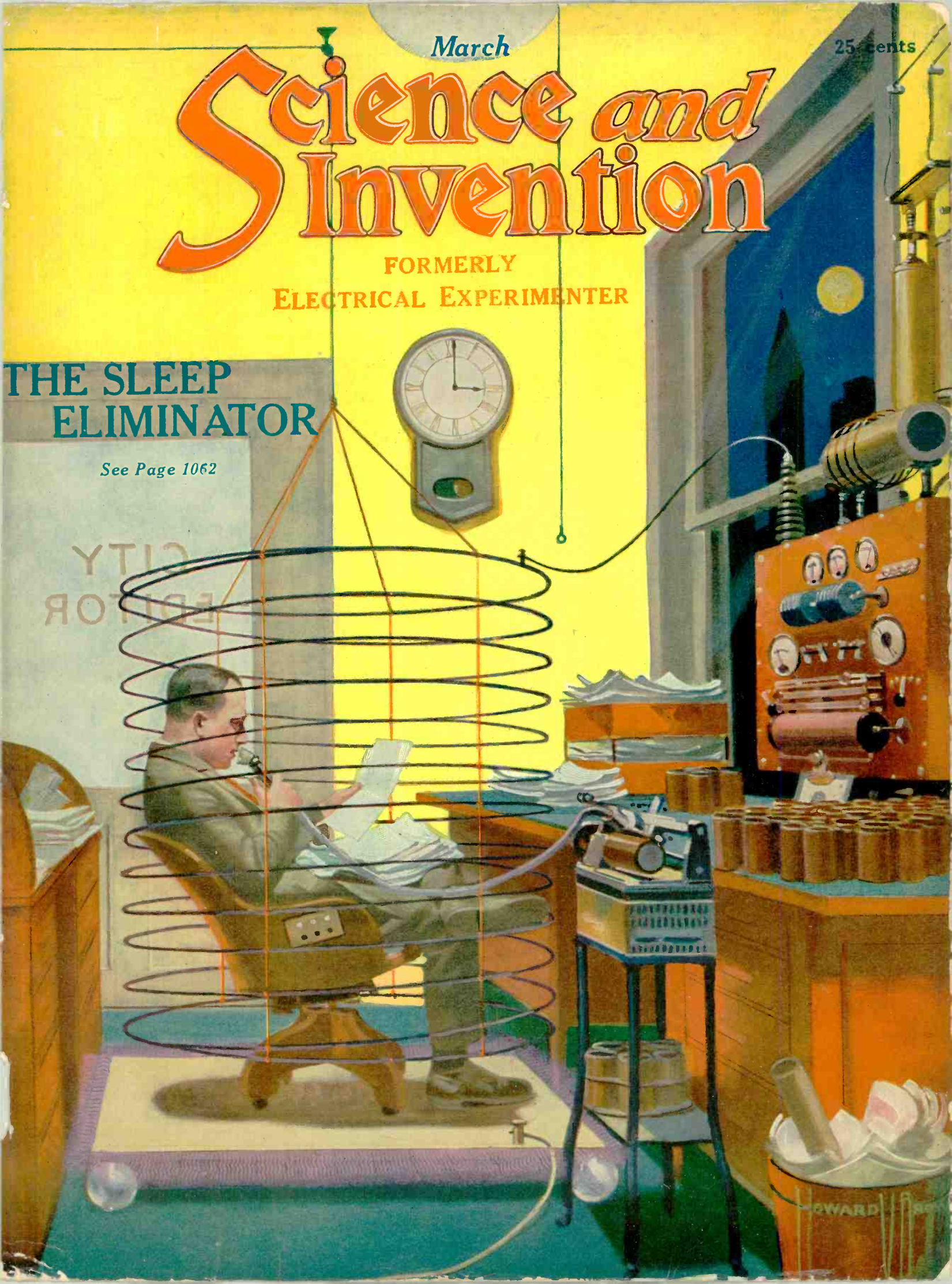
25 cents

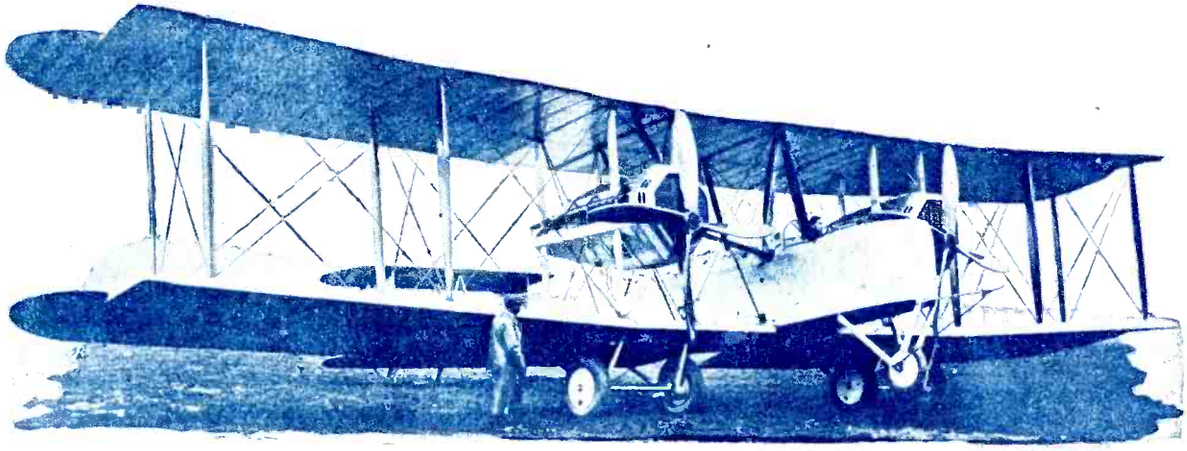
Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER

THE SLEEP ELIMINATOR

See Page 1062





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No other industry offers the wonderful chances for big money-making that the Airplane Industry offers to ambitious men. Many more trained men will be needed to fill big paying jobs. The airplane has come to stay—it will soon be a part of our everyday life. The men who get in now are the ones that will cash in big. Look at the "big fellows" in the automobile game today. They represent power and wealth because they got in early—you can do the same in Aviation and you have an advantage because you can be trained before you start.

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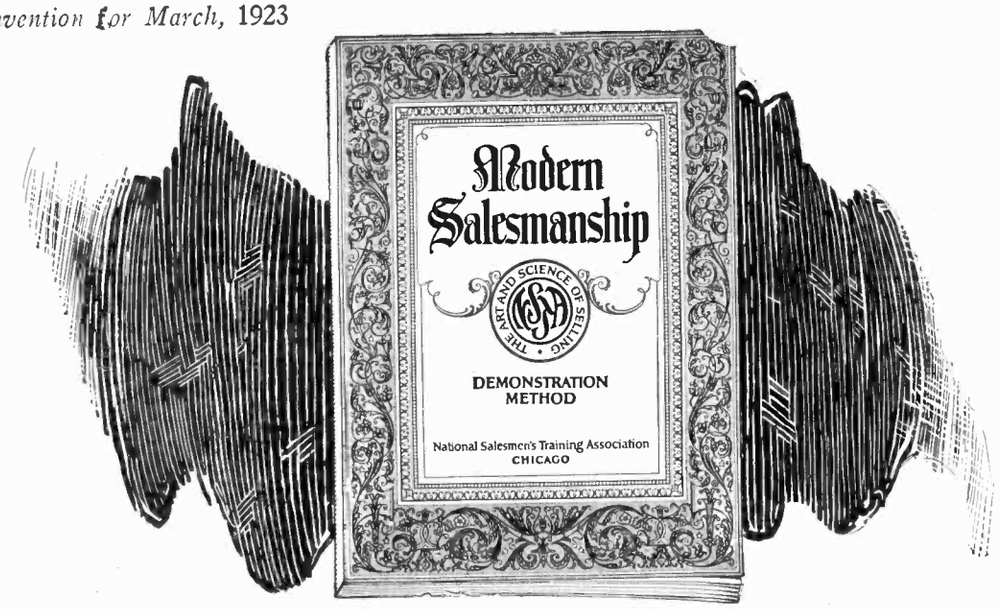

NOW FREE!

The Book That Has Shown Thousands the Way to Amazing Salary Increases

Do you want to leave tne rut of routine work and start right out making more money than you ever dreamed possible? We have done exactly this for thousands of men. Here is the book which gave them their start. Read how it is now offered to you—FREE!

TAKE this situation: A man who had worked all his life in a routine job at low pay suddenly surprises his friends, by moving into a better neighborhood, taking a big house, buying a car and blossoming out as a well-to-do and influential citizen in his new community. How did he do it? What is the secret that he used? Simple enough. He knew that the biggest money in business is in Selling, and though he felt that he couldn't sell a thing, he suddenly learned the secrets that make Master Salesmen and then began to make big money.

If only one man had found inspiration enough in this remarkable book to jump to a sudden brilliant success in the Selling field—into a job paying him many times his former salary—then you might call it luck. But thousands have done it.

R E A D !

Charles Beery of Winterset, Iowa, stepped from $18 a week as a clerk to a position making him $1,000 the very first month. J. P. Overstreet of Dennison, Texas, read this amazing book, left a job on the Capitol Police Force at a salary of less than $1,000 a year and in six weeks earned $1,800. F. Wynn, Portland, Ore., an ex-service man, earned $554.37 in one week. Geo. W. Kearns of Oklahoma City found in this book a way to jump his earnings from $60.00 a month to $524.00 in two weeks, and C. W. Campbell learned from it how he could quit a clerking job on the railroad to earn $1,632 in thirty days.

Your One Chance to Make the Biggest Money of Your Life

Not one of the men whose names appear in the panel at left had ever sold a thing before—not a dime's worth. Yet every one of these men, through reading this book, discovered an amazingly easy way to jump suddenly from low pay to extraordinary earnings in the Selling field.

Sounds remarkable, doesn't it? Yet there is nothing remarkable about it. There are certain ways to approach different types of prospects to get their undivided attention—certain ways to stimulate keen interest—certain ways to overcome objections, batter down prejudices, outwit competition and make the prospects act.

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"Modern Salesmanship" tells exactly how the National Salesmen's Training Association will teach you these principles in your spare time at home.

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Street .....

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

Age ..... Occupation .....

Vol. X
Whole No. 119

Science and Invention

FORMERLY

ELECTRICAL EXPERIMENTER

March, 1923
No. 11

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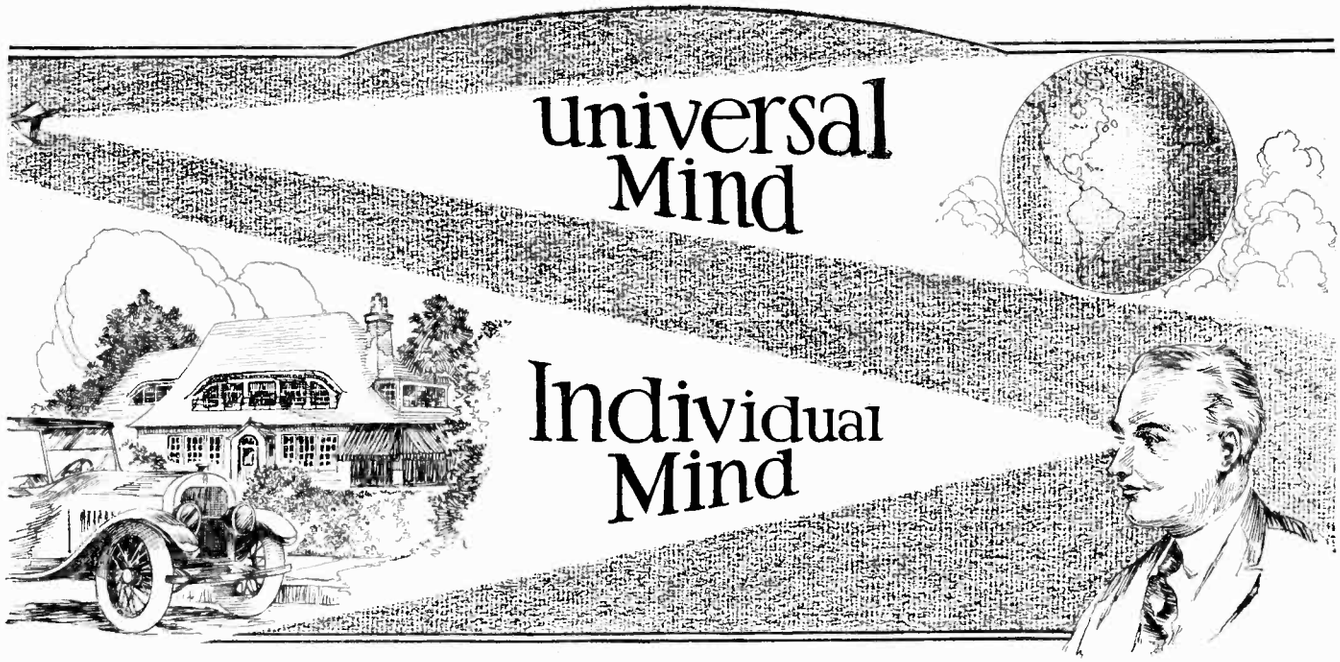

The Creative Power of Mind in Action

You Can Create the Things You Desire

MIND is the real motive power behind all creation, both natural and artificial. The Universal Creative Mind projects into the formless mass of uncreated substance a mental picture of a world, with continents, and oceans, and islands, and mountains, and valleys, and teeming life; and in due course the uncreated substance takes the form of the mental picture.

The individual human mind, under proper conditions, projects into its environment a mental picture of a splendid home, and forthwith the materials for that home and the money to pay for them begin to move together. The same is true of any other specific thing the individual may desire.

What One Thing Do You Desire Above Everything Else in the World?

That desire can be realized. You can have not only that one thing, but what things soever else may be necessary for your happiness. You have within you the creative ability to bring these things into existence and into your possession. The Universal Creative Mind exclusively occupies at least four-fifths of your brain and nerve-substance, and its manifestation in you is called your subconscious mind. It is infinitely wise. It is infinitely powerful. It is all-creative. It created your body from its very beginning, and still repairs, renews and sustains it. It is your Greater Self, your God-Self, your Real Self. Once the individual comes to know his marvelous indwelling Self, and takes it into partnership in his life and affairs, he becomes the architect of his own fortune, the reins of his destiny come into his own hand, and he makes his life just what he wants it to be.

It is remarkably easy to get acquainted with your Real Self, and taking it into partnership puts real life into living. Judge Daniel A. Simmons, one of the best known and most successful practical psychologists in the world, has introduced a great many men and women to their real Selves, and as a result of that introduction they have acquired splendid homes, fine jewels, vastly increased incomes, coveted promotions, business and professional successes, literary and dramatic achievements, and many other such like things. Many of them who were sick have healed themselves of nearly every kind of stubborn disease, and some of these healings have been truly miraculous. We have their reports of these things—a great mass of them—in our files, and since we have used the picture of a home at the top of this page, we here quote from just one of these reports which tells about the acquirement of a home.

"It seems that lately everything is coming my way, just as though I were being carried forward by some unseen power. Only this week a business deal came to me which placed myself and family in a most beautiful home valued at Ten Thousand Dollars. This home is just like what I have been visualizing, even to the steam-heated, electric-lighted garage."

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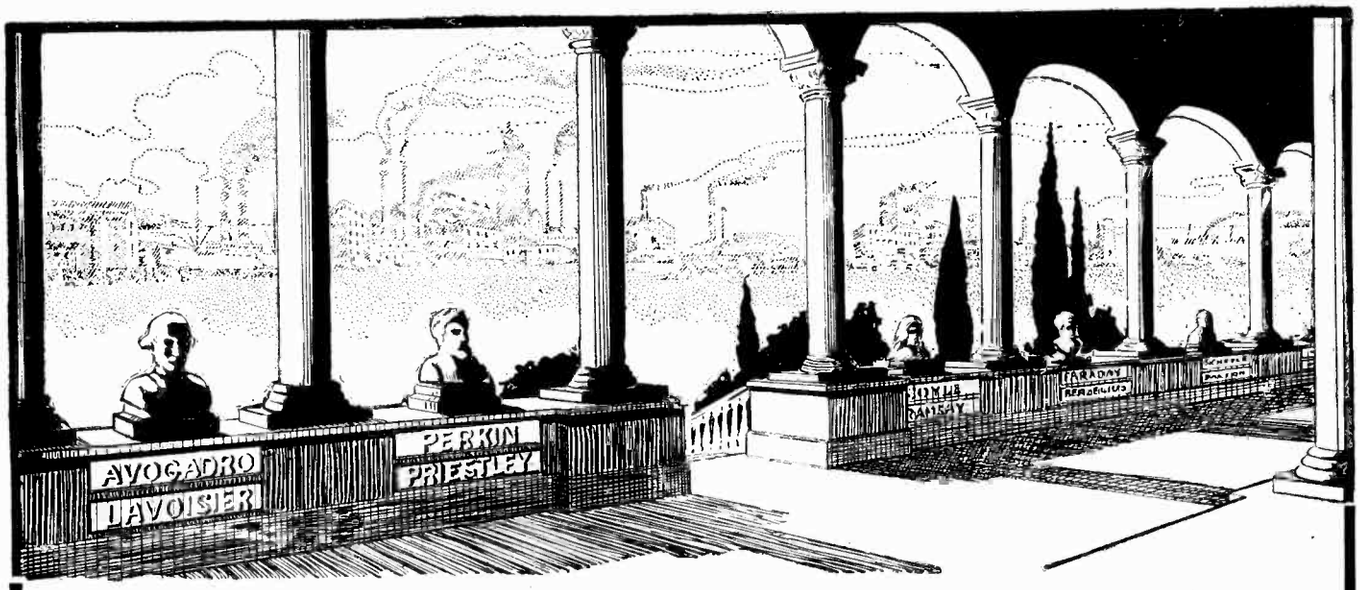

THE HALL OF FAME

Will There Be A Niche For You?

NO man knows what is in store for him. Men now famous in business and scientific worlds were obscure only yesterday. Men today unknown may leave their names in the HALL OF FAME. Great discoveries have been born over night—marvelous scientific deeds sometimes were the results of decades of labor, other times the outcomes of a scant week's research. Truly, no man can tell what the future holds for him. But it is within the power of each and everyone of us to control our own destinies, by self-training and diligent study to fit ourselves to render a lasting service to the world—a service that will bring reward, perhaps in fame, perhaps in riches. **You control your own future.**

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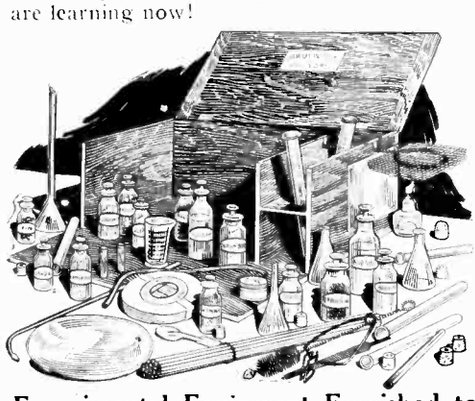

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Volume X
Whole No. 119

Science and Invention

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MARCH
1923
No. 11

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

How Empty Is Space?

WE often hear the remark, "as empty as space," which we utter frequently, quite unthinkingly, having accepted the theory that space indeed is empty. But is it really? When we sum up the evidence, and there is a good deal of it, we find that space is not at all empty, but on the contrary is filled up with a great quantity of matter. When we say that space has no atmosphere or gases, we must take this with a large grain of salt. To be sure, let us say, halfway between the earth and Mars, or between the earth and Venus, if we could "sample" a bit of this "vacuum," we probably would be surprised to find that it was not so nearly complete as we once thought it was. As a matter of fact, scientists tell us that there is no such thing as a 100 per cent vacuum anywhere.

To prove this, we know, as a fact, that the earth is gradually losing a good deal of atmosphere as the years pass by. Thus, for instance, the moon once upon a time had an atmosphere the same as the earth, but due to the fact that its gravitational pull is so much lower than that of the earth its atmosphere passed out into space more quickly. Physics teaches us that nothing is lost in nature. Where, then, did all this atmosphere of the moon go, and where does the atmosphere that the earth loses in the course of centuries go? We also know that Mars is losing its atmosphere and has lost the greater part of it already, so that there is only a fraction left of what there was before. All of this air or gas of countless celestial bodies, be they stars or planets, has spread through all space, where it can still be found, although, of course, in a very attenuated condition.

We venture to say that average space contains a vacuum somewhat better than that in our ordinary electric light bulb, which, as we know, is only a poor one, technically called "a soft vacuum." This vacuum is not to be compared at all with, for instance, that found in a high grade amplifier tube used for radio purposes. The rarefication in the latter is far greater than that of the ordinary incandescent lamp. So we see that the outer space probably contains a good deal of gases which, while very tenuous, are not at all to be compared with the next-to-impossible absolute vacuum.

Besides this tenuous atmosphere or gas, the outer space contains a tremendous amount of floating matter, as can be proven readily by anyone. There is not a single night when, if you watch long enough, you will not see one or more shooting stars illuminating the sky. And if you see such shooting stars, it is safe to say that other millions of observers who are watching for them, can see them as well every night. We know what these shooting stars are. They are meteorites, usually composed of metallic iron, that drive into our atmosphere, there to be reduced to metallic dust, which, after the meteorite has exploded, falls down harmlessly to the earth. Once in a while a big meteorite crashes down and specimens as large as a small house have been found. Some of the larger pieces are preserved in our museums. But we do not see, by any means, all of these meteorites. There is a tremendous amount of meteoric dust floating about in space, aimlessly, which, if it strikes the earth, has not sufficient speed and mass to make any great pyrotechnic display. Such meteoric matter settles down slowly upon the surface of our planet.

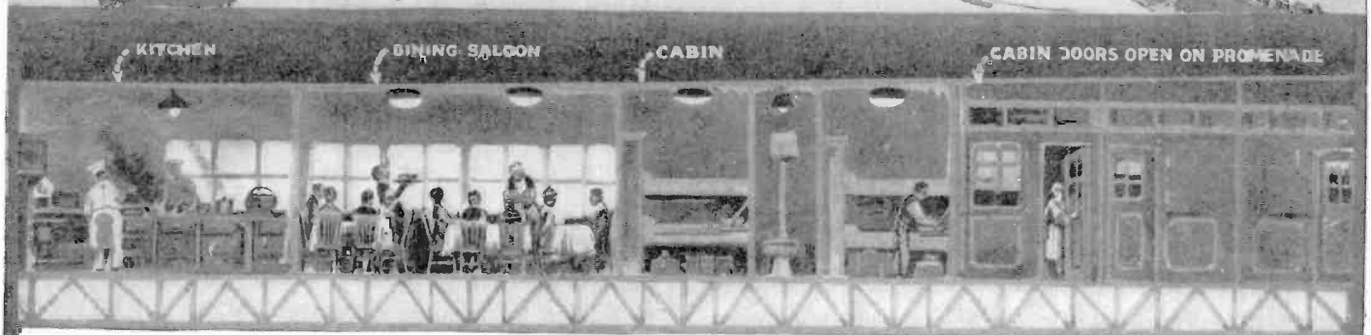
It has been calculated that the sun alone attracts enough of such meteoric matter in the course of a century to amount to a mass that is as great as our moon—a tremendous amount. If the earth is between 20 and 35 millions of years old—that is, if it has formed a crust for this length of time as our geologists assure us—and if only 100 tons of such meteoritic material falls down upon the earth each day (this is a conservative estimate), you can figure out for yourself the tremendous amount of material that must be floating in space.

And we must not forget that at certain times of the year, when we pass through one of the large meteorite swarms—which meteorites are the remnants of destroyed planets—the amount of matter that is thus deposited not only upon the earth but upon the moon as well as upon other planets, amounts to a colossal figure.

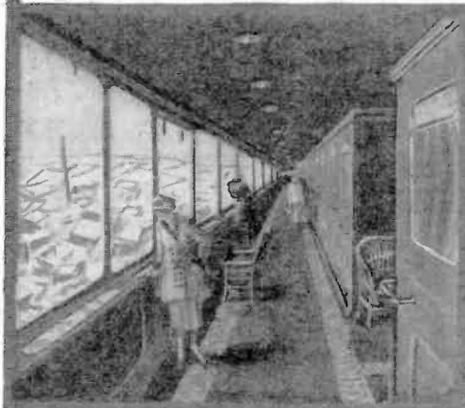
It is safe to say that when man finally perfects his "stellar express" the greatest problem will be, not how to get from one planet to another, but how to safeguard the flyer from the impact of meteorites traveling at a speed anywhere from 5 to 30 miles per second.

H. GERNSBACK.

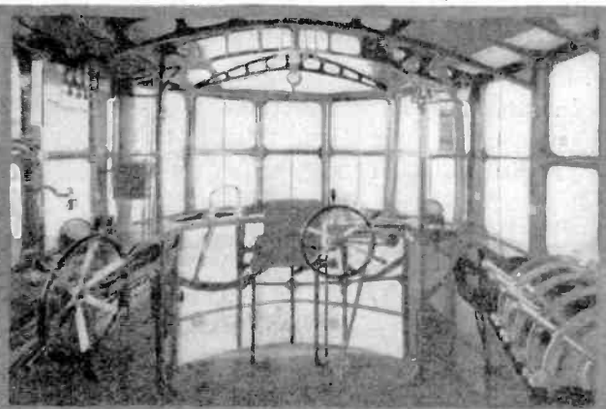
BERLIN-NEW YORK-CHICAGO
VIA THE AIR



The longitudinal view showing the various compartments along the promenade deck of the new giant dirigibles, being built for the Berlin—New York—Chicago air traffic. Note how comfortable the passengers will be while flying through the air at an altitude of several thousand feet. Meals will, of course, be served en route, and as the other pictures on this page show, the passenger compartment is of different design than that followed in previous aircraft of this type, in that the cabins are all arranged in one continuous section in the forward part of the ship. One can sleep in perfect comfort on these giant airships, minus the noises encountered in railroad sleeping cars.

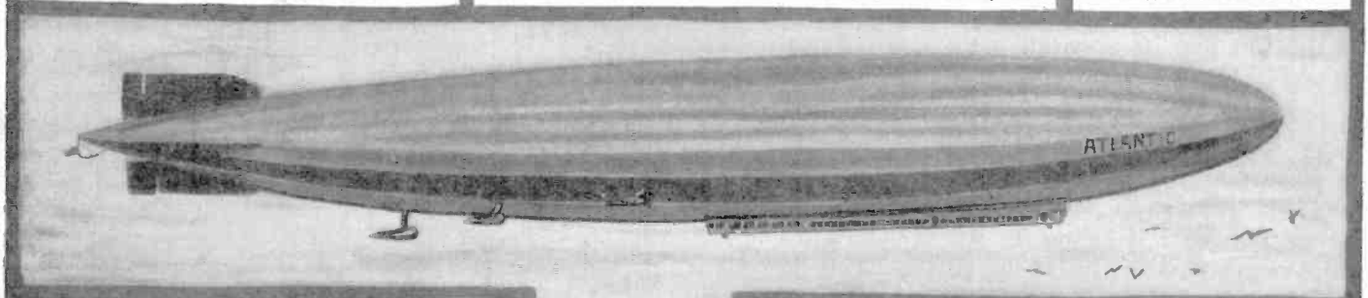


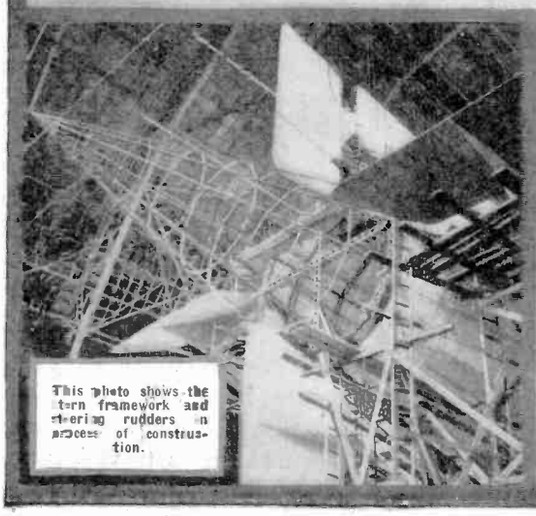
View along the promenade deck of the huge trans-Atlantic dirigible. These decks will be lighted by electricity and glass panels in the rail shelf will permit the passenger to look directly downward.



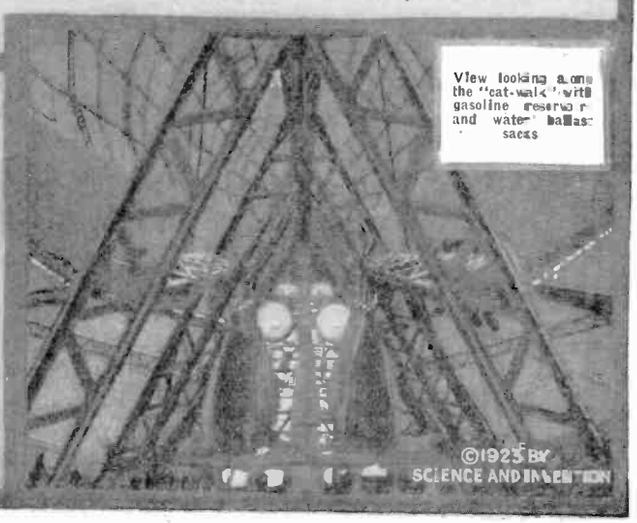
This view shows the interior of the airship Commander's cab, the horizontal and vertical rudders being operated by means of the wheels shown, while the handles at the right control the various engines driving the propellers. The front of the cab, as will be noted, is made of glass all the way down.

The Schutte-Lanz airship in the course of construction in German factory, less the external skin.





This photo shows the stern framework and steering rudders in process of construction.



View looking along the "cat-walk" with gasoline reserves and water ballast sacks

Chicago-New York-Berlin Via the Air

By Dr. H. BECHER

"WE learn by making mistakes," runs an old saying. We learn to overcome and to avoid dangers as soon as we have but once come into contact with them. Germany has undergone this experience during the war with regard to her aerostats when necessity forced her in these four years of war to run through a period of development of thirty years as far as devising and constructing aerostats is concerned. The final product of endeavors had been an excellent model of inflexible aerostat, the *Schütte-Lanz*. Fully appreciating the merits of this, leading American concerns of commerce and industry established in connectiom with Dr. Schütte, the General Air Service, a branch affiliated to the American Investigation Corporation, who in the near future will call into existence a regular aeronautic commercial traffic first of all in America. The project is to raise in America a preliminary share-capital of 50 million dollars which is to be increased afterwards and to build three large Schütte-Lanz dirigible balloons or aerostats of about 110,000 cubic metres capacity. Setting these going a regular traffic will be opened up on the line New York-Chicago to begin with; a second line, New York-Berlin, is to follow soon after.

Of course, a few single aerostats only will not answer the purpose. There will have to be created besides large ports, well provided with gas-works and hangars to house the aerostats and the hangars must include stable ones and some capable of being turned. There must be set up *masts for anchoring,* provisions made for affording refuge, etc.; wireless telegraphy and the meteorologic service will have to be adapted to the necessities of aerial traffic. The different countries will have to work together for which purpose international agreements will have to be made and all progress of technic must carefully and continually be studied so that the necessary development will neither be stopped nor retarded.

And besides, the whole project must be carried out in a manner so it will turn out to be *profitable.* If you mention to an outsider the approximate sums necessary for constructing one single aerostat of large size or for creating a well equipped port, he will in turn doubtfully shake his head and express his opinion that to his mind it would seem impossible to find any subscribers to a project like this. And yet he is wroug! Comparison will show better than figures and counts could do, where the fault lies in the reasoning of this critic. If you travel today on board of one of those huge modern steamers from New York to Hamburg, you do not think for one moment—and surely no one else does—that this steamer might just as well go back and forth doing her service without properly built ports containing docks and quays and all requirements for proper landing, discharging and re-loading. On the contrary, everybody knows that in the harbors of all large seaports millions of dollars are invested. Everybody knows further that compared with these sums the cost of building the steamer herself counts almost as a mere trifle. As a matter of course extensive measures have to be taken for securing navigation on the ocean as well as on rivers, exact sea-charts must necessarily be drawn up and constantly controlled, the navigable road must be regulated, dangerous spots marked by lighthouses, light-ships, and buoys; and last but not least a regular and well organized meteorological service, encircling all parts of the world, must be maintained. In short, high working expenses are incurred constantly which in some way have to be reimbursed.

In the aeronautic service matters are quite the same; here also we need ships and ports. But there is one profit compared with the navigation service, i.e., that in the free atmospheric ocean we need no light-ships, no charting of channels, etc., and that thus a considerable part of the running expenses connected with the ocean service does not come into existence.

In the present article by Dr. H. Becher, one of our Berlin contributors, we are told of the newest plans for a trans-Atlantic air service in which the latest aeronautical developments are to be applied in building huge gas-filled airships, which are intended to link Berlin with New York and Chicago. The financial and other arrangements have, it is said, already been completed, and the present plans call for the building of three large dirigibles, of the type shown in the photographs on the opposite page. The dirigibles are of the Schütte-Lanz type, and every precaution is to be taken in the pleasure machines to guard against explosions or fire. It is intended to fill the balloon compartments with non-inflammable helium gas, and the builders are planning to replace the benzine motors with those to be operated with heavy oil. The engines are, moreover, to be placed in separate gas-tight compartments of their own.

Careful and thorough calculations of the profit have thus far shown that in an aeronautic service suitable to all modern requirements passenger prices will suffice which are but little above first class passenger prices of our modern saloon-steamers. In fact, taking here into account the saving of time, the *air service will really be cheaper than a steamship- or railroad-service,* for "time is money"; this proverb being to-day more valid than ever before in every business project. For instance: The highly paid correspondent of one of the large newspapers has to be travelling constantly all over the world; he must be everywhere where there is "something going on". If this correspondent, in using the air-service, has to be idle but one month a year in all, instead of three months as by using the steamship- and railroad-service, the profit for himself and his newspaper will most probably be some hundreds of times larger than the somewhat higher price for using the air-service would amount to.

Another example: If a representative of finance, of commerce or diplomacy, or the reporter of a newspaper of world-renown, has to go from New York to Berlin, it will take him at least 8 days to travel by steamer and by railroad. If the air-service on this route were a fact to-day, it would not take him more than about 2 to 2½ days. The great saving of time is obvious.

A means of traffic for multitudes the air-service will never be, because the carrying capacity of an aerostat is too small as compared with the running expenses of the whole service. An aerostat like that which Schütte-Lanz intend to put into service between New York and Germany, can take about one hundred passengers only, but these will certainly enjoy all the comfort which the travelling public is accustomed to on board of the modern fast steamers.

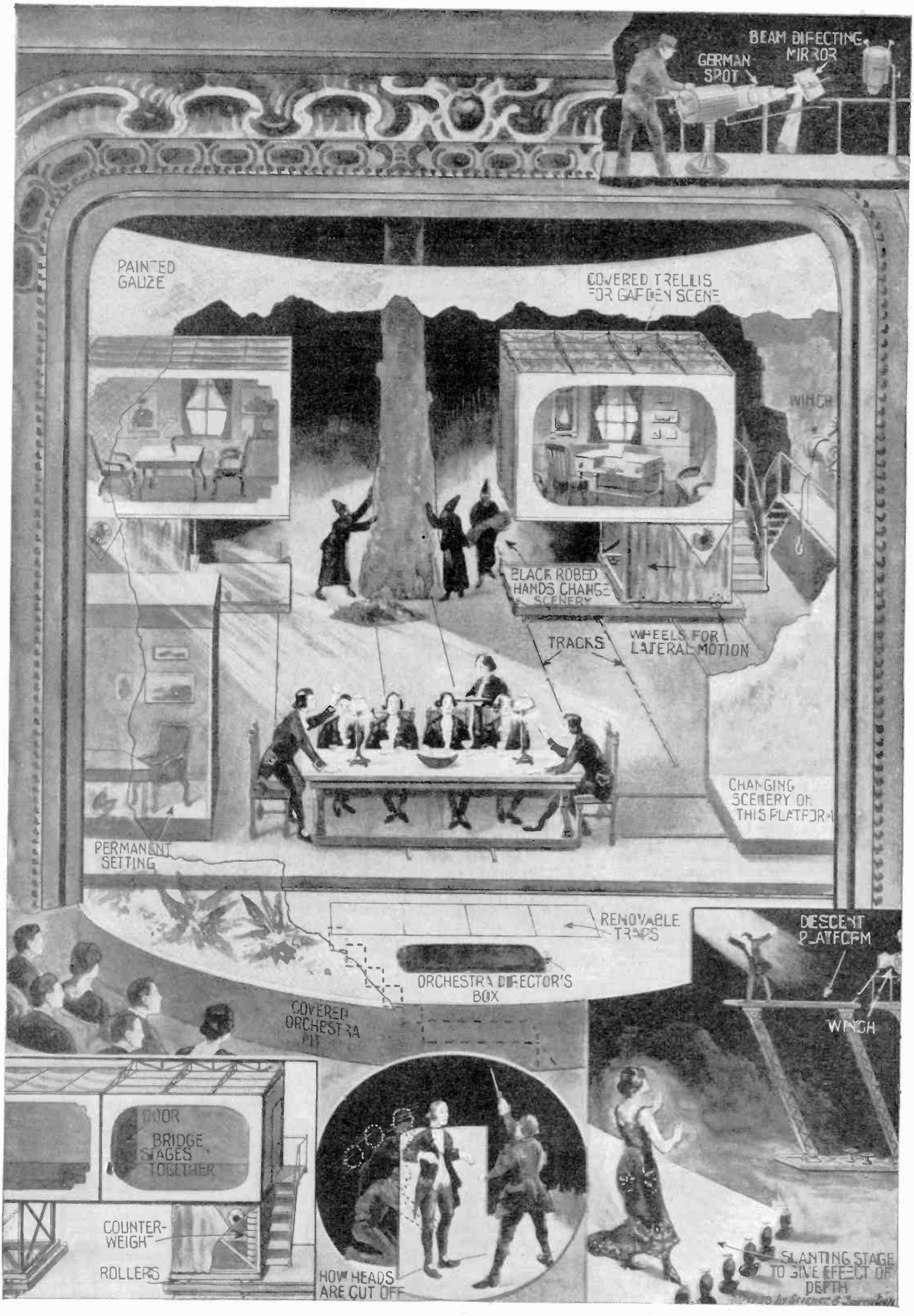
As a second important factor in the profit of air-service we must mention the mail-service. Cablegrams and radio-telegrams are very expensive and the secrecy of business is nowadays no longer guaranteed. Over-sea letters go too slowly by steamer. This obvious deficiency is done away with by means of the air-service which at a comparatively low charge and in a very short time carries most important news from one part of the earth to another. A letter weighs very little, the charge for forwarding it can therefore be small. It does not at all appear utopian to think that in future times on certain routes mere *post-aerostats* may be in service which do not take any passengers at all but forward exclusively mail and matters or goods of high value. The American Mail-Service, for instance, has already had excellent results in forwarding letters from New York to San Francisco and back again by airplane. This service is arranged in such a manner that an airplane carries the mail during the first light-day period after having started. In the evening of that day the mail is delivered to a fast-train going in the desired direction which again in the morning gives the whole matter to another airplane for delivery at destination. Forwarding at night by means of airplanes is not possible as yet, because flying and landing at night for a vehicle like this is still too dangerous.

A few words may here be allowed on the relation of aerostat to airplane. It would be wrong to believe that they should exclude one another or be in competition with each other. On the contrary, they must both be considered *necessary supplements* to one another, the aerostat representing a fast-communication for large distances, while the airplane with its greater rapidity but its present still much smaller radius of action, comes preferably into question for small distances.

If we should sketch out upon a globe an air-service comprising all parts of the world, as we might expect for the future, we could limit ourselves to a few, say about a dozen lines, representing all routes from one country to another and beyond it. At the ends of these routes a fine net-work of lines would represent the short-distance routes of the airplanes within the different countries themselves.

Finally a few words on the security of the aerostat.

The gas-filling is generally considered to be very dangerous. The hydrogen contained in the balloonets mixed with the atmosphere, forms, it is known, an explosive mixture. Consequently, on board the aerostat every possibility of an explosion must be avoided and there must be no possibility of conflagration. This aim has been attained in practical manner in which there is of special importance the discharge of gas which Schütte-Lanz has adopted in his system in the shape of gaspits. A second danger which is also connected with the airplane, is the benzine motor which nowadays is still necessary for driving the aerostat. Benzine-vapors are easily set ablaze, but even this danger is not to be taken in earnest on board of a modern aerostat. The *motor plant,* for instance, is put into special tightly closed gondolas which hang at quite a distance from the main body of the aerostat, there being thus always a strong current of air passing between the gondola, the source of danger, and the balloonets in their casing. In consquence of this arrangement there would be, even if a little fire should occur inside of the gondola, no harm whatever done to the ship itself, as experience has shown.



In "Johannes Kreisler," the latest New York theatrical sensation, there are forty-one scenes, which are changed right before the audience without dropping the curtain. These marvelous scene changes are effected by switching off the lights, the stage attaches being garbed in black; these rapid transformations being aided by a number of clever moving scenic structures, as shown above.

Rapid Scene Changes in "Johannes Kreisler"

By JOSEPH H. KRAUS

ONE of the most spectacular productions on the American stage today is now being viewed by thousands of theatre-goers daily at the Apollo Theatre, New York. This production was imported from Germany, where it was first shown under the name of "Die Wunderlichen Geschichten des Kappellmeisters Kreisler." Svend Gade, a Danish inventor, was also brought over to construct the stage and produce the scenic effects, he being the inventor of the system of rapid scenery changing used. In the play, forty-one scenes are to be counted; there are twenty-one in the first act, ten in the second act, and ten in the third act, all of which pass before the eyes of the audience within the prescribed period of two and one-half hours. There is no intermission at all between scenes.

Just a few words with regard to the story of the play itself, will be given and then we will continue with the description. Part 1—Johannes Kreisler has written an opera in which Undine is to star, Undine being a character in the opera. Kreisler is befriended by Julia, a girl whom he meets, and is invited to her house by Julia's parents, where he subsequently teaches her to sing. A Padre tries to persuade Julia's mother to have her take the veil, and warns her against the musician. A rich man also enters and proposes for Julia's hand. On a subsequent visit, Kreisler is told that the Padre has taken Julia to mass, which creates in him, maddening visions. He sees Julia tied to a whipping post, with the Padre scourging her unmercifully. As Kreisler cries out, the scene rapidly changes, and the whipping post becomes the convent cross, before which Julia is praying. They return to Julia's room and the rich man enters. Again Kreisler has a vision in which the rich man is seen offering hoards of gold to Julia. Kreisler enters upon this scene, where the money bags turn into skulls, skeletons, and spooks. Again the scene changes to Julia's room, where she and Kreisler have an understanding. She informs him that she doesn't want riches, but wants him. Just then, as they embrace, the Padre enters, and Kreisler is ordered away.

Part 2.—Kreisler, now musical director of the Royal Opera, is commanded to appear at the Grand Duke's Palace, to play music for a dance. He refuses, but Euphemia, the Duke's niece, coaxes him to play for her pleasure, which he does. Kreisler's rivals and enemies mock him. The Lord Chamberlain, having proposed to Euphemia, adds to the Grand Duke's worry over her growing intimacy with Kreisler, but she assures him she will do what is right. Kreisler seated at his desk writing in the following scene, is tortured by oppressive imaginings, his enemies standing about him, laugh at him, and with his baton he cuts their heads off. This beheading scene is shown in detail in the insert in our illustration. The scene changes to one at the stage door of the Court Theatre, where Kreisler, mastering himself, says that he will direct the ballet in the opera, which ballet he has been instructed to introduce. The next scene is in front of the curtain of the theatre, where the rehearsal of Kreisler's opera *Undine* is to take place. After violent words with the director, Kreisler throws his baton down and leaves the theatre. Outside he meets Euphemia, who gives him her hand and says farewell. For the second time he has lost all.

Part 3.—Kreisler still telling the story to his friend, states that he has entered a theatre to steep himself in Mozart's music. He explains that Donna Anna, Julia, and Euphemia are all one and the same—his Undine. He adds that although Donna Anna was at the moment on the stage, he felt her presence behind him, the scene changing to indicate this. The bell rings, and Donna Anna must return to the stage. While singing, she stretches her arms alluringly toward Kreisler, who drawn by a super-natural force, floats from his box through empty space, down to her on the stage. This takes place supposedly at two o'clock in the morning, after Kreisler had fallen asleep in the theatre box. They embrace, and a moment later she lies lifeless in his arms. The scene changes to the room where he is telling the story, where Kreisler is informed that the opera would not be played because Donna Anna died at two o'clock that morning. Kreisler closes his eyes, and falls into a slumber from which no one can arouse him, his soul passing to meet his Undine, or otherwise Euphemia, Donna Anna and Julia.

* * *

The scenic effects in this production are remarkable because of the extreme rapidity, with which they flit before the eyes of the audience. The ordinary footlights are not employed, colored spot-lights taking their place. Here we find amongst the innovations, several new German spot-lights, which instead of requiring their entire body to be shifted in order to change the position of the spot, are fixed and stationary with regard to their carbon housings, lenses, color screens and diaphragms. The beam from these machine gun-like spot-lights is thrown upon a mirror, which reflects the light making it possible to rapidly change the location of the beam, in much the same manner as a boy with a mirror can reflect sunlight, directing it very easily toward any spot desired. These lights instead of employing large colored screens, use a strip of colored gelatine only one inch wide, and about six inches long, blending colors from a vivid violet to the other or red extreme of the spectrum. Sliding this back and forth just a little out of the focus of the beam of light, where the rays concentrate before being thrown upon the mirror, it is possible to rapidly change the color. An iris diaphragm slightly larger than a silver dollar, controls the amount of light. These spot-lights are located upon a special gallery erected just back of the proscenium arch.

The orchestra pit is entirely covered, the director observing the scene through an elongated prompter's box. A flight of stairs leading from the roof above the orchestra and extending below the stage, permits Kreisler to go down to a platform later in the play, to direct the musicians in the scene when the opera is being staged. This flight of stairs is covered by removable traps. Extending from the forward edge of the orchestra box (for the pit now is a sector of a circular box, the orchestra being completely covered), an immense gauze curtain rises upwardly, being attached at the upper end to an iron supporting rail. The gauze curtain itself is painted. This provides for a change of scenery behind it, when one of the smaller stages is illuminated, without the necessity of lowering the regular drop. The audience can see through the gauze curtain when the stage is illuminated, but when the stage is in total darkness it appears as though the curtain itself was absolutely opaque. Strange to say, the actors never see the audience.

In order to facilitate the changing of the scenes rapidly, the stage has been divided up into six smaller stages, which may be almost completely drawn out of the way. There are three sets of longitudinal tracks, upon which flat platform-like cars roll, which may be drawn forward or pushed back whenever desired. On the center platform smaller settings are mounted and on the two platforms on either side running parallel with this, some of the larger scenes are erected. Each of these platforms contains a double story structure, the upper story of which extends considerably beyond the lower one. This particular construction may be shifted at right angles to the platform upon which it rests, as it also moves on rollers. Thus it is possible to construct a bridge with one of these on either side. Either a complete scene or a half scene may be erected on the half bridges.

Each bridge is equipped with its own supply cable and electric lights, and at no time are the usual footlights of the stage or the lights in the flies, lit up, except in the settings when the space of the entire stage is employed. In order to make it appear that a person is walking off into the distance, the main platform of one of these double-deck structures is gradually pushed toward the rear of the stage by figures draped in black, and hooded like members of the Ku Klux Klan. The other movement of the double-decked structure is also utilized, so that at the same time that the main platform is being moved toward the rear, the bridge section is pushed laterally or toward the

(*Continued on page* 1099)

April Feature Articles in Science and Invention

Measuring the Heat From the Planets. By Donald H. Menzel, M.A.

The Thing From—Outside. By George Allan England.

Producing Burning Ship Scene on Stage.

The Birth of a Clay Pitcher. By Jay B. Elliott.

Talking Over 70,000 Volt Transmission Line By "Wired Wireless."

Utilization of Tidal Power—Latest European Development.

Wave Traps and Interference Preventers. By A. P. Peck.

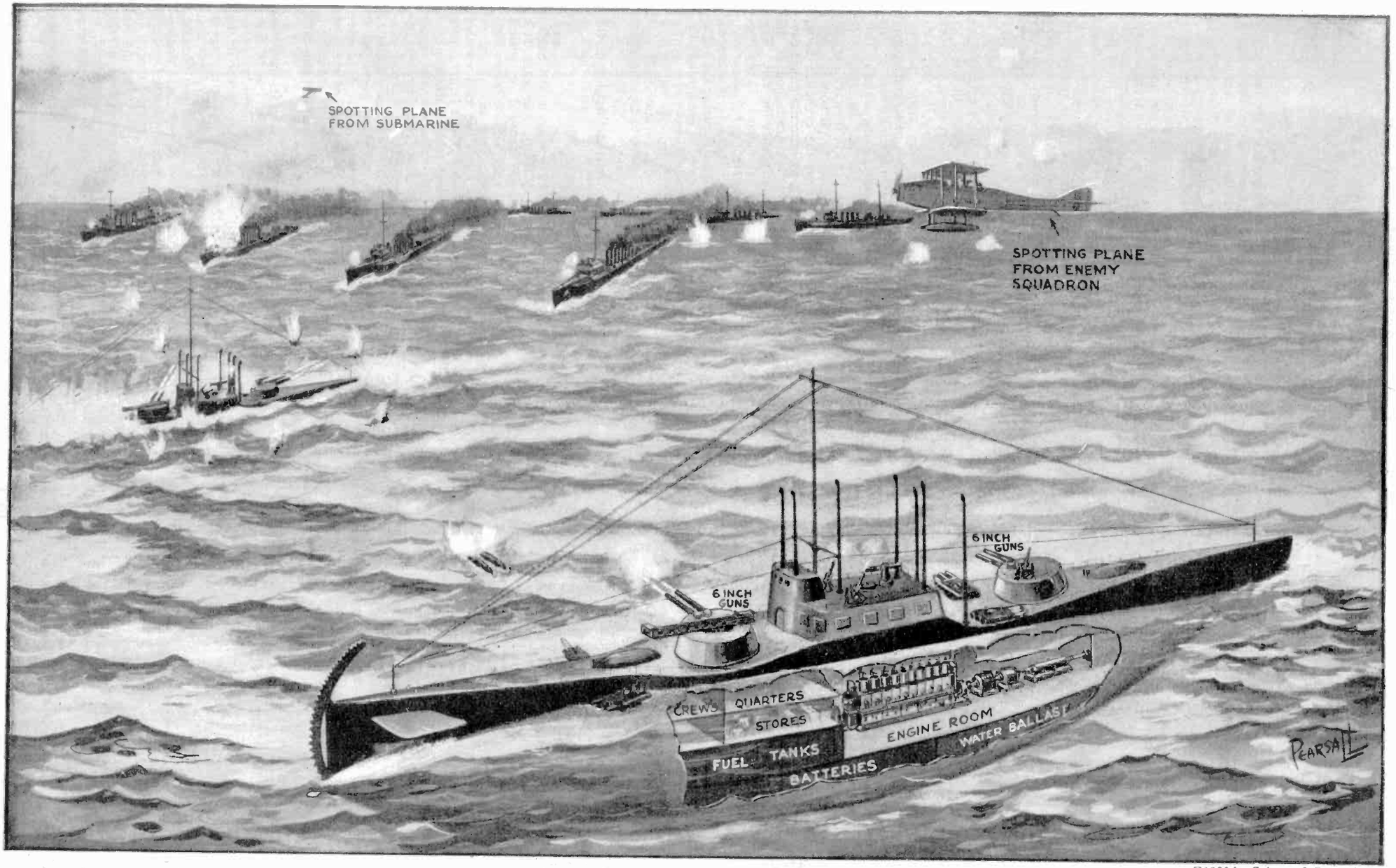
How to Build an Ultra-Selective Short Wave Tuner.

What Will Be the Future of Radio Broadcasting? By H. Winfield Secor.

Producing Helium From the Carbon Arc.

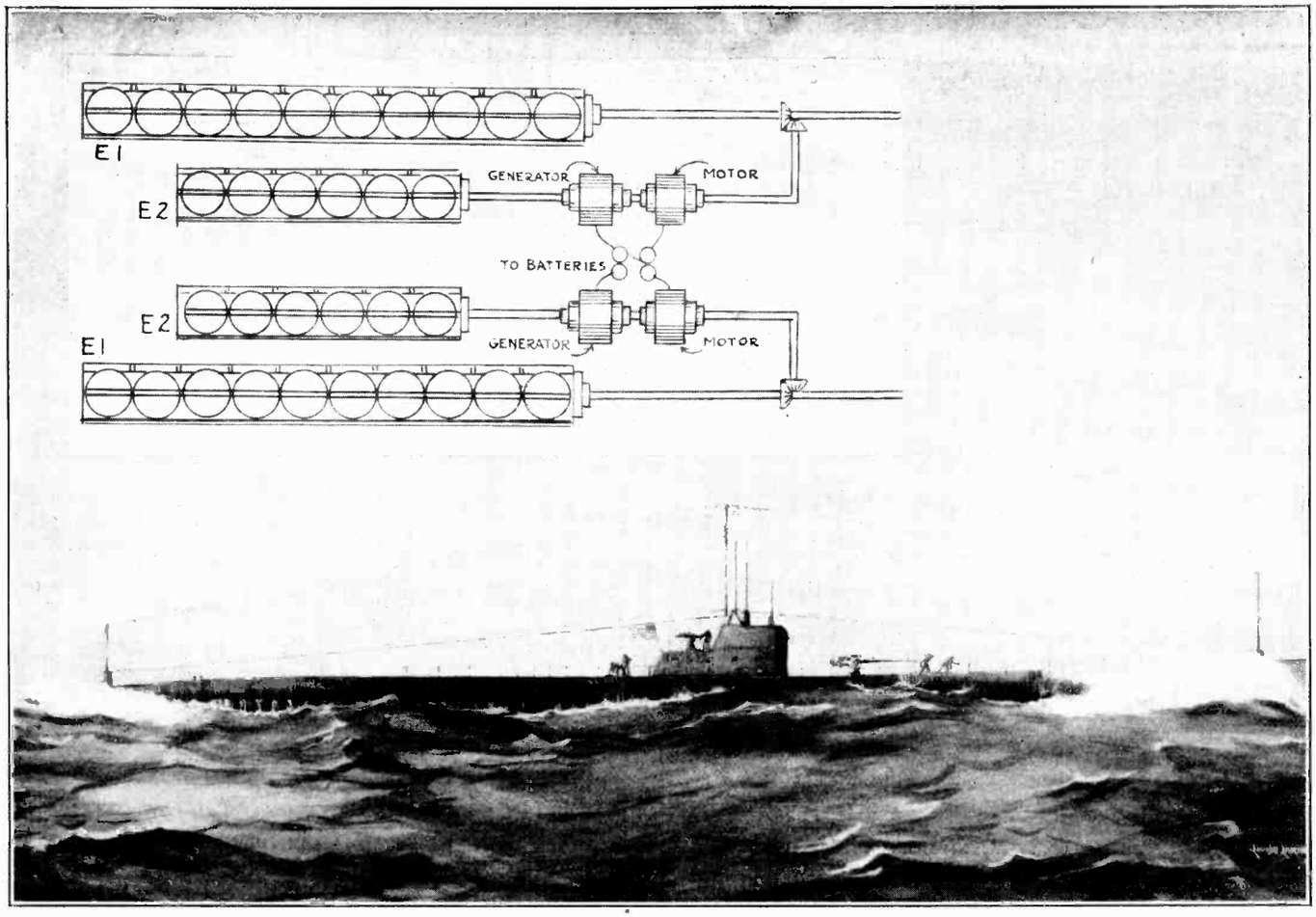
Pipe, Cigars or Cigarettes—Which? By Ismar Ginsberg, B.Sc. Chem. Eng.

All the Earth's Atmosphere in One Tank. By Charles Nevers Holmes.



THE SUPER-SUBMARINE OF TOMORROW

The super-submarines of the future in action. The vessel in the foreground is covering the retreat of the second submarine, which has been badly hit by the destroyers. The eight destroyers constitute the attacking force. The first division of four destroyers is attacking the submarine making a crash dive. The second division will shortly make a turn to the left and attack the submarine in the foreground. This action brings into play all the features with which a submarine of the future must be endowed. The six-inch guns, enclosed in water-tight turrets, are far more powerful than the guns carried by the destroyers. One of their hundred pound shells is sufficient to put any destroyer out of action, if it does not sink the vessel. The Diesel engine and the electric drive give a submarine comparatively a far greater speed than the Diesel engine with the electric drive. The vessel in the foreground is operating at a top speed of twenty-four knots. In the vessel of the size of the one shown here, it is quite possible to stow a small airplane, which would be invaluable as a scout and as a spotter for the gunfire. In order that this plane can be launched, a catapult is mounted on the fore turret. The anti-aircraft guns are used to drive off enemy planes attempting to bomb or spot the enemy's gunfire. Note the number of periscopes. It is the practice even nowadays to put a number of these observation instruments on a single submarine, in order that the vessel's usefulness is not put to an end with the destruction of one or more of them. The demonstrated efficiency of the deck torpedo tube is responsible for its use aboard this ship. Note the fore tube on the left, or portside of the ship. The outside torpedoes are scarcely out of the tube before the middle or third tube is discharged.



Our new submarines of the V type, which have just been laid down at the Portsmouth Navy Yard. The insert shows their engines, which are of the M. A. N. Diesel type. Those marked "E1" are the main drive engines, which operate on the shafts, at the end of which are the screws which drive the vessel. Those marked E2 are engines of the same type, of less than half the power. They are used to drive the generators, which in turn charge the vessel's storage batteries for submerged cruising. The motors just aft of the generators take their power from the batteries when cruising submerged. In the event it is desirable to use the full power of all the engines on the surface, such as would be the case in fleeing from a more powerful vessel, the E2 motors can add their power to the main drive engines in the following manner: The generators are cut off from the batteries and connected directly with the motors, which in effect gives the same electric drive system as used on our larger battleships. Thus all engines are connected with the main drive shafts, giving the maximum power at the time it is needed. This mechanical feature makes these V boats the forerunners of the super-submarines of the future.

The Submarine of Tomorrow

By GRASER SCHORNSTHEIMER, Naval Expert

STRANGE as it may seem, the full powers of the submarine were not revealed in the late war. As a commerce destroyer and raider, its use was fully demonstrated, but its value as a scout and as a deterrent to the advance of an enemy force was in no way revealed. The submarine of the future must be capable of all these duties, though each vessel of the future type will probably be designed for specifically one duty or another.

The greatest submarine in service today is the French "Halbroun", formerly the German "U139". She is really a large vessel of 1930 tons surface displacement and 2480 tons submerged. She is considered an ocean-going cruiser. In design she is a forerunner of the great boats which will attempt to control the seas in time of war twenty-five years hence.

She has a complete double hull, which is well sub-divided into many compartments. She is fitted like a battleship with anti-rolling tanks. Her engines are the ultra-modern 6 cylinder, 4 cycle Diesel motors of the M.A.N. type. They are two in number and develop 3500 horse power to give the vessel a speed of 17.75 knots on the surface. Having been designed for ocean cruising as a commerce destroyer, her endurance is very high—18,000 miles at a speed of 8 knots.

The submerged motive power is derived from electric motors operated by great storage batteries, which are charged by generators operated by the Diesel engines when the vessel is cruising on the surface.

American submarines have not been so successful as those of foreign makes. The principal reason has been the inability of private engine builders to construct a Diesel motor practicable to the submarine.

But our engine difficulties, which seem to be purely those of design, are now over, as the Navy Department is undertaking the manufacture of proper engines in Government shops. German submarines and the latest types of the best German Navy Diesels were brought to this country shortly after the war. These engines, the famous M.A.N. or German Navy type were carefully measured and new ones were built at the Brooklyn Navy Yard. They are wonders of perfection which seem to have overcome the defects of other types. Per horse power they are lighter and more efficient than any engine we have ever had heretofore. Several submarines of the "S" type have been re-designed with these Diesels and they have considerably bettered their past performances, though before this change, the "S" class had proved itself to be the finest in our submarine service.

Last year the Navy Department received the initial appropriations to cover the construction of three of the nine "fleet" type submarines authorized in 1916. With these new boats it will be possible to start anew our submarine history with real vessels built by Navy engineers, on Navy designs and in Navy yards. They were assigned to the Portsmouth Navy Yard for construction and their engines will be built at the Brooklyn Navy Yard. A most advanced design has been given them.

These boats are known as the "V" class. They will be about 335 feet long, have a beam of around 37 feet and draw about 16 feet of water when on the surface. The normal surface displacement will be 2,025 tons and submerged the ships are reported as around 2,500 tons. The engines will be two 2400 horse power M.A.N. Diesel motors operating on the main drive shafts. There will be two auxiliary 850 horse power engines to drive the electric generators which charge the storage batteries for submerged cruising. *And to test the theories regarding the practicability of the electric drive for increasing the speed of submarines these electric generators are directly connected with the motors which are in turn connected with the main drive shafts and can be used for surface cruising!* All the naval constructors will say regarding these boats is that they are expected to have speeds of about 21 to 22 knots, but others, very well informed, expect that these Diesel driven American submarines will equal the speeds of the British steam driven "K" boats—of 24 knots!

The cruising radii of these "V" boats will be very large, permitting them to operate with the battle fleet on all occasions. It is

(*Continued on page* 1100)

New Process Color Black and White Movie Films

By LEWIS YEAGER

SCORES of experts have been working night and day for months in the Famous Players-Lasky Studios in California to turn out 200,000 feet of colored film for the new Cecil De Mille motion picture *Adam's Rib*. The Company will soon be operating twelve composite automatic machines each capable of producing 1,000,000 feet annually. This new machine, which will be one of the most intricate to be found in the scientific world, will operate automatically after an operator threads the film through it and presses the control button. It will be to the Movie World what the cotton gin is to the Textile World, and what the linotype is to the Newspaper World. Radio appliances are comparatively simple as compared to this new addition to the resources of the scientific field. The unit-block of twelve machines will cost $70,000.00.

Loren Taylor is the inventor of this new machine which colors black and white films. It is a case of necessity being the mother of invention, for Mr. Taylor already occupies a place in the front row in the leading inventors in the cinema world. The Taylor process requires no modification of camera or projector, and this together with the wonderful color effects made it appeals to Mr. De Mille.

Scenes in the new Cecil De Mille picture to be released by Paramount, used many feet of it. Not only will it be used in title decorations, but in many intricate movie scenes.

The new machine will do all this complicated work at a stroke. Other systems requiring a variety of equipment have obtained excellent results, but Mr. Taylor has accomplished the impossible. He takes a picture made with the ordinary camera, touches it with his magic wand, and hands it to the exhibitor who may use it in any projector.

We shall now see why machinery is necessary. If you could get into the color laboratories of the Company, which few are able to do, you would find the film passing through many machines, each in charge of an operator. These experts have been working night and day preparing film for the new motion pictures. There are 275 copies of this film; each film is 10,000 feet long, and about 1,000 feet of colored film is used in each picture. In other words, 300,000 feet of colored film is necessary. The sections of colored film are first made in the color laboratory, then assembled and cemented in the proper parts in the main black and white film.

In order for one to understand the system of colored movies, an explanation is required. The motion picture camera only records its views in black and white, and colored pictures as with the ordinary camera are out of the question.

Motion pictures are taken at the rate of 16 per second. The film must actually stop 16 times. Each time it stops, the shutter gives an exposure. The film after perhaps a thousand or more feet have been exposed is then developed giving a negative and the positive is printed on another similar strip and is finally ready to be run through a projector. The projector is a machine which jerks the film in front of the light 16 times per second, so when Dorothy Dalton hits the villian with a pitcher, it is in reality a string of pictures we see. The eye retains one image until the other is before us. This is described by the physiologist as visual persistence.

Inventors have used various types of apparatus to make colored pictures. The majority did not go with standard equipment and hand coloring was often used through necessity rather than choice. This is why Mr. De Mille was greatly interested when he saw the colored piece of film resulting from the work of Mr. Taylor. This process did not require a different camera or projector.

The details of the present process are guarded by the company but the system now used and which will be incorporated into the composite machine can be understood from our illustration.

Colors are due to different wave lengths of light and each has a different effect on

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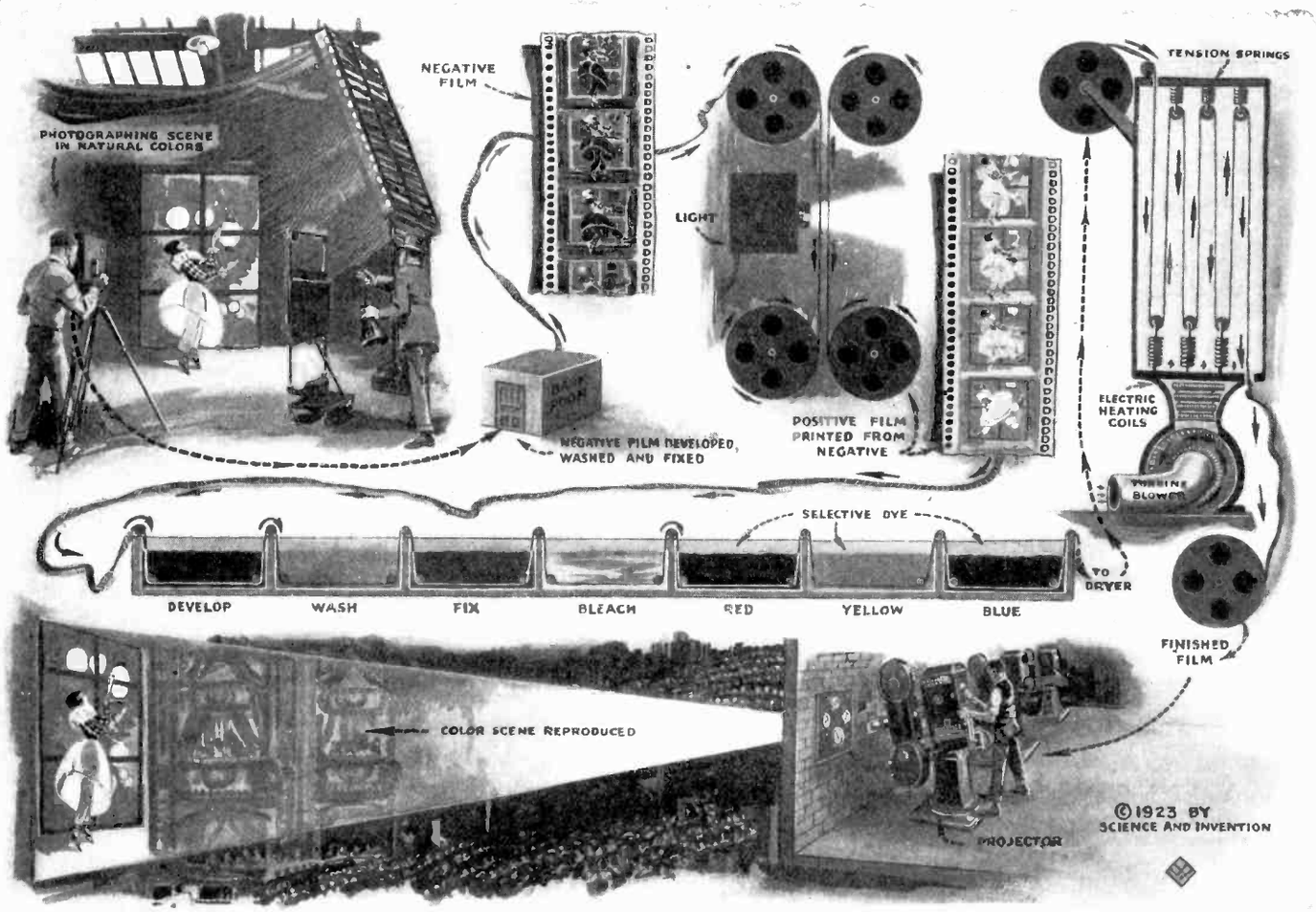
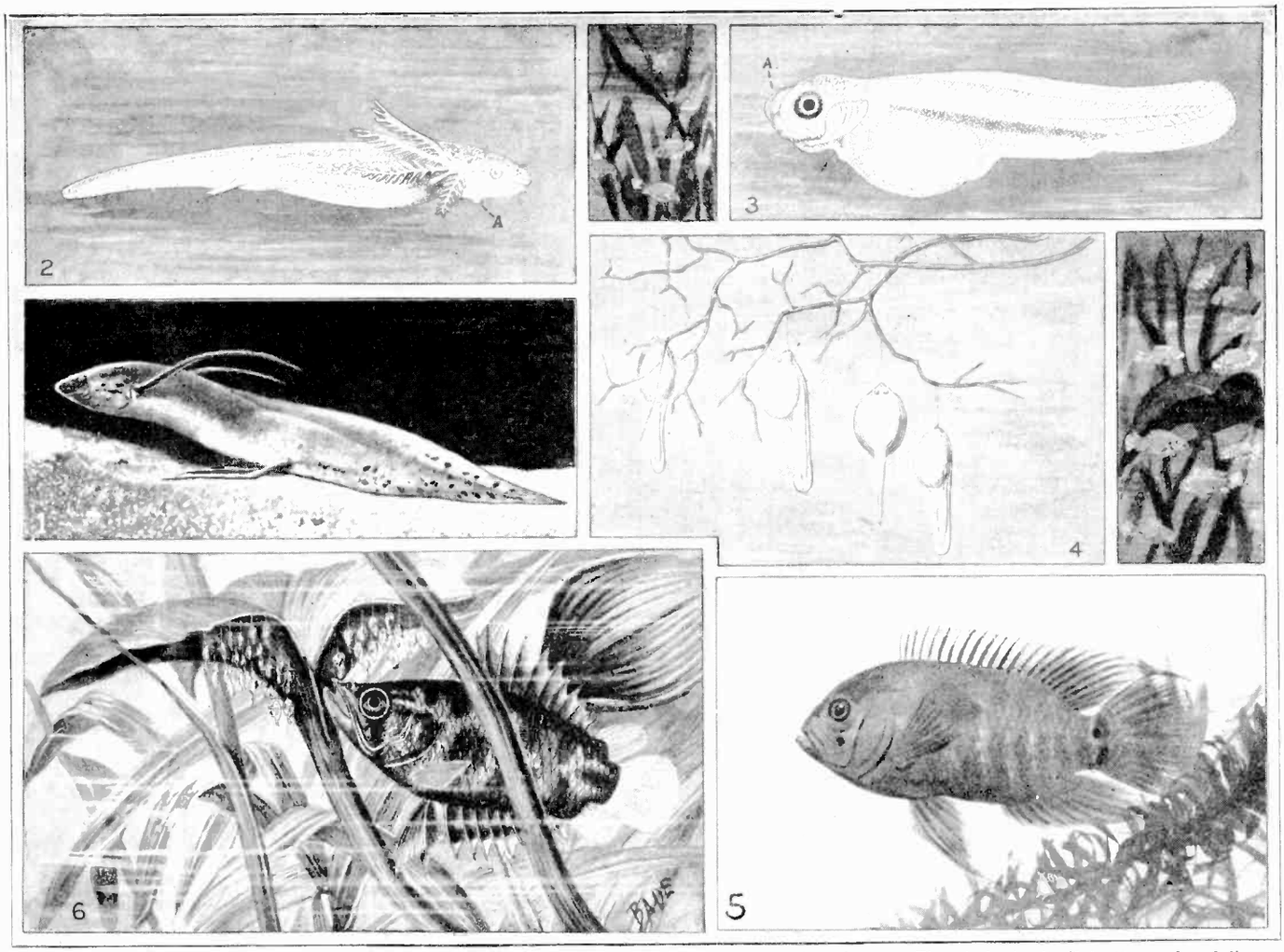


There are several colored movie production schemes now in use which give satisfaction, both with regard to the output and the quality of pictures, but it has remained for Mr. Loren Taylor, a motion picture scientist, to evolve the process here shown, which is at once the simplest and the fastest color movie production method yet evolved. The pictures are taken with an ordinary movie camera with standard negative film. This film after developing, washing and fixing, is passed through the printing machine, and as many black and white positive films produced as are needed. These positive films are then passed through the bleaching and dyeing baths as shown, the various black and white tone values absorbing the proper dyes as the film passes through the successive baths. The film is projected in a standard machine and the films are remarkable for their clearness, there being no fringing of the colors whatever.



1—The lung-fish Protopterus, is able to breathe air directly, as the places in which it lives often dry out. Then it buries itself in the mud and lives by respiration of the air. 2—The young of Lepidosiren, another lung-fish, have their cement organ on the under side of their head at A. They also have a strikingly amphibian characteristic in that they have large external gills. 3—A is the large adhesive cement organ borne on the front of the head of the characin, Sarcodoces odoe. 4—The larvae of Hyperopisus bebe hung from rootlets in the nest by means of threads coming from the cement organ to keep the breathing organ free from mud and to provide them with fresh air. 5—Acara bimaculata, a fish now often kept by fanciers, also hangs up its young ones: it is a native of South America and attains a length of four inches. 6—A very peculiar fellow is Polycentropsis abbreviata. It hangs the eggs on the under surface of some aquatic leaf. The young, recently hatched fry, hang from the leaf by means of a short thread and are further cared for, and protected, by the male.

Fish Hang Up Young to Ripen

By Dr. ERNEST BADE

NATURE often follows peculiar paths to reach its goal. Its inventive genius is unsurpassed. Obstacles are surmounted with such ease and such apparent simplicity just as if they did not exist. And then it makes no difference whether she makes a little side trip now and then to while away an idle hour and get out of the rut of her daily monotonous existence: all that she desires is to accomplish her final task. Then the will to live lights its lantern, as Schopenhauer has pointedly exclaimed, and it is this will to live which finds a way, under certain condition, for existence to be made a possibility.

The meaning of the expression of life, is, everywhere in organic nature, combined with the immutable law of the variation of the individual and this variation together with heredity form the basic principles in the theory of development. Otherwise new properties and characteristics could not have been made a possibility, and without the law of heredity it could not have been retained and passed on to other generations who not only have kept it, but perfected it still further.

Although variation of the individual is a primary characteristic of life, the force of self-preservation and reproduction of the species must be added. Every animated being feels this force, every individual attempts to push the other fellow against the wall, every species fights for its right to exist. Each change and each new characteristic and property inherited or variability attained, is employed in its battles. And so, through the ages, each species develops its progeny with better adapted weapons. It is, and will remain, a war of all against all, for war is here a better development, an approach towards the perfect and ideal, a fight for higher attainments.

In tropical and subtropical regions where spring with its rainy season is followed by long dry spells which completely destroy the rivers with their tributaries and entirely evaporate both ponds and pools, so that the deep beds of mud and muck are baked to hard and stone-like masses which, under the powerful rays of the scorching sun, crack into fissures and divide into crumbling plates, the aquatic animals must develop peculiar structures in order to keep themselves, as well as their progeny, alive. The bottom of the inhabited ponds, as long as they are filled with water, consists of a dust-like muck, which, on the slightest disturbance, rises in dense clouds only to settle slowly back again, covering the green waterplants with dirt and entering the delicate respiratory organs of the animals, so that the younger and more sensitive creatures would suffocate if they were not protected in some ingenious manner. This is the reason that a kind of parental care has been devised by the fish inhabitants. It is in the building of nests that it is manifested and it is this practise which keeps the spawn and the young clean and also protects them from disappearing into the mud.

Such builders and protectors of the helpless young are the Cichlids or Chromids, native to the tropical regions of both Africa and South America. There are numerous species, and to differentiate one from the other is an exceedingly difficult problem, for with slight and almost imperceptible gradations, they blend into the various species. It is even troublesome to distinguish the genera, especially when they inhabit large, closed-in lakes where they have split into numerous races but whose individual characteristics are not, as yet, firmly established. It is during comparatively recent times that all these many forms have been developed, and this change is by no means completed.

The parental care in some of these species is very peculiar. *Acara festiva*, a beautiful fish from the Amazon, deposits its eggs on flat surfaces which have been previously cleaned by it. The young emerge about two days later: sometimes they are helped from the membraneous shell by the parents and

(*Continued on page* 1137)

Recovering Sunken Treasures

A NEW device for salvaging sunken ships has lately been brought to the attention of marine engineers. This is the apparatus designed by Dr. C. W. Eveleth, in which (although the details have not been completely worked out, inasmuch as they would differ with regard to the size of the various parts, depending upon the ships which are to be salvaged), many ingenious features are presented. To overcome some of the difficulties found in various other salvaging schemes, Dr. Eveleth has designed a steel frame supported on either side by spherical pontoons. These are connected together by means of a bridgelike structure. A super-structure attached to this houses the machinery for inflating and deflating the steel tanks, so as to cause them to rise or submerge, as desired by the operator. This super-structure is completely enclosed and is fitted with the necessary safety air-valves, so that it will not be submerged accidentally. The pontoon unit in operation is submerged below all wave motion. In addition to the regular pontoons, the structure is provided with jacks attached to it. These are operated under air or water pressure. The jacks themselves actuate winches and the winches in turn are connected by means of cables to the lifting members surrounding the sunken vessel, which will be presently described. Safety valves operating the powerful lifting jacks, prevent more pressure being applied to them than the tensile strength of the cable will stand, consequently, the cable will not break.

Although various methods have been devised for fastening bolts and cables to the sides of a vessel, most of the inventors have assumed that the vessel is lying on an even

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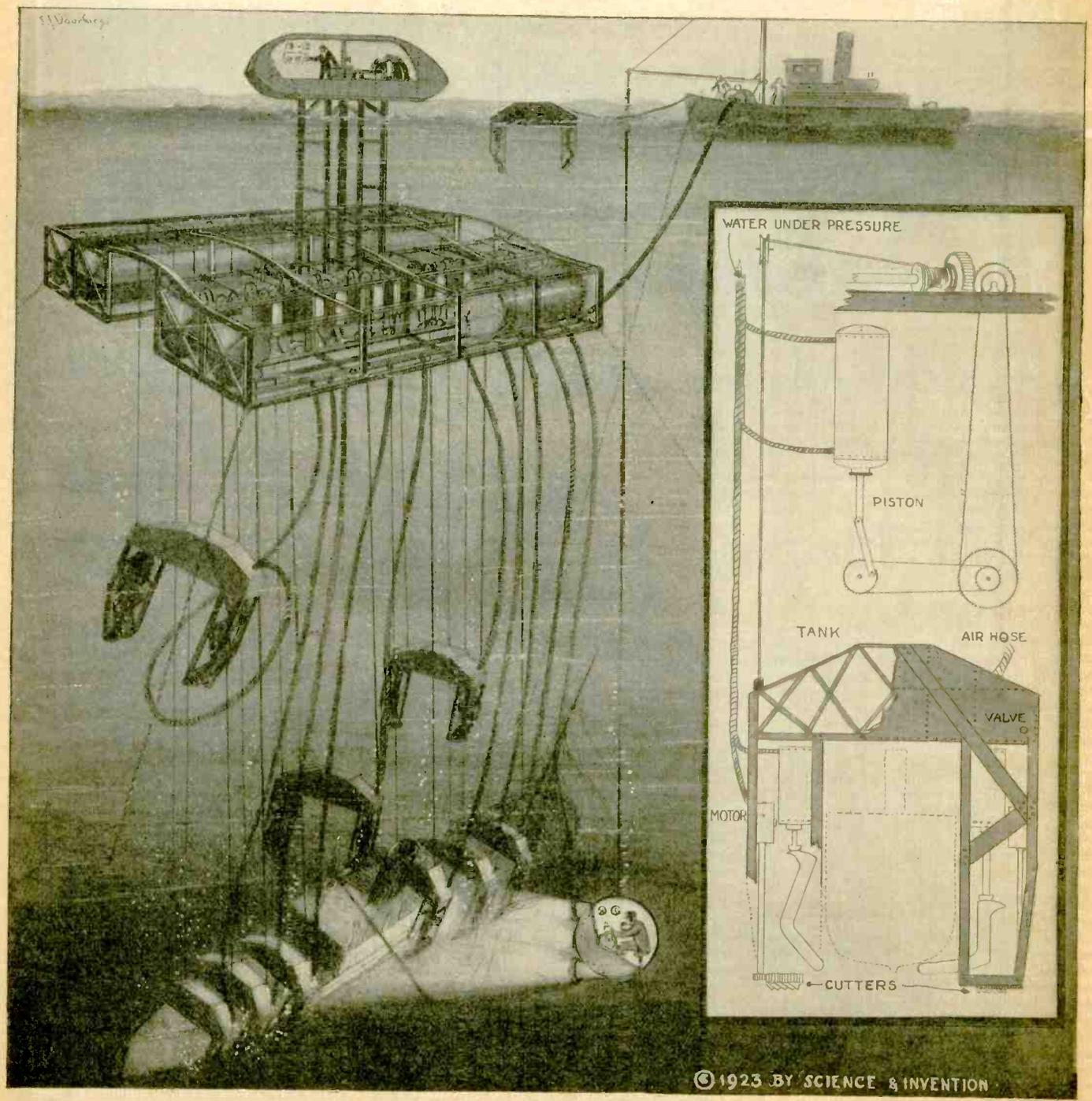
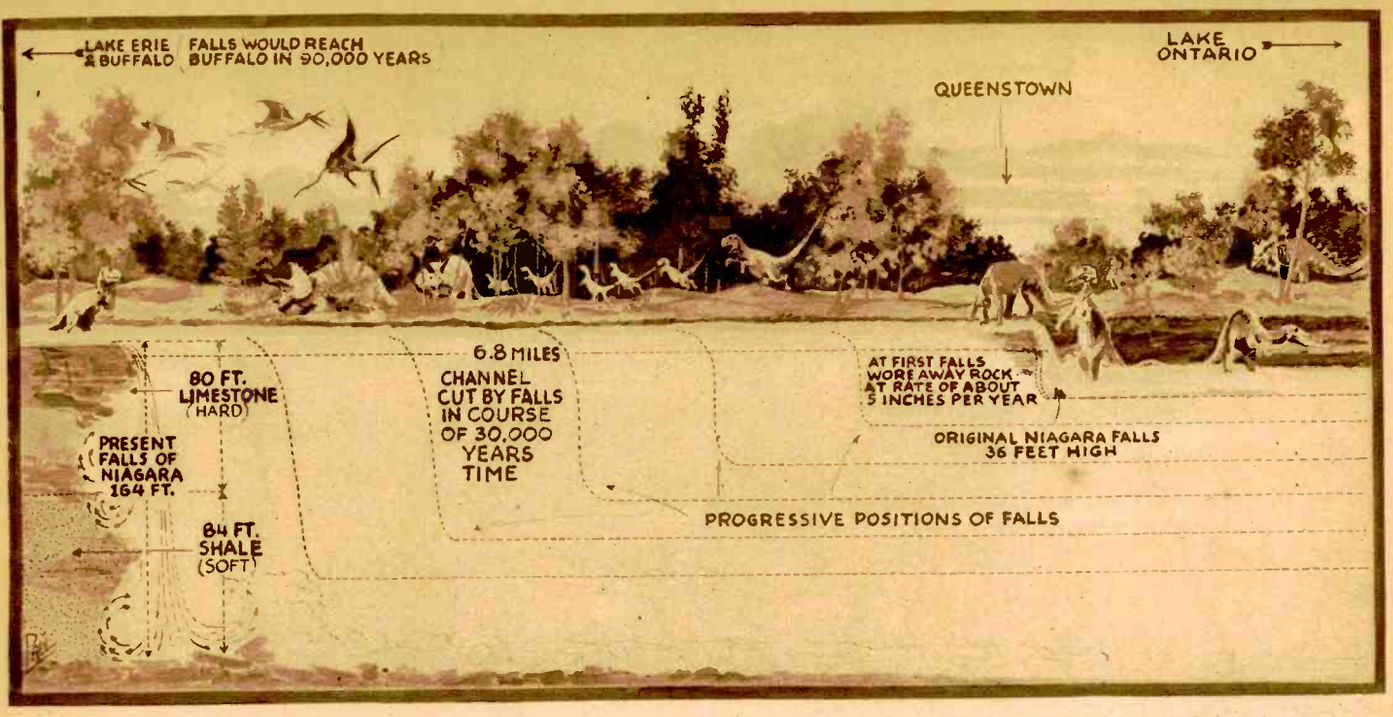


Without a doubt the greatest dream of inventors today takes the form of some machine, device or system, for recovering the treasure in sunken ships, or else for raising the ships themselves, so as to recover the cargo as well as the hulls and engines. One of the latest ideas designed by a New York inventor, Dr. C. W. Eveleth, is shown in the above illustration. The main scheme advocated by this inventor lies in the use of a series of large U-shaped saddles, which are lowered individually over the ship, once it is located, and sliding fingers on each saddle are caused to pass under the boat, so that when all of the cables and saddles are lifted by the buoyant pontoons, the ship will be lifted also.



Geologists have attempted to calculate the age of the world, based on the time required for Niagara Falls to cut the gorge that stretches away from the present great cataract, measuring some 164 feet in height and which, according to scientists, measured about 36 feet in height 30,000 years ago. Mr. Paul has illustrated herewith some of the pre-historic animals which no doubt inhabited the country along the Niagara River in the early days of this great waterfall.

How Old Is the World?

By HARRY VAN DEMARK

A SCIENTIST—I believe it was Garrett P. Serviss—once remarked that it is as hard to find out the age of the earth as it is to ascertain the age of a woman.

In both cases, however, wrinkles tell, and it is only the number of years that remains in question. Geologists assure us that the earth is very, very old, but when we ask them to set down its age in centuries, or millennia, or periods of millions of years, they shake their heads and simply reply:

"Its age includes many ages, but we cannot tell the length of any of them, not even of the latest and shortest, which is the Age of Man."

Still, some geologists are not averse to guessing on this subject, occasionally, and some of these guesses are very interesting. One California geologist did not attempt to fix the whole age of the earth, but only that of the wrinkle on its face known as the Sierra Nevada Mountains. Those mountains, he says, are about three million years old.

He reaches this conclusion by a study of the changes that have taken place on the face of the earth in California since the Sierra Nevada Range began to assume its present form. From the observed rates of erosion, and other natural processes affecting the rocks, he deduces the number of years that have elapsed since the commencement of the changes.

All of which recalls the method by which geologists have determined the time required for Niagara Falls to carve out the gorge that stretches away from the foot of the great cataract—though with no great accuracy or agreement of estimates.

As a matter of fact, the data for such a calculation appear to be much more definite and certain in the case of Niagara than in that of the Sierra Nevadas, and yet for the work of the Falls the estimates of time vary from twelve thousand to thirty-six thousand years. At the most, however, it will be observed that Niagara is very youthful, when compared with the great Californian mountain range, just as the latter appears a mere infant when its age is measured with that of the Laurentian Range of Canada, which has been worn down in the course of ages almost to the root.

The Sierra Nevadas, however, have had a double life. There was an older mountain range on their site which perished, the scientists tell us; perished before the present range with serrated peaks and precipitous chasms was thrust upward like a young tree springing from the stump of its fallen ancestor.

When we study the subject, there seems something almost lifelike in the growth of mountains; they do not attain their maximum stature all at a leap. The first great uplift of the Sierras, the geologist thinks, elevated the range about 2,500 feet. Even that took time, while the giant pressures were at work. Vast periods also elapsed while the growing mountains swelled upward to their culmination of fourteen or fifteen thousand feet. Perhaps they are still growing, though such growth would be inappreciable by the naked eye.

Age has its common marks everywhere. Just as an old man stoops, shrinks in stature, becomes round-shouldered, so a time-worn mountain loses its aspiring peaks, smooths down its jagged outlines, rounds off its steep slopes, sinking lower and lower under constant wear of the elements, until only a line of green-carpeted hills remains to mark the place where once tremendous summits rose into the region of perpetual snow and flashed back the sunshine from a crown of glaciers.

It seems relatively an easy task to calculate the age of a mountain range which, like the Sierra Nevadas, had a new birth at the beginning of quarternary time, the latest period in the geological history of our planet. It would be far more difficult to apply the measuring tape of the centuries to the great Appalachian Range, which lies just beyond our Atlantic seaboard.

The Appalachians date back to the remote carboniferous age, which ended so long ago that nobody, probably, would be willing to hazard a guess at the number of millions of years which have since elapsed. The Appalachians may have been magnificent giants in their day, such as the rugged sky-piercing Rockies, but time has conquered them as it will conquer the Sierras, and now their verdured flanks and tops delight the unalarmed eyes of railway tourists, winding on swift trains of steel cars through the rich valleys that have fattened on the substance of the disintegrated peaks.

To quote from Mr. Serviss: "The glory of a sun is gone when it passes from light to darkness, from solar incandescence to planetary opacity."

Likewise, the splendor of life for a mountain departs when it sinks from white to green, and from the abode of snow to the levels of grass and verdure.

Dr. R. Lotze, in his new work *Jahreszahlen der Erdgeschichte* (Yearly Almanac of the Earth's Transformations), says:

"We will now turn to North America, the third greatest source and the third great scene of glacial activity, which, like North Europe, was covered under a huge mass of inland ice. As the ice disappeared, which must have occurred at the same time as in Europe, little by little the region of the Great Lakes of the present day became free of ice; their water had to seek the sea. Between the Erie and the lower level of Lake Ontario, a waterfall formed, and poured over the intervening declivity. This was the beginning of Niagara Falls. By the wearing action of the falling water, the weaker strata at the bottom of the falls were washed away, so that the upper harder strata had to fall.

"In this way the waterfall cut its way constantly backwards into the rocky layer, and even today it is working its way back toward Lake Erie. In the course of time, it has cut away a channel 11.3 kilometers long or about 6.8 miles, which in its various parts shows clearly the history of its production. Originally the falls were only 11

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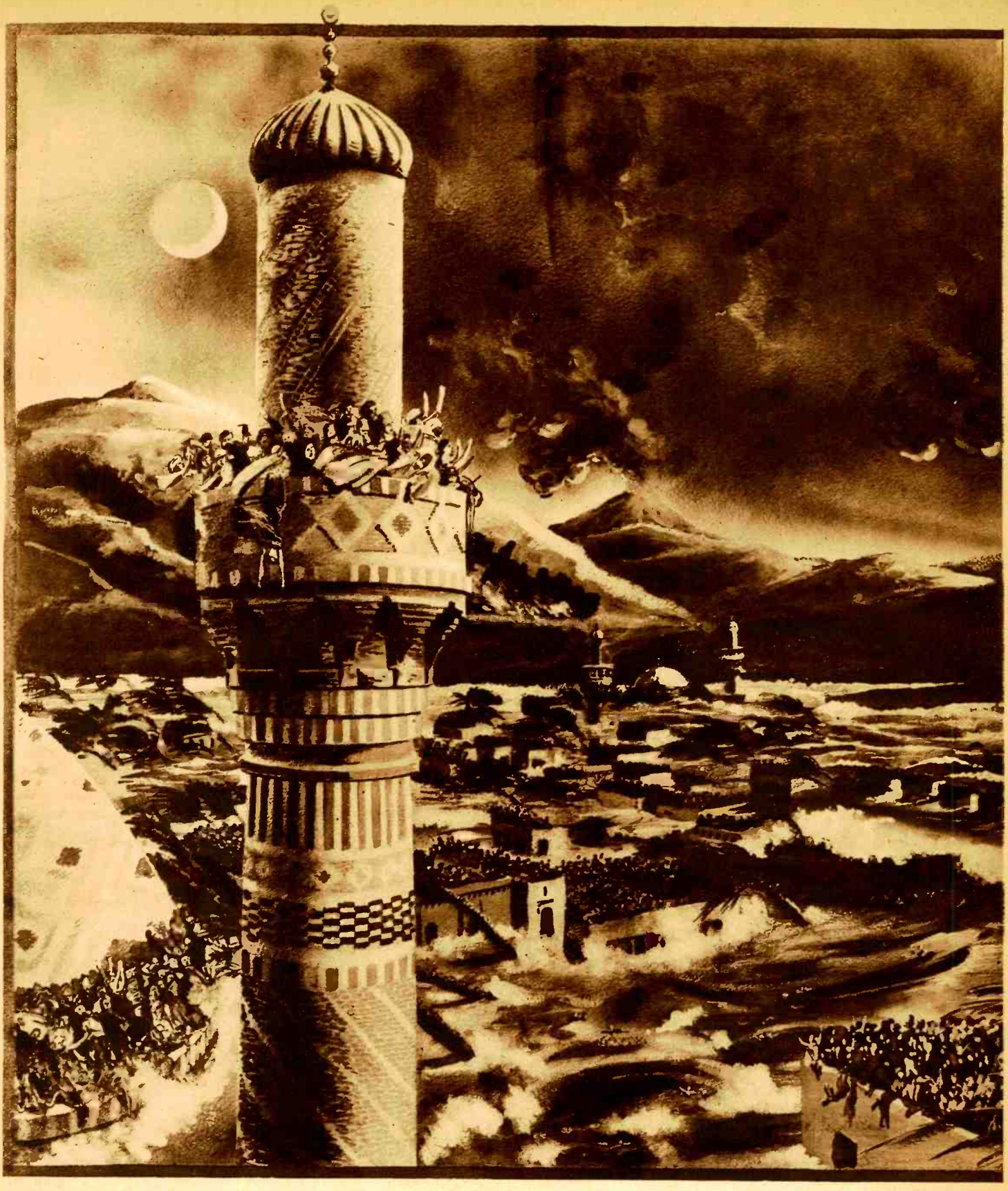

The Star

By H. G. WELLS

IT was on the first day of the new year that the announcement was made, almost simultaneously from three observatories, that the motion of the planet Neptune, the outermost of all the planets that wheeled about the sun, had become erratic. Ogilvy had already called attention to a suspected retardation in its velocity in December. Such a piece of news was scarcely calculated to interest a world the greater portion of whose inhabitants were unaware of the existence of the planet Neptune, nor outside the astronomical profession did the subsequent discovery of a faint remote speck of light in the region of the perturbed planet cause any great excitement.

Scientific people, however, found the in-

" . . . Above were the lava, hot gases, and ash, and below the seething floods, and the whole earth swayed and rumbled with the earthquake shocks. Soon the immemorial snows of Tibet and the Himalayas were melting and pouring down by ten million deepening converging channels upon the plains of Burma and Hindustan. The tangled summits of the Indian jungles were aflame in a thousand places, and below the hurrying waters around the stems were dark objects that struggled feebly and reflected the blood red tongues of fire. . . . "

telligence remarkable enough, even before it became known that the new body was rapidly growing larger and brighter, that its motion was quite different from the orderly progress of the planets and that the deflection of Neptune and its satellite was becoming now of an unprecedented kind.

Few people without a training in science can realize the huge isolation of the solar system. The sun with its specks of planets, its dust of planetoids, and its impalpable comets swims in a vacant immensity that almost defeats the imagination. Beyond the orbit of Neptune there is space, vacant so far as human observation has penetrated, without warmth or light or sound, blank emptiness, for twenty billion times a million miles. That is the smallest estimate of the distance to be traversed before the nearest of the stars is attained. And, saving a few comets, more unsubstantial than the thinnest flame, no matter had ever to human knowledge crossed this gulf of space, until early in the twentieth century this strange wanderer appeared.

A vast mass of matter it was, bulky,

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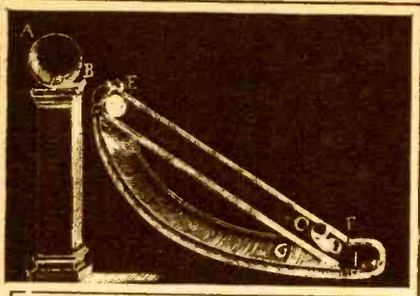
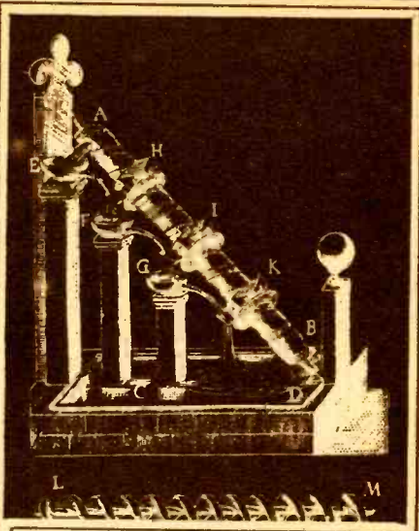
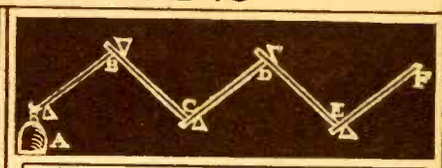
ANCIENT MECHANICS



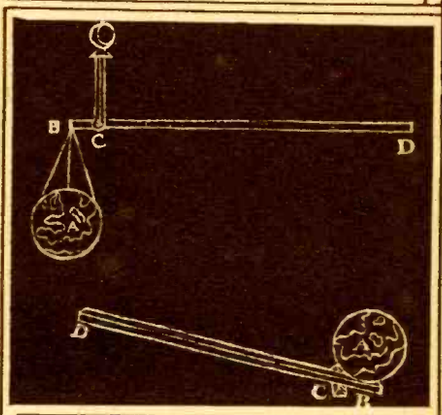
An attempt at perpetual motion. The ball, C, is supposed to be drawn up by the magnet, A, to return to the bottom and be drawn up again repeatedly.



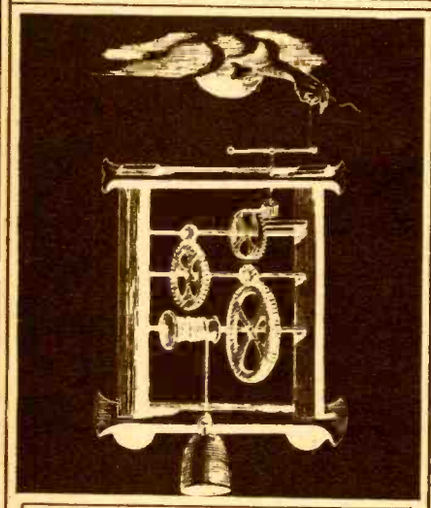
The Bishop's own conception of perpetual motion, based on Archimedes' screw, only it did not work.



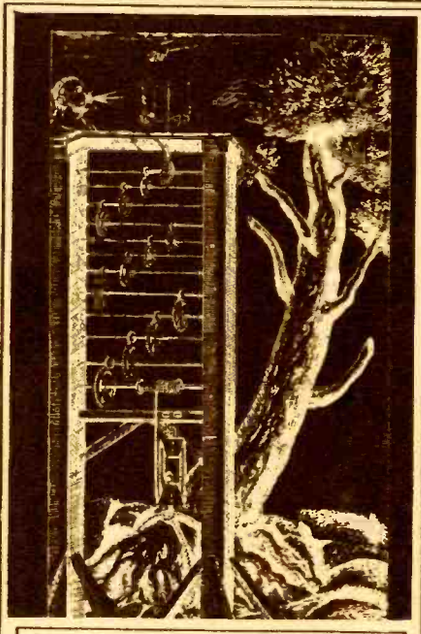
An example of the compound lever, as given in the strange old treatise.



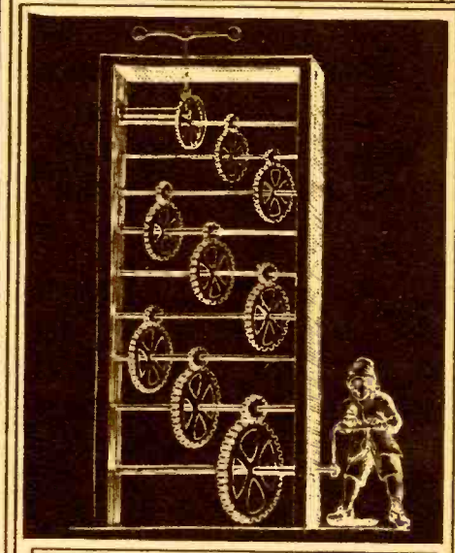
Moving the world and weighing the world. The diagrams illustrate Archimedes' boast about the lever.



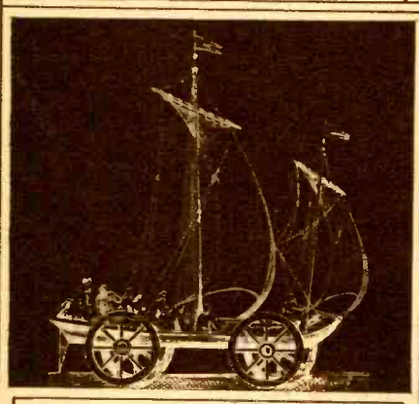
The Bishop's train of wheels, a trivial force raising a great weight.



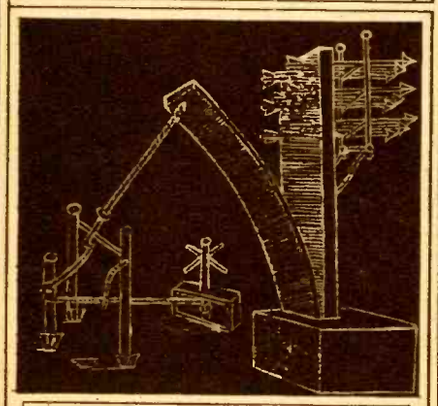
Uprooting a tree by the human breath. What about the friction?



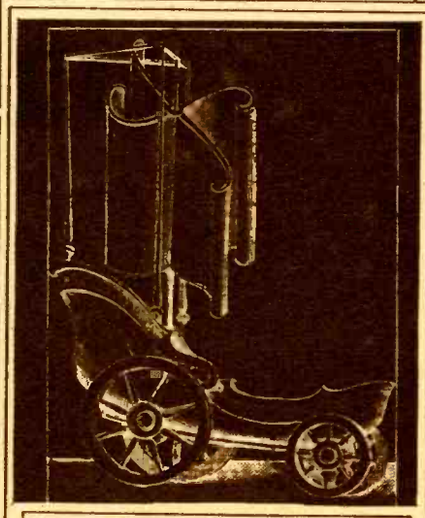
The attainment of the velocity of the celestial bodies by a train of gear wheels.



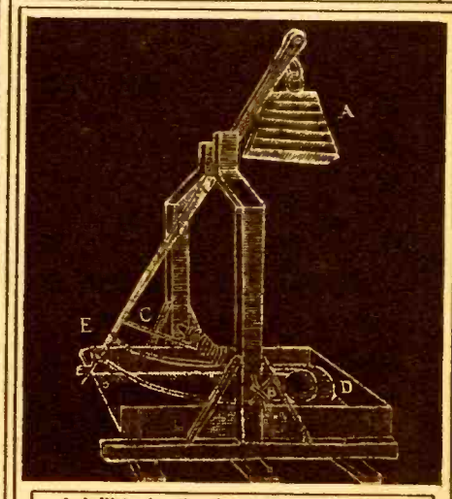
A sailing chariot which was used on the Holland beaches.



A catapult discharging a flock of arrows; a machine-gun of former generations.



Bishop Wilkin's idea of an improved sailing chariot.



A ballista for throwing great stones. Sometimes human heads or bodies were used as projectiles.

Bishop Wilkin's Mathematical Magic

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

READERS of the amiable Evelyn's diary, and those who have perused the less amiable Pepy's diary, will have encountered several times the name of Bishop John Wilkins, who was born in 1640, and died in 1672, and attaining promotion in the church of England, eventually became Bishop of Chester. Besides his activities in the line of his religion, he was greatly interested in natural science, and he with Evelyn figures among the founders of the Royal Society of Great Britain, one of the leading scientific societies of the world. When twenty-four years old, he published an odd little book which now is a great curiosity, kept in the Reserve Department of the New York Public Library, on the subject of the moon. He claimed that there was every reason to believe that the moon was inhabited, and even seemed to think that there was a possibility of mankind traveling to the moon. This little book gave him considerable celebrity. He also discussed the topic as to whether the earth was a planet. But when we get to another of his works, "Mathematical Magick," also a very small book, but illustrated with a number of engravings, we get at quite an interesting lot of material. On the opposite page we have reproduced some of the illustrations shown in this treatise, in which he investigates many things, including perpetual motion, the mechanical powers, sailing chariots, catapults, ballistae, which subjects we specially name here, because the illustrations appear opposite.

One attempt at perpetual motion is shown, in which a magnetized ball is supposed to draw another free iron ball up an inclined plane, and when the latter reaches its top it is supposed to fall through a hole therein, the magnet being unable to keep it up any longer, and to return to the foot of the inclined plane, to be drawn up again by the magnet. This of course is a very crude attempt and absolutely futile. In a later page he describes an Archimedes hydraulic screw, which by turning draws water up to its top, and which water is discharged into water wheels, which are supposed to turn the screw. He got quite excited about this he says, and felt like calling out with Archimedes, "I have found it! I have found it!" But, he says, when he came to look into it, he found that it too would not work.

We now come to some of his mechanical powers. He shows a set of levers arranged in quite a curious zig-zag fashion, with each one of the power arms ten times as long as the resistance arm. We can go right down the line and find an enormous increase, and this is what interested him. Returning now to his friend, Archimedes, of whom he speaks quite often, he illustrates the proposition by which the sage of Syracuse said he could move the world on the end of a lever, and shows the world on a steelyard about to be weighed. So much for the lever.

Now we come to his trains of wheels. These he calculates out on the basis of the large gear being ten times the diameter of the small. So again he goes down the line, multiplying by ten, and shows that a man by the least force exercised upon a handle, can raise a great weight. And he goes further than this. With a very large train of wheels, he shows a man pulling a tree up by the roots, by simply blowing against a windmill which turns the gears. Going to the other end of things, he shows how by placing a man at the other end, and turning a handle, a great velocity can be imported to the vane at the top of this gearing, and he figures out that at a thousand turns per hour at the man's end, the vane at the top could be made to move as regards its extremities with the speed of the celestial bodies.

He describes a sailing chariot shown here, which was used on the beaches of Holland. He says it ran from Sceveling to Puttem, a distance of over forty-two miles, in two hours, which he regards as an enormous speed, making a running man seem to move backwards. He made a proposal for a chariot to be operated by a wind mill, and we give a reproduction of his design for this.

He discusses the weapons of the ancients, and those of his own era, and says the catapult, an engraving of which from his book is reproduced on the opposite page, was used to shoot arrows sometimes in various directions, sometimes all at one point, and shows how by releasing the elastic board, a flock of arrows could be sent against the enemy. The ballista he says, on the other hand, was used for throwing stones, and gives us a construction of that implement, which is shown here in reproduction also. This he regards as a very wonderful affair. He says that the biggest shot fired by modern guns, in Europe at least, weighs 64 pounds, while the ballista could throw mill stones and tomb stones, weighing up to 360 pounds, and Archimedes is credited with discharging 1200 pound stones. He says that the combatants used sometimes to put men's heads or bodies into the ballista and discharge these into the town they were besieging.

He now comes to the Turks, and says that they had a cannon which would fire a 1200 pound projectile and it took 150 yoke of oxen to draw it about. Referring to arrows, he has some curious stories. He says that the arrows from the catapult were sometimes ignited from the friction of the air, so that they burned. He tells wonderful stories of the Turkish archers; of their arrows penetrating thick wood and iron plates. He quotes an earlier author, C. Mersenns, telling of a wonderful air gun, which at a distance of twenty-four paces would flatten a leaden bullet against a plate of iron, and he cites also a curious old theory, that arrows and bullets had their greatest penetrating force at a good distance from the muzzle of the gun, which of course is absolutely false, although he takes it as matter of general knowledge.

Two other things greatly interested our Bishop, flying and the submarine. He believed very properly that if an aviator got high enough in space the earth's attraction would cease, which certainly would facilitate the flying process. He says, "flying so generally derided—being esteemed only as the dreams of a melancholy and distempered fancy". This makes curious reading for us, when we can remember how Professor Langley failed to receive adequate or even serious support in his pioneer work in aviation. Our Bishop refers also to Burton who in his famous *"Anatomy of Melancholy"*, has stated: "Some new fangled wit ('tis his cynical phrase) will sometime or other find out this art."

A writer in Blackwood's Magazine of July, 1917, is a little hard on the Bishop. He is inclined to make fun of his long rows of ciphers, which he had to use to express his multiplication of force by his gear wheels. So when Bishop Wilkins begins to describe the possibility of submarine work, he tells of nothing he himself has done, but has to go back to the work of Cornelius Drebbel, born in the sixteenth century in Holland, who is said to have gone under water in the Thames, from Westminster to Greenwich. He is said to have purified the air by a liquid, surmised to have been cream of lime, and the Bishop describes how by a sort of leather bag, the submarine could be entered under water or a person could leave. The bag being fastened tightly in advance of the person first, it would then be tied tightly behind him, and finally by releasing the outer fastening he could emerge, and swim to the surface. Similar bags were to be used for the oars, for the helical propeller had to wait nearly three centuries for its invention.

On one of the copies of *Mathematical Magick* in the New York Public Library some oldtime reader has inscribed his views concerning the Bishop's gears and trains. The faded inscription is only partly legible reading "Good Bishop pray allow some . . . . . for friction."

The Ever-Changing Gulf Stream

It has been reported by mariners recently that the Gulf Stream was 30 miles nearer shore than it was 10 months ago. This immediately started up the weather prophets, who now claim that the recent hot spell experienced along the east coast, and especially in New England, can be blamed upon the nearness of the gulf current.

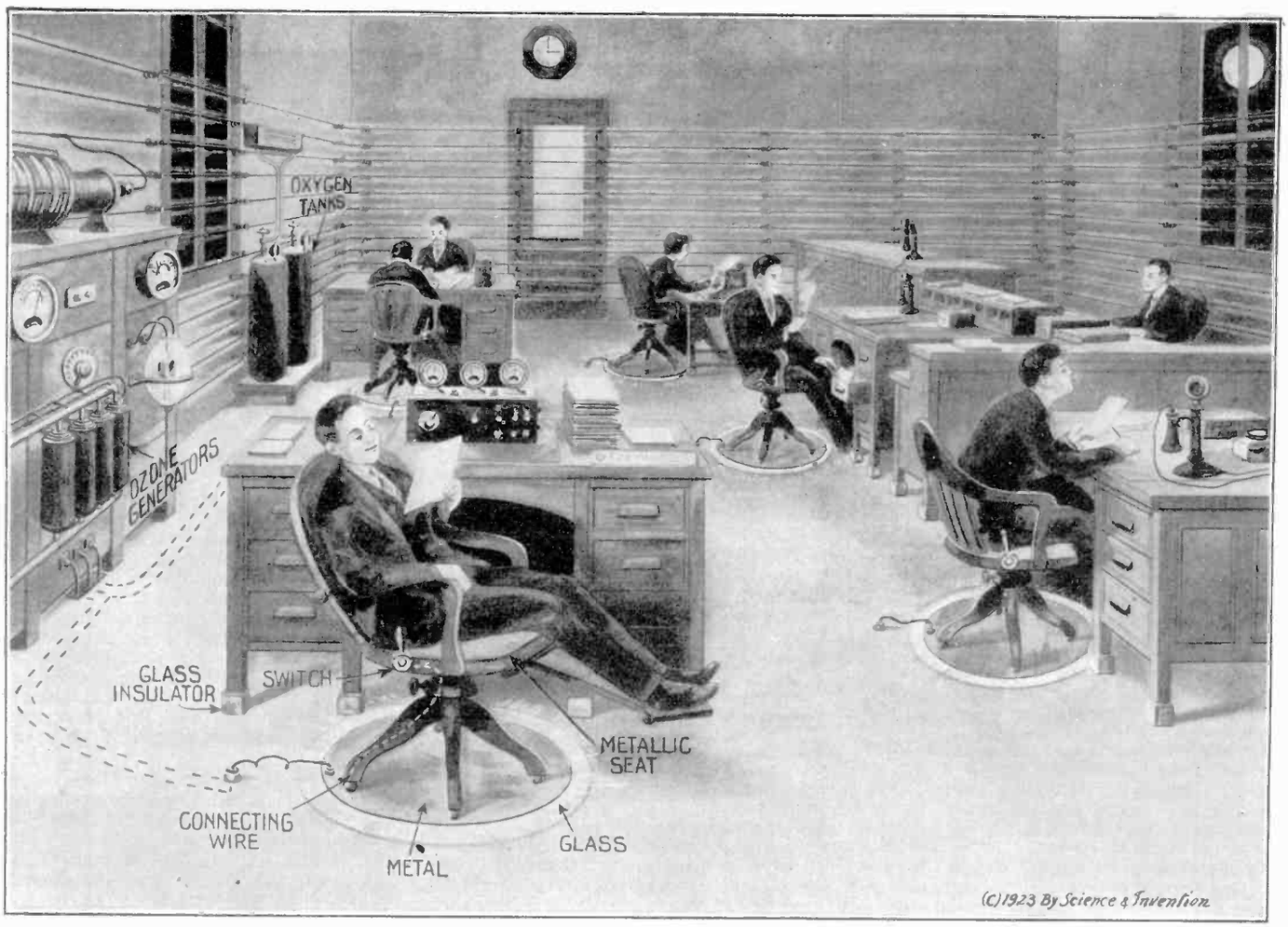
The French scientists claim that the United States are creating a tropical New England and making England and France frigid. The trouble, according to the Frenchmen, lies in an innocent little railroad, built several years ago from Florida out to the Florida Keys. It was built on a trestle with loopholes left between the islands whereever there was an appreciable current.

An authority, Commander Brown, head of the Navy Hydrographic Bureau of Boston, says that the Gulf Stream does not touch New England. It heads out to sea below Nantucket, and only affects people from Boston when they go fishing off the Grand Banks. What influences the New England coast, the commander states, is a branch of the Labrador current swinging counterclockwise from Newfoundland. Accordingly, if the Gulf Stream does change, it could have small effect on New England. Furthermore, western Europe has not had weather recently that could be laid to a change in the stream. England had a rainy summer, which is the normal result of the Gulf Stream being right on the job.

Three factors influence the course of the Gulf Stream. The first and most important of these is the high declination of the moon. The second cause would be a high barometer in the north Atlantic and a low barometer in the south. The combination changes the course of the stream by reducing its rate from two knots per hour to one or one and a half knots per hour. The trade winds off the south of Cuba would be a result of this. The third cause of a change in the stream would be an unusual storm.

The Navy Department, having examined all the available facts, believes that the Frenchmen's theories are unfounded.

Contributed by J. WARREN BARNABY.



The Sleep Eliminator as installed in a modern newspaper office. Mr. Gernsback, in his article, suggests, in order to eliminate sleep, to remove the cause. The cause of sleep is increased blood pressure, also certain changes in nerve cells after the body has performed a certain amount of work during the day. These causes are removed by D'Arsonval currents, which are set up in a huge electric coil, strung along the walls of the office as seen. These currents, as is well known, reduce the blood pressure. The oxygen, as well as the ozone with which the air is charged in small quantities helps to rejuvenate the system. A secondary electrical system gives the nerves certain rhythmic shocks, almost imperceptible to the subject. These are used to stimulate the nerve cells that have become sluggish. It is thought that by these means sleep can and will be eliminated entirely.

The Sleep Eliminator

By H. GERNSBACK

Member American Physical Society

COMING INVENTIONS NO. 8

ONE of the most ancient and universally-known phase, not only of human existence, but of almost the entire animal world, is *sleep*. It is such a habit with us that we never give it the slightest thought, and we do not bother our heads much about it, unless we suffer from insomnia or if important work keeps us up, perforce, when we are trying to fight off sleep.

But what is sleep itself? No one knows exactly. There are many theories of sleep today, the best known being the following: the Chemical, the Circulatory, and the Histological.

The *Chemical* theory mainly has to do with auto-intoxication. This theory is based upon the fact that certain products of decomposition of living substances influence the continuance of cell activity, but recent researches in the bacteriological laboratory have proved that while the body is working during the day's activites certain ptomaines are formed in the human system more rapidly than they can be oxidized and eliminated. It is maintained that while we sleep, such poisons gradually become oxidized and are thus removed from the blood.

The *Circulatory* theory has to do with congestion of the blood vessels. It is a theory no longer accepted by scientists.

The *Histological* theory has to do with the nature of the nerve cell, because microscopic examination has shown conclusively that such nerve cells have different chemical properties when the body is in a waking or in a sleeping or fatigued conditon.

Other outstanding phenomena, characteristic of actual sleep, are full relaxation of nearly all the muscles of the body; slow and rhythmic, as well as deep breathing; a slow and weak pulse, and considerably lessened arterial pressure.

But is sleep really necessary, and could man or animal do without it? The answer must be in the affirmative, once we discover just the exact reasons why sleep takes place.

We find, for instance, that protozoa and other simple forms of life seem to dispense with sleep, without any trouble. Many fish, for instance, do not sleep, and while their activities may not be the same at all time, they do not seem to know what sleep, as we know it, really is.

In other words, sleep is a habit formed by human beings, mainly due to astronomical reasons. If the sun had been shining upon the earth constantly we probably would not know now what sleep is. For one part of the day we have light; for the other part, darkness. After sundown it is no longer possible to see, and the caveman and our other ancestors simply lay down and formed the habit of sleeping until the sun came up again. That this is a true statement is best proved by the fact that as soon as artificial lighting appeared, the human race no longer needed as much sleep as did our cave ancestors. Even as recently as 500 years ago, people went to sleep at sundown and got up when the sun rose. That means an average of ten to twelve hours sleep. The modern human being gets along comfortably with from six to eight hours, as his artificial light keeps him awake, and the less he works physically the less sleep he needs.

Naturally this statement does not hold true of a laborer or a man who performs great physical exertions during the waking hours. Such a man becomes really fatigued and his blood pressure during the night time must be brought to normal, and his nerve cells must be regenerated once more.

But we are safe in saying that if the human race continues as it does now with artificial light during the entire night, a time will come, in 10,000 or perhaps 50,000 years, when sleep will be required no longer.

Edison, a few years ago, made some very striking observations when it was necessary to work literally day and night in his laboratory. He selected a number of young men

(*Continued on page* 1114)

Waterproofing and Mothproofing by Electricity

By ISMAR GINSBERG, B. Sc., Chem. Eng.

THERE are four important textile fibers, cotton, wool, silk and linen. While they differ in origin, structure and properties, they all possess one characteristic in common, albeit in different degrees, and that is permeability to moisture. Water will penetrate through their structure and naturally through the fabrics woven from them. This fundamental property of the fibers gives rise to a definite disadvantage in the fabrics themselves. The wearer cannot keep dry in water-pervious garments when exposed to rain; non-waterproof fabrics will not keep out the rain, when used as protective coverings, as in tarpaulins, in tents, etc.

Ever since this disadvantage in the fabrics was first recognized, attempts have been made to overcome it. It was found that when the textile cloth was impregnated with India rubber, the product was waterproof, but unfortunately it became air-proof as well. Those of us, who have worn rubber raincoats on a warm day, know how uncomfortable they can be. It was also discovered that chemicals could be used in producing a water-proofing effect in fabrics. This consisted essentially in depositing an insoluble soap on the fibers, by first impregnating them with soluble soap solution and then precipitating, that is, throwing down the insoluble soap by acting on the impregnated cloth with a solution of a proper chemical. Such waterproofing, commonly known as chemical waterproofing, is merely a superficial treatment, for the film of waterproofing material lies on the surface of fibers only and is soon either worn off or washed away.

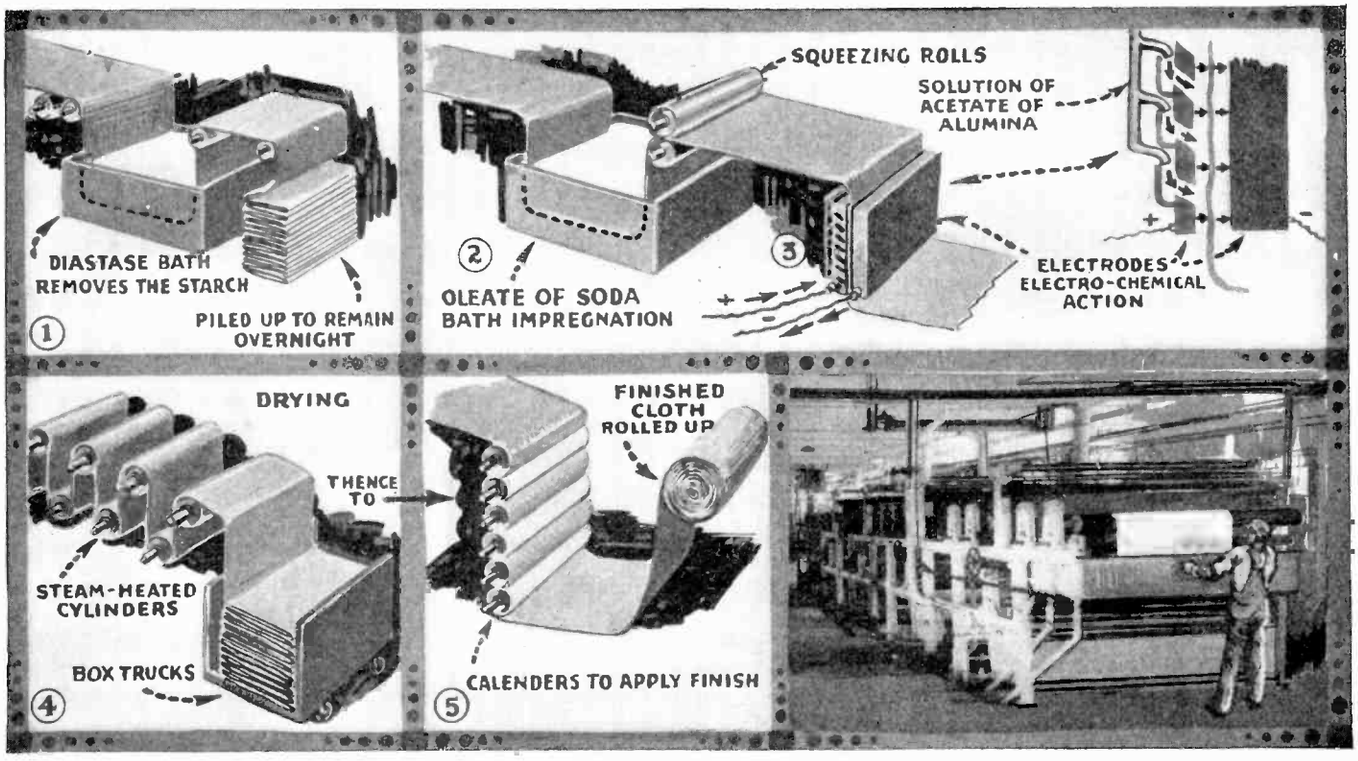
The process of waterproofing textile fabrics with the aid of the electric current combines all the advantageous waterproofing effects of the rubberizing process, and still gives a fabric which is ventilating, which allows air to pass through it, while resisting perfectly the passage of water. The electric current causes the chemicals, that are used in the process, to penetrate into the internal structure of the fibers, so that the waterproofing substance fills the fine, hair-like passa es in them. In this way a comparatively permanent waterproofing effect is attained. In contradistinction to the chemical process, described above, the waterproofing does not consist of a mere film of substance over the exterior of the fibers, which can be easily washed off, but of a thorough impregnation and filling of their entire structure. Such waterproofing will successfully resist many washings, and not only that but dry cleaning as well, to which the chemically waterproofed fabrics are not resistant at .

It is very interesting to trace the history of electrical waterproofing of textiles, for in its origin it is closely and directly allied to the electrical industry and to one of Edison's inventions, the chalk telephone receiver. The inventor of the waterproofing process, Mr. Alfred O. Tate, who has been awarded the Howard N. Potts Gold Medal for his work by the Franklin Institute of Philadelphia, was originally connected with Edison in the very early days of the electrical industry. He worked on the chalk telephone receiver and noted the strong action of the electric current upon an electrolyte which filled the pores of a chalk cylinder, producing thereby sound effects in a diaphragm. Years later, when confronted with the waterproofing problem, he recognized that here was a task which the electric current could solve by forcing or carrying the waterproofing solutions into the fine pores of the textile fibers. The process was perfected and during the war it performed signal service in waterproofing the uniforms of the American and Canadian air forces. At the present time the process is being operated on an industrial scale in the plant at Cranston, R. I., a part of the old and historical Cranston Print Works, where it is possible to waterproof goods at the rate of three million yards of cloth a month.

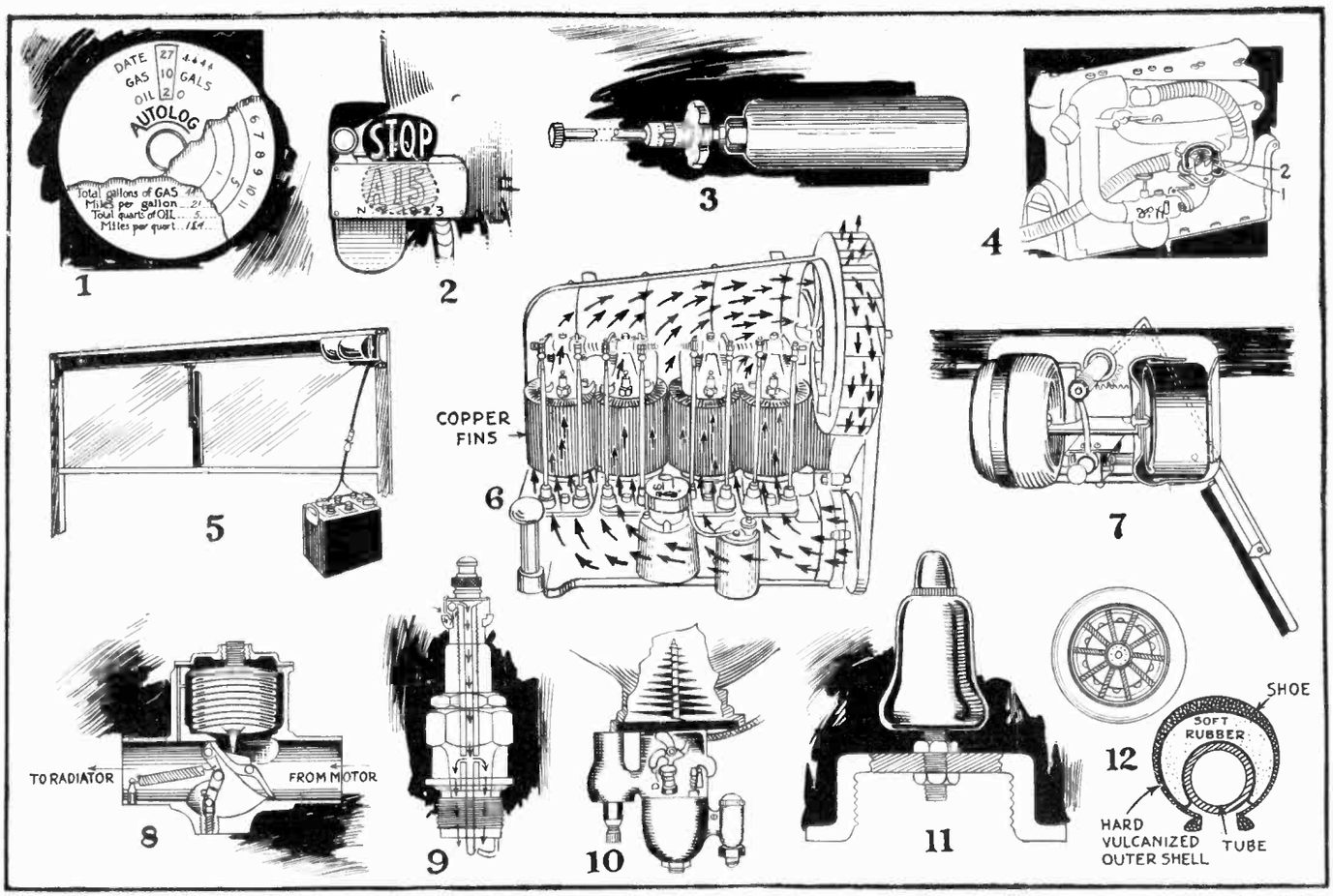
A specially designed machine is used to accomplish the waterproofing. The machine contains either two or four sets of electrodes, the two-set machine being used for silk and wool, the four-set machine for cotton and linen. The cloth first passes through a bath of sodium oleate, which is a solution of soluble soap. Then it passes between the various sets of vertical electrodes. At that time it is impregnated with a solution of the chemical, acetate of alumina, while the current flows from anode to cathode through the chemical solution and the cloth. Chemical and electrochemical reaction takes place with the formation of an insoluble aluminum soap within the capillary passages of the fibers and on the surface as well. After the cloth has passed between all the sets of electrodes, it goes over a series of drying cylinders, heated with steam, so that it is perfectly dry on emerging from the waterproofing machine.

One of the important features of the process is its applicability to all sorts of fabrics. Such heavy materials as sailcloth, overcoatings, awning goods, tent-cloths, etc., as well as thin fabrics, such as sheer silks, ordinary muslin, etc., pile fabrics, such as plush mohair, velvets, etc., and even such special cloths as large meshed bobinette can

(*Continued on page* 1107)



The simplified diagram-chart above shows the important progressive stages followed in the latest method of waterproofing and mothproofing cloth by electricity. Rubber raincoats, for example, are very uncomfortable in warm weather or at any time when it is not cold, as they will not pass air. By the new methods here shown and described by Mr. Ginsberg, an authority on this particular subject, various cloths can be waterproofed and these cloths will, after waterproofing, successfully resist many washings and will even stand dry cleaning, which treatment the ordinary chemically waterproofed fabrics will not stand.



In Fig. 1 is shown a device which allows the driver to keep an accurate record of all gas and oil bought in the course of a month. The metal shell is cut away to disclose the cardboard disc, upon the front of which are spaces for dates and amount of gasoline and oil bought, while on the back are spaces for total records at the end of the month. A combination stop signal, tail light, and license bracket, is shown in Fig. 2. The stop sign disappears in back of the license plate when not in use. A steel tube containing compressed air is shown in Fig. 3. By means of a gauge just above the valve handle, a tire may be inflated to any desired pressure. In Fig. 4 is shown a device for vaporizing low grade fuel. The heavy fuel collects in the basin marked 1, and is held there until heated by the exhaust and vaporized. The fan shaped blades, 2, assist in vaporizing the fuel. A wind-shield wiper which cleans the entire upper surface of the wind-shield, is shown in Fig. 5. This is actuated by an electric motor connected to the starting battery. In Fig. 6 is shown a new type of air cooled motor, employing copper fins electrically welded to the cylinders to increase heat radiation. Fig. 7 shows a wind-shield wiper actuated by the suction of the intake or of the vacuum tank. It can be locked up out of the range of vision when not in use. A thermostat control for the flow of water from the radiator to the motor is shown in Fig. 8. A spark plug with self-cleaning points is shown in Fig. 9. A draft of air actuated by the suction of the motor keeps the points free from carbon. Fig. 10 shows a small resistance coil inserted in the intake manifold, which is heated by means of the starting battery, and assists greatly in vaporizing the fuel. An automatic "low gas" signal, which is fastened on the gasoline tank cap, is shown in Fig. 11. The "super-wheel" is shown in Fig. 12. The spokes consist of heavy spiral springs which absorb a considerable amount of road shock, and within the shoe is a soft rubber insert which protects the tube from punctures.

Novelties at New York Auto Show

THE second week in January was a momentous one for automobile owners and drivers in and around New York City. For the entire week there was a display of all kinds of automobile accessories, as well as complete cars at the Grand Central Palace, and another smaller, but just as interesting show, at Madison Square Garden.

Do you know just how far your car goes per gallon of gasoline, and per quart of oil? This is a question that very few drivers can answer accurately, as they have never taken the trouble to keep an accurate record. However, if he uses one of the devices shown in Fig. 1, he will be able to very easily keep an accurate record of these figures. Essentially this device is a round metal case which clamps on the steering wheel, and which has a removable cover. Within this case is contained a replaceable cardboard disc, which may be rotated from the outside of the case by means of a knurled ring. As may be seen one side of the disc has several concentric circles drawn thereon, and a number of figures around the outside edge corresponding with the days of the month. Between the first and last figures there is a space in which the name of the month may be written. On the opposite side are spaces provided for the speedometer readings on the first and last day of the month, and for the total amount of gasoline and oil used. Several discs are supplied with each device for various months. The driver inserts the name of the month, and the speedometer reading on the first day of the month. He now puts the disc into the device, and turns the knurled ring until the day of the month appears in the opening. Then when he buys gasoline and oil he jots down the amount in the spaces provided, and at the end of the month has an accurate record of all purchases. From this and his speedometer readings he can figure out whether or not his car is running as it should. The card can be then exchanged for another one for the next month.

A unique stop sign which combines a tail light, license bracket, and signalling device is shown in Fig. 2. This is electro-magnetically operated, either from a button on the wheel, or a switch on the brake, and a large red and white stop sign appears when needed. A separate signal light is not used, as the white light emanating from the side of the tail light illuminates the stop sign when it is raised. This sign swings up sideways from inside a thin sheet metal container, on the outside of which is bolted the license plate. The storage battery in the car is used as the source of current for actuating the magnets.

At last the nuisance of a hand pump is eliminated. All you have to do now is carry a small *bottle* of compressed air as shown in Fig. 3 in the tool compartment of your car, and when a tire blows out, you change it and inflate the tire from this bottle. An automatic gauge is arranged on the bottle so that when the required pressure is obtained within the tire, a whistle blows, attracting your attention thereto. It is possible to operate this device even at night without the use of any lights without endangering the tires by over-inflation. Jacks are also manufactured by this company which work by compressed air supplied by these bottles. They make them in several sizes, the largest one capable of lifting a heavy truck. These compressed air bottles are exchangeable for full ones when exhausted in the same way that the old acetylene gas containers formerly used in automobiles could be exchanged.

Carbon dioxide gas is also put up in these bottles for use in extinguishing fires on automobiles, and the gas can also be used for making carbonated liquids by forcing a quantity of the gas through the liquid. A refrigerating container can be used in connection with this carbon dioxide bottle for keeping foods and liquids at a low temperature. These bottles contain gases at a pressure of 1000 pounds, but the danger of an explosion is done away with by having the containers capable of withstanding ten times that pressure. The bottles are inspected and tested by government officials.

Very often with poor grades of gasoline, it is practically impossible to start the car in cool or cold weather, because of the great amount of liquid gasoline caught in the manifold. This trouble is done away with by the apparatus shown in Fig. 4. Here

(*Continued on page* 1101)

Dr. Hackensaw's Secrets

By CLEMENT FEZANDIÉ

No. 14—The Secret of the Motorless Airplane

(AUTHOR'S NOTE.—*At the present moment the French and the Germans are giving considerable attention to the construction of "gliders". At Wasserküppe in Germany, Herr Hentzen recently made a record flight of over three hours duration in a motorless airplane. He traveled a distance of 25 kilometers and reached an altitude of 360 meters. The French have made similar records. The future of such machines is a very bright one. In the following story I give a suggestion for a combined balloon and glider—a combination that seems feasible, and that would, under certain circumstances, possess certain advantages over both the airplane and the balloon, as well as over the simple glider.*)

"HAVE you got anything new on hand, today, doctor?" asked Silas Rockett, as he entered the laboratory and dropped into a vacant chair.

"Nothing much, Silas," returned Doctor Hackensaw—"Things are quiet just at present. Here's a letter, though, that may interest you. It's from a party that wants me to furnish them with a hundred thousand sperm whales."

"What!"

"Yes—Sperm Whales—The order is somewhat unusual, isn't it, even though it is only baby-whales that are wanted?"

"What in the world do you mean?"

Doctor Hackensaw smiled. "I thought you would be astonished, Silas," said he, "but the explanation is really a simple one. You may perhaps know that the Sea of Japan was in former days one of the finest hunting grounds for the sperm-whale or cachalot as it is called. These whales could be found there in large schools. With modern methods of whaling, however, these valuable animals are becoming extinct, and one of the Oriental governments has decided to restock the Japan Sea with whales. Hence this letter. This government wishes me to go to Japan for a few months. They agree to furnish me with a sufficient supply of living egg-cells and sperm-cells taken from the cachalots killed by their whalers. Then comes my task. I am to fertilize the ova and incubate them in a suitable culture fluid in glass jars until the baby-whales reach the stage at which they would normally be born."

"Good gracious!"

"And that's not all, Silas. Whales, as you probably know, are mammals—that is to say, the mother-whale feeds her young on her own milk. So to feed these hundred thousand prospective baby whales until they are able to take care of themselves, I am to send to Japan several shiploads of condensed milk! What do you think of that for an order?"

"It beats anything I ever heard of. Are you going to accept?"

"I don't know yet. Perhaps I'll take a run over and get things started for them. I haven't much at hand at present except my motorless airplane that I'm going to test out this afternoon. If it proves successful I may take it along with me and use it for whaling purposes."

"A motorless airplane? You never mentioned that before. Do you mean a glider?"

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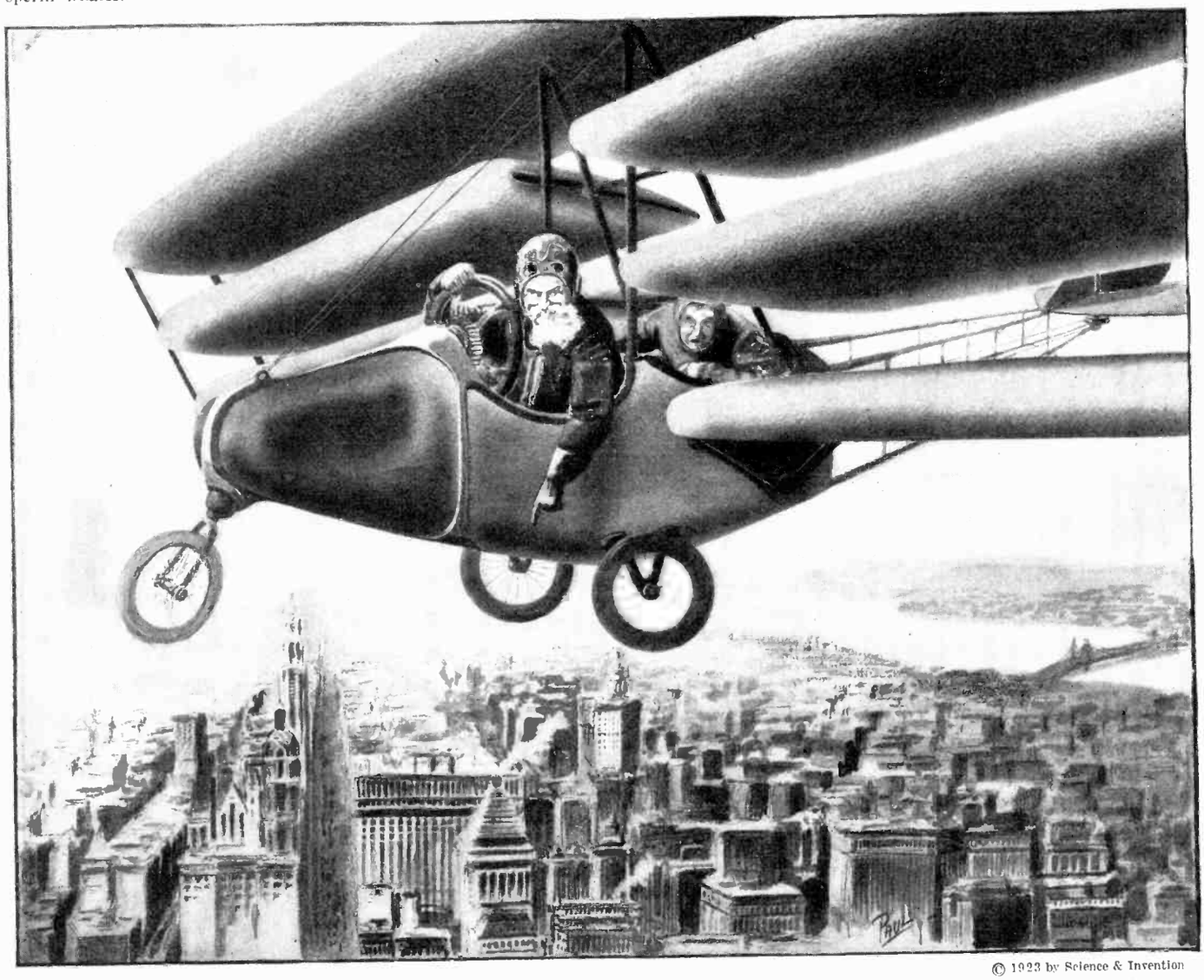

"'You see, Silas, we have none of the noise and fuss here of an ordinary airplane. . . . I can rise and land most anywhere, because my ascent is practically vertical. Then, too, the start and the landing are effected as slowly as I wish, thus eliminating two of the greatest dangers of the airplane. For war purposes, too, this faculty of hovering is very useful. See how easy it would be to drop a bomb on one of New York's skyscrapers from here!' . . . Silas looked down and was forced to admit the truth of his companion's remarks."

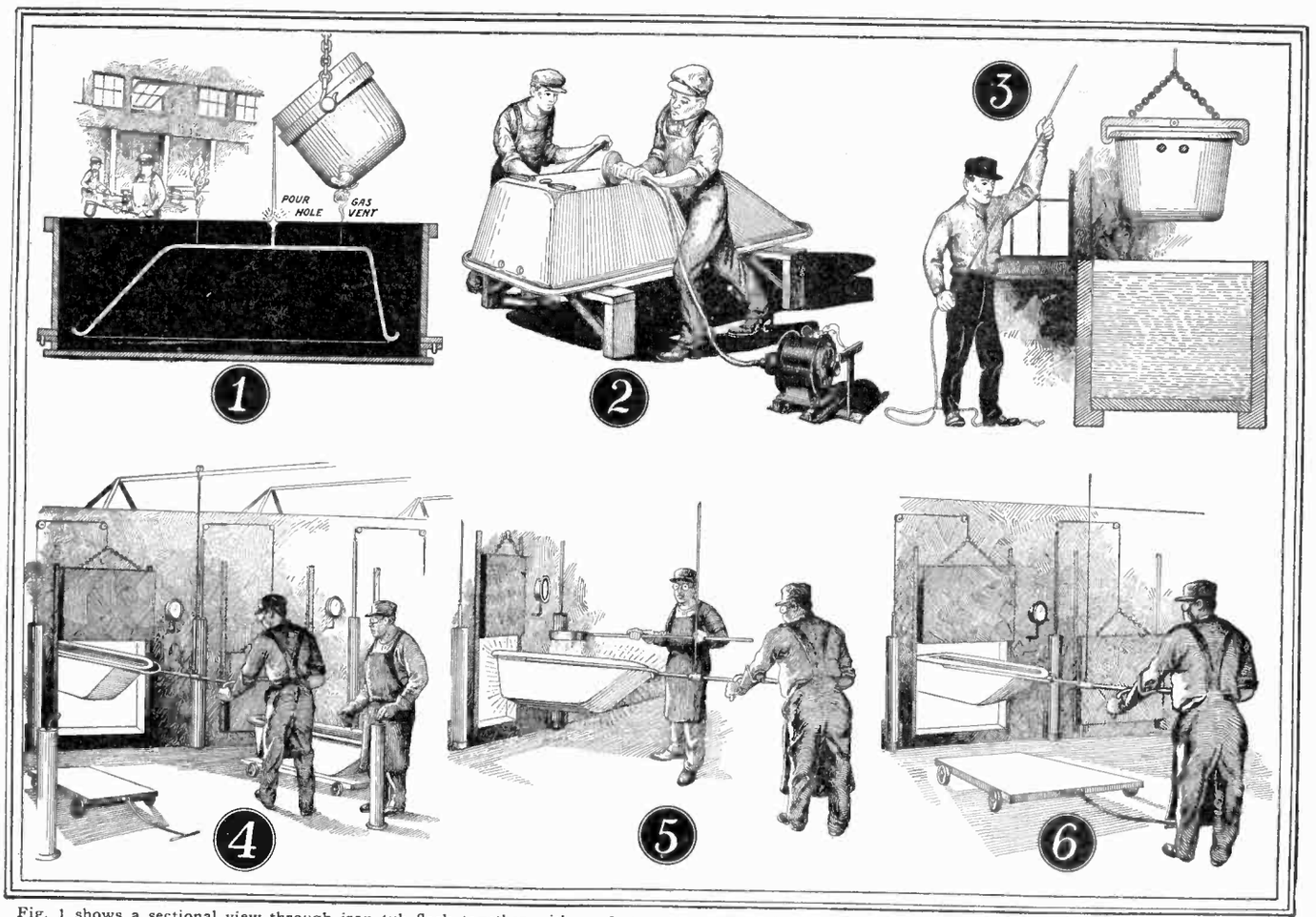

Fig. 1 shows a sectional view through iron tub flask together with sand, two gas vent holes and pouring hole in center, with large ladle of molten iron being poured into the latter. Fig. 2 shows tub upside down with one operative using file, while second man uses flexible shaft emery wheel to grind down and finish rough iron tub. Fig. 3 shows section of pickling solution vat with tub being lowered into it for purpose of cleaning thoroughly before enamelling. Fig. 4 shows view of gas heated enamelling ovens with compressed air cylinders for opening and closing oven doors, together with electric pyrometers, etc. A man is shown operating an air valve, also another man with leather apron and large boom about to place iron tub in oven. Fig. 5 shows red hot tub removed from oven, and one operative sifting enamel powder over the tub. Fig. 6 shows tub being replaced in oven so as to fuse and bake on enamel.

How Enameled Iron Tubs Are Made

By H. WINFIELD SECOR

ONE of the commonest things that we see and use every day is the white enameled iron wash basin, and also bath-tub. We buy the iron tub or basin, get our plumber to install it, and promptly forget all about it, except when we want to use it. It is an interesting story which has not been told heretofore, describing the process of casting these large iron vessels and enameling them in huge ovens, which resemble miniature infernos.

In the accompanying illustration the successive stages followed in making an iron bath-tub are shown. The same operations hold true for wash basins and other vessels and containers of this type. There are some smaller water containers of the enameled type, which are made from pressed steel and not from cast iron, but the latter, older process still holds the field to a large extent.

Fig. 1 shows a sectional view through the iron flask or frame in the foundry which is filled with molder's sand, which has been prepared with a wooden or iron pattern of the tub, so that a hollow space is left in the sand into which the molten iron when poured, will flow and form the tub. Gas vent holes are made in the top of the mold as well as one or more pouring holes, into which the molten iron is poured from a large ladle. These large ladles necessary to hold sufficient molten iron, for pouring such a large object as a bath-tub, are handled by two men, a handle extending from either side of the ladle for several feet. In the foundries where these large castings are made, the traveling cranes carry large clay-lined buckets of molten iron down along the foundry, and any small serving ladles used by the men are filled from these.

After an hour or so when the castings have *set*, and the temperature has decreased considerably, which slow cooling is adopted to prevent too quick a temperature change and possible cracks occurring in the casting, the molding flasks are knocked apart, the sand cleaned out, and the castings put on small trucks, and run to the cleaning room.

Fig. 2 shows mechanics busy cleaning the rough cast tub. Coarse rasp files are used for some of the work, while most of the rough projections, edges, etc., are finished off smooth with a small emery wheel driven by a flexible shaft, from a motor or line shaft. In this way the mechanic can take hold of the flexible shaft and run the rapidly revolving emery wheel over any part of the tub he desires. The inside and outer surface of the roll rim receives special attention in finishing, as this must be very smooth in order to give a perfect enameled finish.

The iron tub is next thoroughly cleansed of all dust and iron particles by treating it to a pickling bath. This may be an acid or a caustic soda solution; it thoroughly cleanses the iron surface, and prepares it for the enameling process.

The tub then goes to the enameling room. See Fig. 4. Here we find a line of great enameling ovens, which are heated either with gas and compressed air, or else with fuel oil fed under pressure, the insides of the ovens being lined with tile or fire-brick, with the flame burners placed around the outside, but protected by an outer wall to conserve the heat. When the door of one of these ovens is raised by a compressed air cylinder and plunger arrangement, as shown in the drawing, (the valve controlling the air pipe line being placed quite a distance from the doors, due to the terrific heat,) the inside of the furnace when fully heated looks like a duplicate of Dante's inferno. The leather-aproned men who place the tubs as they come from the finishing room in the furnaces to heat them up to red heat, which takes about eight to ten minutes usually, pick up the tub from the truck with a long bar containing a U-shaped iron cradle at one end, and a double handle on the other. This bar is suspended from its center by a chain or cable from the ceiling. This bar is about twenty feet long and in this way the tub can be placed in the oven or removed without undue discomfort from the heat.

Electric pyrometers or temperature indicators are fitted to the ovens in most modern baking rooms, so that the temperature of the oven can be regulated to the proper degree. When the tub is thought to have been heated sufficiently, that is, to a red heat, the door is opened by one of the men who takes care of this part of the job, and the handler grasps his long tong bar and places a U-shaped crutch under the tub rim, and pushing down and walking backward,

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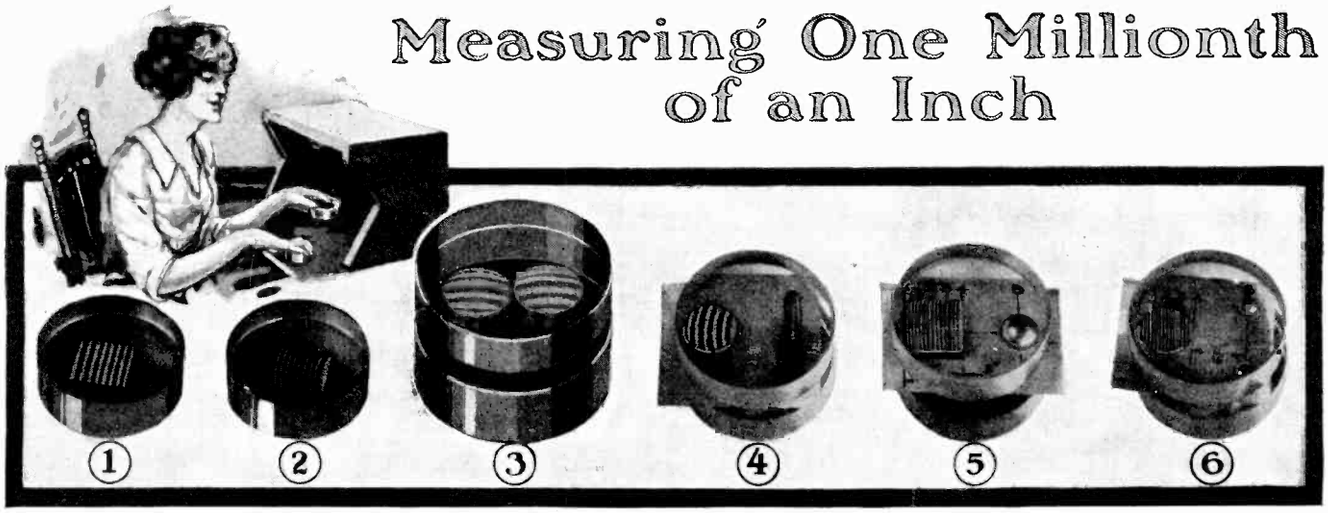
Measuring One Millionth of an Inch



1—A gauge flat within a millionth of an inch. 2—Curved bands show that the near and far edges are lower than the middle of the gauge. 3—Comparing thicknesses of two gauges. The gauge at the left is shorter by a half band, or five millionths of an inch. 4—Measuring the diameter of a plug. 5—The arrangement of the cardboard templet for measuring the diameter of a ball bearing is here illustrated. 6—The two balls here shown are identical, as is evidenced by the parallel lines or light bands. In the upper left hand corner the method of making measurements is demonstrated.

ALTHOUGH measurements correct to within a distance of a millionth of an inch are possible, very few individuals understand exactly how such measurements are made. Simplicity is the watchword. Such a thing does not seem possible in such accurate measurements, yet all the instruments required are two so-called glass *flats* whose surfaces are perfect planes, and a fixed or known gauge. The glass flats are not lenses; they do not magnify, they merely present a *perfectly smooth true surface* of a plane. The gauge is of known dimensions, accurately ground. If two pieces of flat glass are placed together, so that the film of air between the plates is very thin, a series of colored interference fringes or bands will be seen if viewed in the daylight. This effect is often visible when washing windows with water containing kerosene. But interference of light waves resulting between two plates when viewed in monochromatic light, or light of one color, gives a series of alternate light and dark spaces rather than the colors seen in daylight.

The average wave length of a beam of light is approximately two one-hundred-thousandths of an inch, or twenty millionths of an inch, but the light and dark spaces noted, result from interference of light waves. It is evident therefore, that the bands which are a noticeable distance apart, are not light waves themselves, but respectively indicate places where interference and reinforcement of the waves occur between the two surfaces at one-half wave length intervals. Therefore, each dark band shows a distance not of twenty millionths of an inch, but ten millionths of an inch, and the number of bands which are seen, indicate the steepness of the wedge of *air* occurring between the optical flat and the gauge. If these bands are seen to be parallel, then we are positive that the gauge is accurately flat. For the purpose of measuring the gauge which is not perfect, the optical flat is placed upon the gauge, whereupon a series of curved lines would be noticed. By referring to the diagram, the method of indicating the amount of curvature of the surface may readily be seen. Consequently, our second measurement is easily found, that is to say, a person can instantly tell that the surface of a gauge is not flat, and by simply projecting a line from one edge of the curvature of a dark band to the opposite end, and dividing the distance between the two interference bands into tenths, we are able

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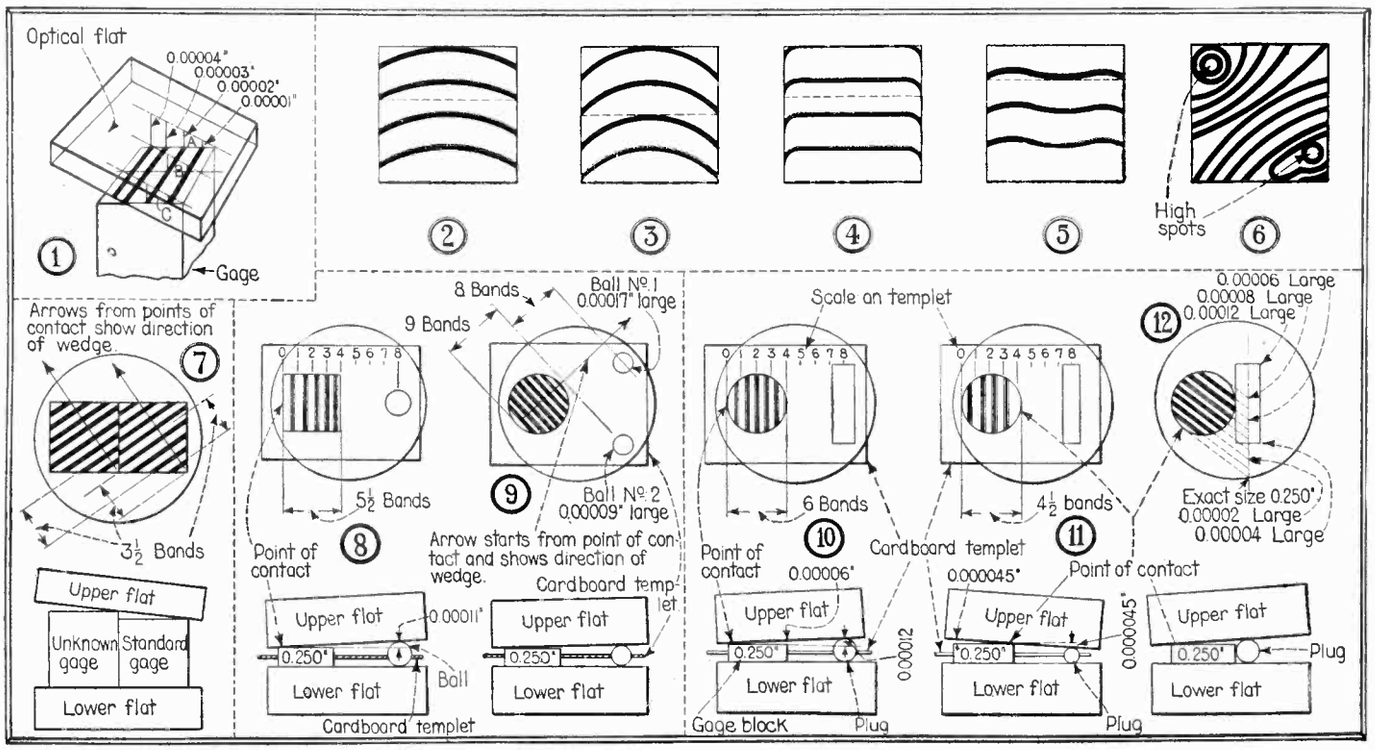
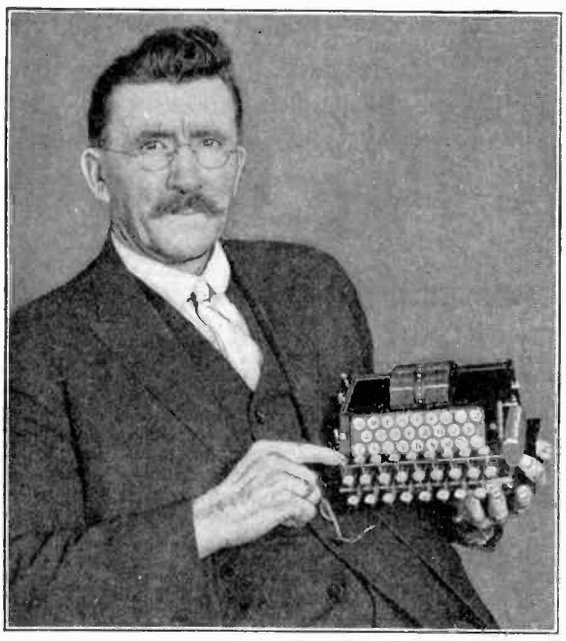


1—The interference bands shown above, locate vertical steps of .00001 inch between the contacting surfaces. They are shown here in an exaggerated condition, the optical flat resting on a gauge. 2—Curved bands indicate curved surfaces. The side edges are low by five millionths of an inch. 3—Convex surface; side edges low by ten millionths of an inch. 4—Side edges rounded; five millionths of an inch. 5—Surface hollow in center, higher on each side of center. Error of three millionths of an inch. 6—Note the high spots in this example; error, sixty millionths of an inch depression. 7—Comparing two gauges; top and side view shown. The standard gauge is three and a half bands, or thirty-five millionths of an inch shorter than the unknown gauge. 8—Measuring the size of a ball by means of a cardboard templet, and lower and upper flats. The ball is oversized by five and a half bands, or .00011 inch. Five and a half bands must be doubled, because of location of the point of contact. 9—Balls are not uniform in size. 10—Measuring the size of a plug, the plug is .00012 inch larger than the gauge. 11—Plug shown above is .000045 inch smaller than the gauge. 12—The tapering plug shows bands as indicated in the illustration, the bands inclining relative to the plug.

Machine Makes 12,000,000 Keyless Codes

By H. D. HUNTER

OCCUPYING less than a cubic foot of space and weighing less than a portable typewriter, an electrically driven machine which codes, transmits and decodes nearly 12,000,000 different, unrelated and keyless codes has been invented and patented by Edward H. Hebern, of California.



This tiny machine, weighing less than a portable typewriter, is capable of transmitting codes and also decoding messages. None of the codes are keyed, so that it is quite impossible to decipher the same by ordinary mathematical means. There are about eleven million separate and distinct code combinations possible with it.

Hebern's invention, which is now under test by the code experts of five nations, including the United States, has been subjected to fifteen months' experiments by agents of the American Secret Service, in an effort to decipher messages sent by it. So far, according to the inventor, they have failed to decode one word out of hundreds on which they have worked. The machine, whose basic principle is that of the telegraph-typewriter, can be used for all secret messages, sending and receiving either by wire or radio.

The instrument—which is still waiting for a name—presents the appearance of one of the early wax cylinder phonographs. Its case is 8 x 10 x 6 inches in dimensions, and it weighs six pounds. From the top of this box rises a half cylinder of metal, divided in the center by a slot rather more than half an inch in width, into which drops the *key* or *master* wheel, which contains the secret of the invention. On the upper half of the front of the box are 26 small transparent dials, arranged in three rows, on each one of which is painted a letter of the alphabet. This is the receiving deck. Directly under this, occupying the lower half of the front is a series of 26 keys, also containing the letters of the alphabet, arranged in the same order as on the "universal" typewriter keyboard.

With the machine as far as described, messages may be sent and received in plain English or in any other language using the English alphabet, or one approximating it in characters. The brain of the invention, however, is a little spool, about three inches in diameter, or less, and rather more than half an inch in thickness. Around the sides of the wheel, spaced around its edge at equal intervals, are 26 openings, through which are seen the letters of the alphabet. On the rim, likewise, are corresponding apertures, showing the letters in the same order.

The inventor will say nothing about this spool, which he calls the *key wheel*, and without which no codes, other than the ordinary codes, made by man, and, therefore, decipherable, can be sent. Inside the wheel, each letter-space is connected by a separate wire with a binding post in the center. There are possible, with these 26 letters and 26 wires, entirely different combinations numbering 11,881,376. By means of inter-codes, inside-codes, codes-within-codes, etc., it is possible to make codes to the number of 403,303,146,321,064,400,000.

Ether Used in Manufacturing Ice Cream

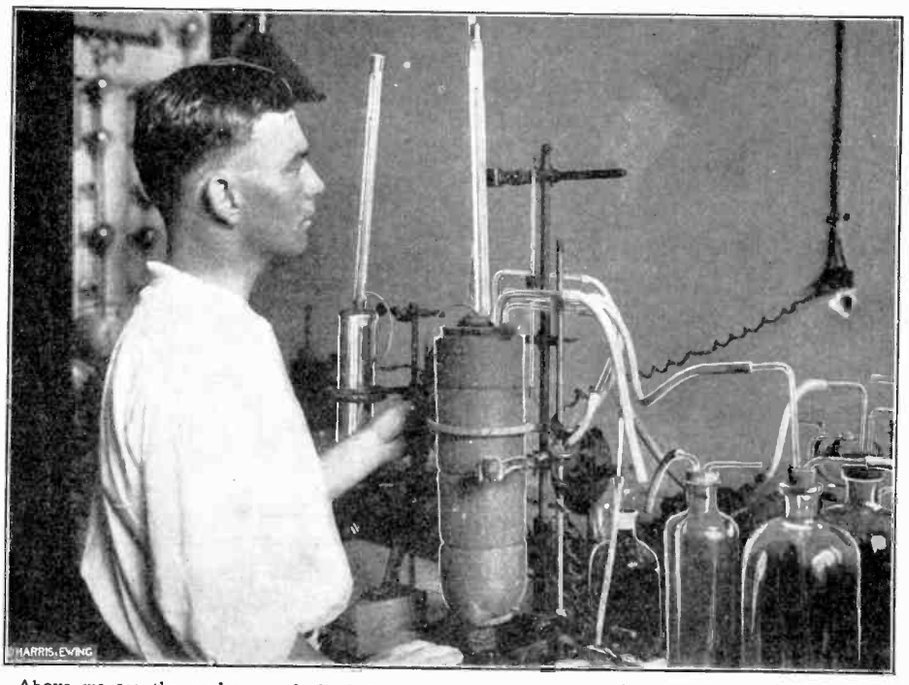
Ether, that light, volatile, inflammable liquid so widely used as an anæsthetic because of its power to produce insensibility to pain, has been adapted to a new role of usefulness. P. N. Peter, a chemist in the Dairy Division of the United States Department of Agriculture, recently discovered its value as an agent in determining the expansion when freezing ice-cream. It is the first time ether has been applied in the process of refrigeration of ice-cream.

The determination of the expansion in freezing ice-cream is essential to the successful manufacture of this popular delicacy. The manufacturer terms this expansion an "overrun," which indicates an increase of the mixture over the original quantity of ingredients. The prevailing method of making known the percentage of expansion is to make comparisons in volume of a sample of the original mixture and a specimen of the "overrun." In the manufacture of ice-cream, air is whipped into the raw product, the injection of this air being primarily responsible for the inflated yield.

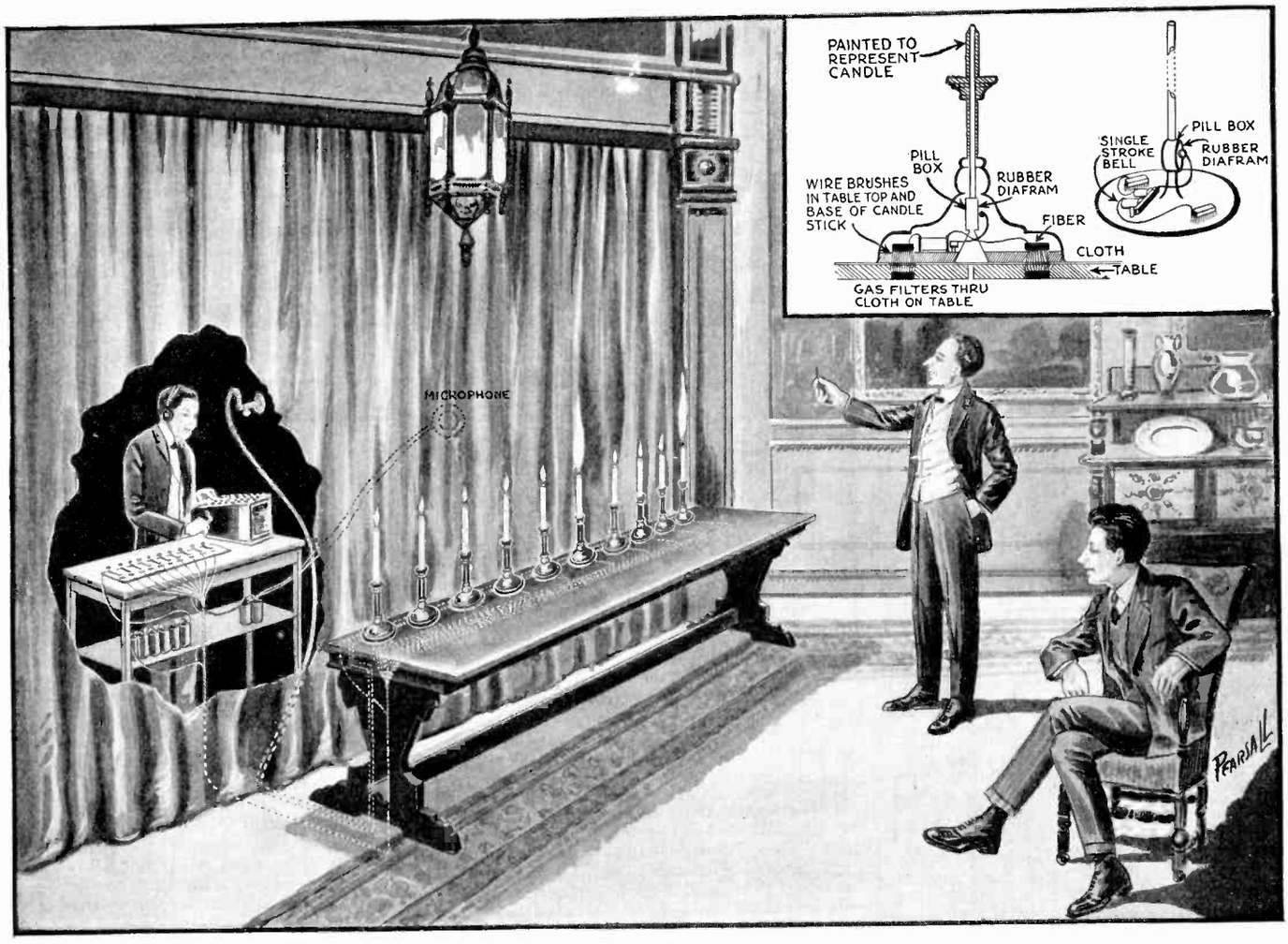
The apparatus for making the expansion determinations consists of a large Dewar flask, wrapped with a heavy layer of felt. Two concentric glass tubes extend through a cork into the center of this flask, the space between these two tubes being occupied by air which serves as a means of uniformly lowering the temperature. A dilatometer bulb and a thermocouple are contained in the inner tube. Temperatures are measured by means of a five-junction thermocouple, while dilation is determined in a capillary tube.

The use of ether in refrigeration methods has been occasionally employed in plant experiments in extremely arid regions of the United States where the application of ice mixtures is difficult because of the excessive temperature in a desert. The use of ether in the manufacture of ice-cream, however, is a fresh application of this liquid commonly identified with operating rooms and hospitals where human pain is to be reduced to an insensible quantity. The use of ether in determining the expansion of ice creams, gives a cleaner and more easily regulated method than the present system of determination by weight. It is, however, the costlier of the two.

Contributed by S. R. WINTERS



Above we see the modern method of determining the expansion in freezing ice cream by using ether instead of the weight system for indicating the degree of expansion.



The effects produced by the flames of the candles in which their light flares up at the command of the operator, are developed by a tambour device placed in the gas line of the individual candles. Illuminating gas supplies each candle, the single stroke bells striking against the rubber diaphragm cause the flame to spurt up. The detail in the upper right hand corner shows the apparatus required, which is controlled by an assistant behind the scenes.

The Amateur Magician

By JOSEPH H. KRAUS

THE OBEDIENT CANDLES

HENRI HARGRAVE, the famous magician, had promised to give me information regarding the *Obedient Candles,* a new electrical novelty, which he had just invented, so, inasmuch as I already had an appointment with him, which I did not hesitate to keep, I soon found myself in the throes of mysticism.

On a table in Hargrave's laboratory were ten candles in their respective candlesticks. "It won't do you much good to examine them," Hargrave commenced in explaining the trick, "because, as you have heretofore found, nearly all of the apparatus which I build, may be examined by skeptical individuals. So I will show you what the effect is at first and follow this up with the explanation. Suppose you take a sheet of paper and a pencil, and jot down a series of numbers, commencing with the figure 1, if you like, and culminating at the figure 9,999,999. You may choose as many figures as you desire, in any arrangement, and then total them up. Call them out as you write them." While I was calling out the figures, he was busy lighting the candles. Needless to say, I called out a group, jotting them down as I did so, which would stagger a skilful public accountant, if he attempted to total the amount.

Hargrave turned to me just as I had exclaimed "That's enough!" and said, "Before totalling the figures you have given, I wish you would look at the candles. A flicker denotes a numeral. Three flickers in succession signify 'yes,' and two signify 'no' when numerals are not being considered. In this way, the candles will not only answer your questions, but will also add, subtract, multiply or divide for you. Just write down the number of flicks which emanate from the individual candles for your result."

Immediately my answer came. The first candle at the extreme left did not waver, the next one flared up and down five times in succession, the third one four times, the fourth one seven, and so on. According to Hargrave, my answer was correct. It took me some time to figure up the amount, but when finally I succeeded I found that the candles had told the truth. I asked them to subtract one number from the other, and before I could draw a line beneath the second group of figures I had jotted upon the paper, the candles were responding. I then commenced to ask them several questions. The entire group replied in unison. I then changed my tactics and asked the reply of candle No. 1, which was forthcoming. The flame in the others did not move, except for a slight draught of air, caused by an open window some distance away. When I asked of candle No. 3 whether candle No. 1 replied to my question, two flicks indicated 'no,' and I was promptly informed which candle had replied by the number of flicks delivered by candle No. 6, to which the next question was put.

My age was given by candle No. 10, and many other replies which were received were extremely humorous.

Hargrave did not manipulate any controls. Finally he reached over, grasped one of the candlesticks, and blowing the flame out, came toward me. I examined it and found it to be an imitation candle, having a metal top with a small hole therein. Aside from that, it did not seem at all suspicious. It was up to Hargrave to give me the details. The base seemed so thin, it would have been almost impossible, in my opinion, to house any electrical apparatus therein The usual method of making contact by means of points, was not in evidence, although I did notice two small wire brushes projecting from the base of the candlestick-holder.

Hargrave opened up one of the candlesticks, and the entire system was revealed. Essentially it was a gas appliance. A thin copper tube led to the top of a fake candle painted to resemble the real object, but for which a real one could be substituted if desired, the essential fact being that a hole must be drilled through the candle itself, to permit the introduction of the copper tube.

(*Continued on page* 1113)

MOTOR HINTS

FIRST PRIZE, $25.00
BATTERY CHARGING REGULATOR

The illustration shows the construction and connections for a charging regulator

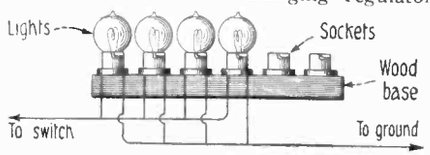


Fig. 1

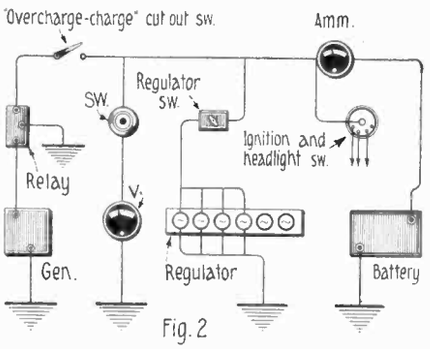


Fig. 2

The circuit diagram above shows how to connect a number of lamps across the battery, so that the dynamo will not overcharge said storage battery, when the car is being used on long distance runs.

switch mounted on the dash board of the car. On long drives, or at any time when there is danger of overcharging the battery, the regulator switch is turned on, and the charging rate will be diminished, the amount depending on the number of lamps used and their candle-power. Extra sockets are provided, which are not in the circuit, and may be used for carrying extra car lamps.

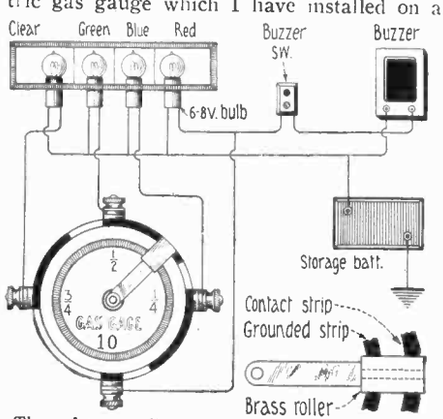
As shown in the diagram, it is the best practice to connect a voltmeter across the charging wire from dynamo to ground, together with a suitable push button switch, so that the condition of the battery can be ascertained before by passing some of the charging current through the headlights as some drivers do, or else through the regulator lamp bank, as here suggested. Some garage mechanics recommend the placing of a switch in the main charging wire from the dynamo as here shown also, so that if there is danger of heat developing within the battery, this switch can be opened, thus allowing the dynamo to run idle, the battery of course receiving no charging current. In this case the ignition and lights are operated from the storage battery, the same as if the engine were not running at all.

The voltage of a storage battery on open circuit does not mean anything, and the potential could be read either while the dynamo is charging the battery, or else while the battery is discharging, lighting the headlights, etc. The potential when fully charged will be about seven volts. If a dynamo is charging the battery, the voltmeter will indicate about nine volts or more; discharging with the dynamo disconnected , the battery potential will register about seven volts or less, when fully charged.

Contributed by FLOYD OAKLAND.

SECOND PRIZE, $15.00
LAMP SIGNAL GASOLINE GAUGE

The accompanying drawing shows an electric gas gauge which I have installed on a McLaughin or Buick car, and which has worked quite satisfactorily. Any gasoline gauge can be insulated at the proper intervals by cardboard or fiber for the live side of wiring, and the inner strip is grounded directly to the dial or gauge. Where gauge is used for filler cap also, snap connections can be employed, or a collar of composition with contacts imbedded, could be used to slip over and around the gauge. Roughly when the tank is three-quarters to one half full, the clear light circuit is complete; when one half to one quarter, the green light; on quarter to one gallon the blue, and at the one gallon mark the red light and buzzer circuit is completed. Of course, this would not show the exact number of gallons in the tank with only four lights, but the system could be carried on as far as one should care to go. This notifies the owner of the car that when the buzzer rings, he had better fill up his tank at the next gas station.



The safety gasoline gauge indicates how much gasoline is in the tank. When the supply is running low a red light is flashed, and a buzzer operated simultaneously.

Contributed by J. B. HALL.

ELECTRICITY ON THE CAR

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

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

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

The following prizes will be paid:

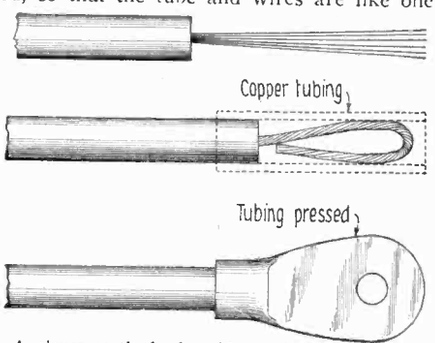
FIRST PRIZE.....	$25.00
SECOND PRIZE.....	15.00
THIRD PRIZE.....	10.00

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

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

THIRD PRIZE, $10.00
IMPROVED WIRE TERMINALS

A solderless insulated wire terminal, which will keep the wire from breaking where it joins the terminal, is here shown. It is made of a piece of copper or brass tubing. A piece of tubing just large enough to slip over the insulated wire is procured, and this should fit tightly. If the tubing is too large, the wire can be tapped to the proper size, or if too small, the insulation can be cut down. Then strip wire of insulation for about one and a half inches or more, according to the size of the wire, and bend stripped wire in the center. Slip copper or brass tubing over stripped wires, and about one-quarter of an inch of insulated part, so that the bare wire will not project through the end of the tube. Put in a vise and squeeze the tube, being careful not to break any part covering the insulation. A hammer can be used to close up the tube if a vise is not available. The wire and the inside of the tube should be clean, and the tube pressed, so that the tube and wires are like one piece. A part of the tube covering the insulation can be broken if thought necessary, so that the insulation is clinched in the terminal.



A clever method of making a lug for a wire terminal is depicted above. The rubber wire is bared, twisted into a loop, and pushed into a piece of copper tubing which is then flattened in a vise.

Contributed by ALVIN HEDWALL.

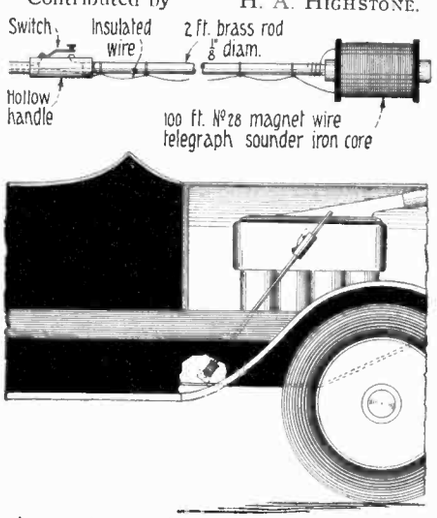
A MAGNETIC HAND FOR AUTOISTS

The little device described herewith will prove itself to be of no little value in picking iron objects from the multitude of inaccessible places into which they seem to have the habit of falling.

It consists of a small electro-magnet wound for six volts, attached to a brass rod several feet in length and ⅛ inch in diameter. Current from the storage battery passes through the rod to one terminal of the winding and returns from the other through a well insulated wire which is affixed to the rod by means of thread or tape. The rod, being of small diameter, readily admits being bent into any desirable shape to reach into different places, enabling the workman to easily remove bolts or nuts which defy every effort to take them out with the fingers.

One hundred feet of No. 28 enameled copper magnet wire wound for 1¼ inches on an iron core 5/16 inch in diameter will readily lift iron objects weighing up to one-half pound. It draws .9 ampere, and heats up only slightly with continued operation.

Contributed by H. A. HIGHSTONE.



A magnet mounted on the end of a rod enables the automobile owner to pick up screws which have fallen into almost inaccessible places. This does not apply to brass screws, however.

Scientific Problems and Puzzles

By ERNEST K. CHAPIN

NO. 6 OF A SERIES

HARD-BOILED OR SOFT?

"WAITER," called the new customer to the man who had just served him, "take these eggs away and bring me some soft-boiled ones as I ordered."

"But you haven't opened the eggs yet, sir," objected the waiter, with difficulty concealing his irritation.

The waiter was puzzled indeed when his customer told him at a glance just how long the eggs had been boiled. Can you tell by looking at an egg whether it is soft or hard boiled?

"Don't have to open 'em," snapped the customer, "but if you don't believe they're hard I'll show you." And so saying he cracked the eggs open and proved his point.

"I'll bet I can tell how he knew the eggs were hard," the waiter said to himself as he went off after more eggs. "He simply shook them close to his ear and noticed that the contents didn't move inside." In a few minutes he was back with another pair of eggs.

A boy showed two barbers a new trick in boiling water. With a glass flask and a tight rubber stopper, he showed them how to make the water boil after it had stopped boiling, without adding heat. Simple—when you know how.

"That's better," approved the customer this time before he had even touched them, "thank you." And away went the astonished waiter wondering whether to think the man was merely a good guesser or whether he really had some uncanny knowledge about eggs.

Would you venture to explain how the man knew?

BOILING WATER WITHOUT INCREASE OF HEAT

"Yes sir," said one barber wisely to another, "it's prefectly marvelous the advances science is making these days. First thing we'll know somebody'll show us how to keep warm without coal, cook our food without gas and—"

"Shucks, that ain't so much," interrupted a small boy who had been listening, "I'll tell you what I can do right here and now. Gimme a flask and a tight rubber stopper and I'll show you how to make water boil again after it has stopped boiling and I won't add anything to it and I won't apply heat."

Can you explain how he did it?

HERO'S FOUNTAIN

Although it is an invention that is well over two thousand years old, Hero's fountain still provokes considerable interest wherever one is shown. Fig. 1 illustrates the construction of the mechanism. When the upper reservoir (E) has been filled with water and a little water is poured into the upper basin (A), the device delivers a stream of water well above the source in apparent defiance of our notions about the impossibility of perpetual motion.

What is the explanation of its action?

Although it is an invention well over two thousand years old, Hero's fountain still provokes considerable interest wherever one is shown. The problem is to find out how the water keeps squirting upward through the central jet at the top, without the use of pumps, heat, etc., Fig. 1.

The authors Fig. 2, at extreme right, shows plan conceived by a store-keeper for a show-window display. He desired the small balloon to rise and fall alternately, this action to be kept up simply by means of a tank of compressed air. Do you think this scheme will work?

PROOF OF THE EARTH'S ROTATION

Supposing that our skies were always cloudy so that the rising and setting of the sun and stars could not be observed, are there any facts that could still be observed or any experiments that could be performed which would demonstrate the earth's rotation?

PRACTICAL LEVITATION

Wishing to attract people to his window displays, an ingenious storekeeper proposes to construct a tall glass cylinder in which a small balloon of light but rigid material alternately rises and falls with its load of miniature passengers. The only motive power which he claims he requires is a tank of compressed air and the only mechanism necessary are two valves operated by levers as shown in Fig. 2, one of which admits compressed air when the balloon reaches the bottom and the other which releases the pressure as soon as the balloon arrives at the top.

Do you think his scheme can be made to work, and if so, what would cause the balloon to rise and fall?

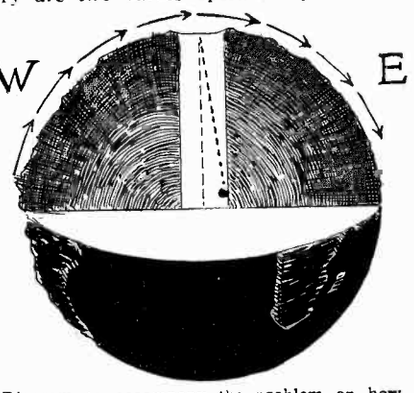
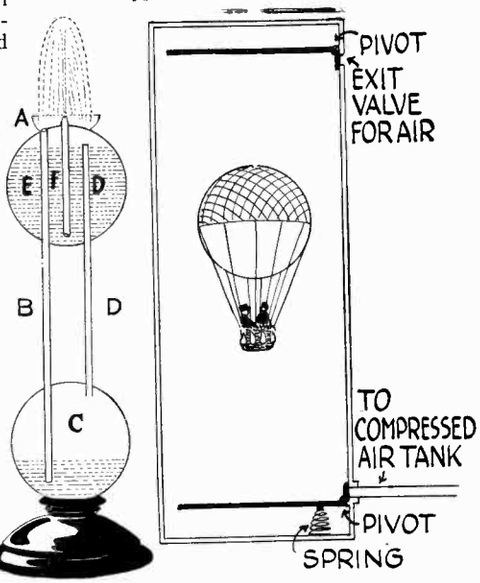
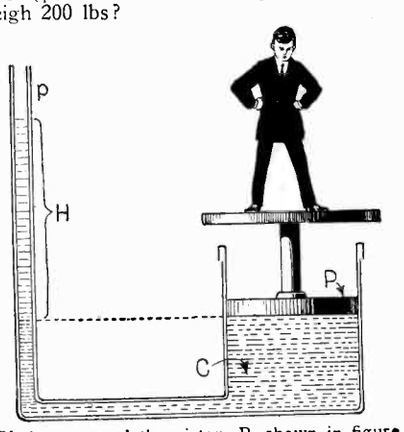


Diagram to accompany the problem on how to prove the earth's rotation on its exis, providing our skies were always cloudy, so that the rising and the setting of the sun and stars could not be observed.

THE HYDROSTATIC PUZZLE

Let us suppose that we have a device as illustrated below, consisting of a piston (P) in cylinder (C) which connects at its base with a small vertical pipe (p) open at the top. The cylinder and tube are first filled with water and then the man stands on the platform on top. Assuming that the area of the piston is 2 sq. ft. and that of the pipe 0.1 sq. in., how high will the weight of the man and piston force the water in the pipe (p) if the man and piston together weigh 200 lbs?

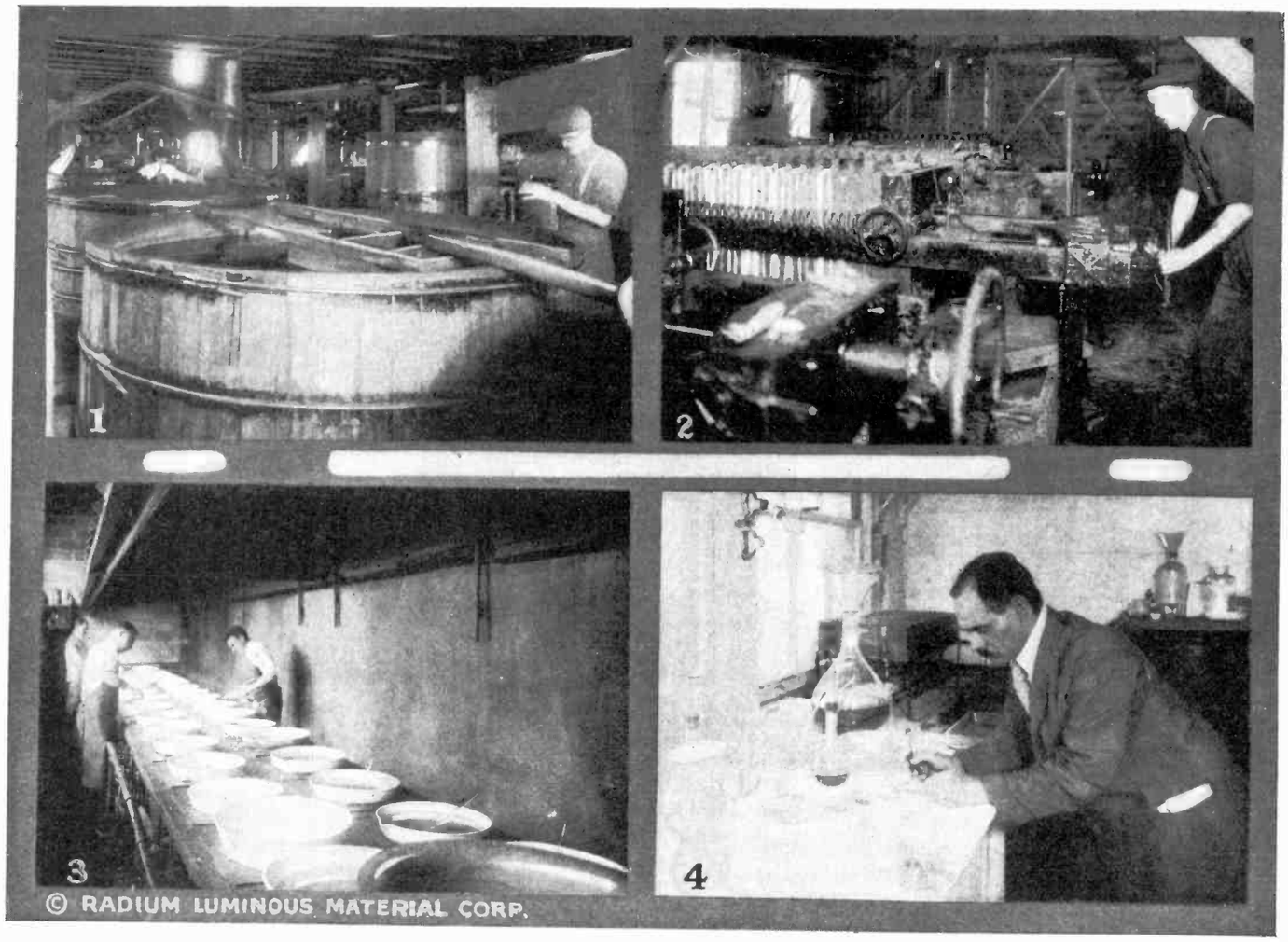




If the man and the piston, P, shown in figure above, weighed two hundred pounds, how high do you think they would force the water in the open tube "p."

Without a doubt the two problems on practical levitation and the hydrostatic puzzle, will attract considerable attention. Those well versed in physics problems will find even then that the results obtained in particularly the last problem, will startle them. The first problem given on this page, if practised, is found to be easily duplicated, and the individual who takes the time to memorize the few simple rules or rather effects which boiled eggs produce when removed from water, will be amply repaid for the time spent in memorizing these facts.

(*Continued on page* 1108)



1—Many thousands of dollars' worth of radium are contained in these large vats. The solution is carefully sampled a number of times each hour. 2—Part of the process of extracting radium. 3—No cook ever watched a pot boil more carefully than these chemists with over $500,000 worth of radium in their care. 4—This picture shows what remains from the big bowls on the long stove.

Practical Chemical Experiments

By RAYMOND B. WAILES

FIRST PAPER OF A NEW SERIES

Extraction of Radium from Carnotite

THE extraction of radium from the mineral carnotite is as interesting as the application of this wonder element to human life.

Carnotite is a radio-active mineral now being mined in Colorado, for its varied contents, mainly for radium. Its appearance closely resembles a piece of dried-out yellow clay, but with properties totally different from the latter. The mineral is radioactive, or emits radioactive rays, because of its radium and uranium content. The rays which constantly pass off from the mineral are totally invisible, even in the dark, for the substance is not phosphorescent as many believe. The purer compounds of radium do, however, emit their characteristic bluish glow visible in subdued light.

A simple test for radioactivity in a substance such as carnotite is fogging by the mineral of a photographic plate or film wrapped up in paper, which has been exposed to the substance for several days. The radioactive rays of the uranium and radium contained in the mineral will penetrate the paper covering in which the plate has been wrapped just as light will pass through the lens of a camera. A piece of carnotite resting on the film side of a loaded kodak will cause a fogging to appear on the film when developed. The carnotite should be at rest on the camera for several days. "Radiumized" light buttons, pull-chain pendants, etc., can also be used in this manner, their radio-active rays passing through the aluminum side or back of the camera.

The Bureau of Mines, co-operating with the National Radium Institute has perfected a method by which the carnotite ore can be worked up and radium salts isolated in a very simple manner.

The author has worked out the Bureau of Mines process with half a pound of carnotite, and has had no difficulty in obtaining radium in the form of radium-barium sulphate. About one gram of this substance was obtained. The presence of radium in the substance was verified by utilizing its radio-photographic effects. A paper clip was placed over a sealed photo plate and the radium-barium sulphate (in its container) was placed over the clip. Developing the plate after twenty hours produced the effect shown in figure 1. Carnotite mineral applied in the same manner did not affect the plate during the same length of time, conclusively showing that the radium barium sulphate contained practically all of the radium contained in the half pound of material processed.

The chemical experimenter should not have the least bit of difficulty in working up a quantity (from a quarter pound or more) of the carnotite mineral for its radium content. The simple precipitations and filtrations with the resulting by-products make the experiment both practical in value and interesting in schematic chemistry.

Method of Extraction

The pulverized mineral is first heated with strong nitric acid (step A) and filtered, the residue being treated with more strong acid again and filtered, the two solutions or filtrates being united. The residue is sand etc., and should be discarded as in actual practice. The solution contains radium, uranium, iron, vanadium (with which vanadium steel is made), calcium, aluminum, etc., as salts. Sodium hydroxide solution is now added (step B) until the solution is *almost* alkaline, but still slightly acid. If alkaline, a precipitate will form which is not desired. Barium chloride solution is now added, and then sulphuric acid. (step C). (Use about 20 cc. of 10% solutions of each). The white precipitate which forms is *radium-barium sulphate*. Filter.

The precipitate is dried, after washing, and preserved. It contains practically all of the radium which was present in the quantity of ore taken. This double salt can be used in many radioactive experiments in which a rather strong unit of radium is required.

In industrial practice, the radium-barium sulphate precipitate is heated with carbon, in furnaces. This reduces the sulphate to the sulphide by taking away its oxygen. The resulting radium and barium sulphides are dissolved in hydrochloric acid and the

solution obtained is fractionally crystallized so as to separate the radium chloride from the worthless barium chloride. It is not practicable for the experimenter to reduce the precipitate with charcoal (carbon) and then dissolve in hydrochloric acid and fractionally crystallize.

The filtrate obtained from the radium-barium sulphate precipitate should now be treated with a boiling sodium carbonate solution (step D). This precipitates iron, calcium and aluminum which were contained in the original mineral. In practice, this is discarded, it being worthless. The filtrate

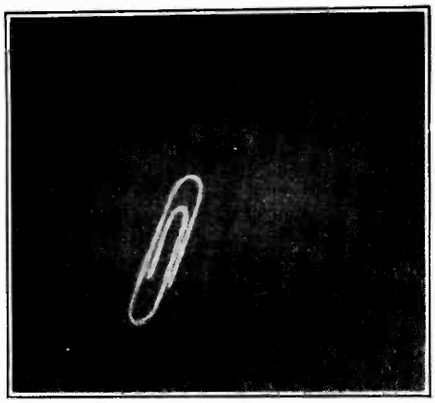


Fig. 1.—To make this radium photograph, the author places an ordinary wire paper clip over a sealed photo plate, while the radium-barium sulphate in its container was placed over the clip. Developing the plate after twenty hours, produced the effect shown.

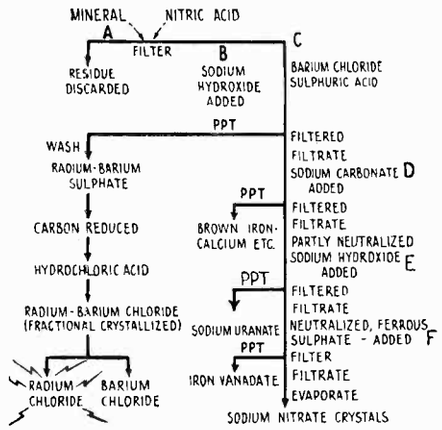
from the solution now contains sodium vanadate and the double uranium sodium carbonate. The yellow color of the solution at this point is due to the uranium present.

Nitric acid is now added to the filtrate until nearly neutralized and then sodium hydroxide is added (E). The uranium will precipitate as sodium uranate. This is used in making yellow glass for vases, automobile headlights, etc. Filter. The filtrate is completely neutralized with nitric acid and a solution of ferrous sulphate added. (F). Iron vanadate (black) is precipitated. Filter. The solution now contains nothing but sodium nitrate with impurities. If the solution is concentrated and allowed to cool in a quiet and covered place, crystals of sodium nitrate will form. In actual radium manufacture, these crystals are treated with strong sulphuric acid to make nitric acid which is then used as the neutralizing agent. or, to dissolve the original mineral as in the very first step.

One of the photos shows evaporating pans used to crystallize the sodium nitrate from the final solution. The mass of solid salts on the draining trays is sodium nitrate ready for nitric acid manufacture.

Utilization of By Products

All of the by products find a ready market. The sodium uranate when heated to



a high temperature yields uranium oxide, finding use in photography, and glass making. The iron vanadate is worked over and the vanadium used to make vanadium steel.

At step D, the sodium carbonate solution is added in excess, *i. e.*, until no more precipitate forms. The solution is then boiled for half an hour, filtered and nearly neutralized with nitric acid and sodium hydroxide solution added (step E), until the yellow precipitate of sodium uranate no longer forms. The solution should be hot at this point. After filtering, the ferrous sulphate solution is added to the *cold* solution, or filtrate (step F).

The above precedure used by the National Radium Institute and the Bureau of Mines can readily be duplicated by the chemical experimenter on a small quantity of carnotite mineral. The by-products obtained, when bottled and attractively labeled make a very interesting exhibit.

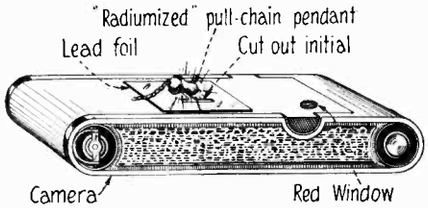


Fig. 2.—You can make a radium picture very easily by using your camera and a radium "button." Cut out a small figure or initial from a piece of heavy lead foil and place this on the back of the camera; then lay the radium luminous button over the cut-out portion of the foil. Do not disturb for several days. Turn the film to the next number and use the rest of the cartridge in the regular way.

It must be understood that the percentage of radium in carnotite is infinitesimally low, and what may be called "radium chloride" contains only a minute proportion of the salt.

An Unsuspected Function of Sugar

By C. L. MELLER

IT is twenty-eight below zero; on either side of the sun may be seen the phenomenon popularly known as sun-dogs, while among the timber is heard an occasional sharp report as of the discharge of a pistol; it is a little uncanny at night. However, the noise comes only from a tree here and there developing a frost crack. A little water lodged in some small wound is sufficient to start the trouble and under the influence of the intense cold a crack develops longitudinally in the trunk just as water pipes burst when the water in them is frozen. Yet trees live through winter after winter of just this kind of weather, altogether unable to defend themselves against the cold, their sap frozen to the very center of the trunk.

Of her means of accomplishing this apparently difficult feat, keeping trees alive through prolonged periods of sub-zero weather, nature makes no secret. She employes sugar to gain her end and has been telling us so, ever since we began to use maple syrup for breakfast cakes. With the processes of plant life such as they are, it becomes perfectly obvious to the chemist that sugar is the only substance that nature could have employed without adding another detail to plant metabolism. A scientific determination, a sort of diagnosis so to speak, brings forth the following facts.

To begin with, we find sugar producing trees growing not only where there is a well defined winter season, but where that season includes periods of low temperatures. Not alone the hard or sugar maple but all the maples will yield sugar, including even that veritable weed of a tree the box elder. Nor is the production of sugar limited to this genus, for we find that the sap of such trees as the walnuts and the birches can be boiled down to a sweet syrup and finally to sugar. Even trees like the ash that do not give their sap by bleeding in spring contain an appreciable amount of sugar, which will boil forth freely from the cut end of a green stick of this wood as it burns. Many an Indian child knows of this source of a bit of sweetness.

In the individual cells, those innumerable little laboratories of each green leaf, the elaboration of starch goes on apace. Now starch being a carbohydrate, a chemical group to which sugar also belongs, it lies within the power of the plant to change starch into sugar. Perhaps it is more accurate to say that plant starch is changed to sugar, sugar being soluble while starch is not. The manner of this change, having no bearing upon the special function of sugar at present under discussion, is a detail which we can spare ourselves discussing here. Sugar then is the form in which this elaborated plant food, this carbohydrate, is transferred from one part of the plant to the other through the medium of solution. When the leaves fall in autumn the manufacture of starch ceases, while that which has been manufactured is in solution but transformed into sugar, though of course by no means all, the greater part of the summer's output having been used up in the process of growth. Enough however remains to start growth again in spring, especially bud growth. It is this sap, this almost pure sugar solution, that freezes solid during winter's zero weather.

That freezing does not harm this sap is obvious from the very fact that the tree can grow again in spring. The question why the sap is unharmed finds an answer near at hand. The sap of a sugar-producing tree can be boiled down to any desired consistency and then be brought back to its former state by simply adding water. Even the final sugar can be redisolved to its former degree of dilution without any change from the original sap, provided of course that the impurities are not in the water added, a contingency that can be avoided by the use of distilled water. Records show that the yield of sugar from the sap of a tree varies from year to year, as indeed does the yield of the sap itself; the sugar content of the sap may be as low as a fraction of one percent or as high as five percent due altogether to the influence of the season, which as yet is by no means fully understood. But an analysis of the sugar reveals it to be almost pure cane sugar with the addition of about one half of one percent of ash. However, the percentage, of sugar is of little importance as compared with the fact that the sugar is present in an almost pure solution.

It now remains for us to see how this acts in relation to extremely low temperatures. After being thawed out a sugar solution is its old self again and can act its part in every way that it did before it was frozen. It is this fact that solves the problem of a tree's

(*Continued on page* 1099)

Experimental Electro-Chemistry

By RAYMOND B. WAILES

PART 9—ISOLATION OF METALS, DYES; PREPARATION OF METALLOCHROMES, LIGHT BY MEANS OF ELECTROLYSIS

THE electrolysis of aqueous (water) solutions by the electric current plays an important part in modern industry. Copper for instance, which goes to make copper wire for electric lines is recovered or separated from impurities

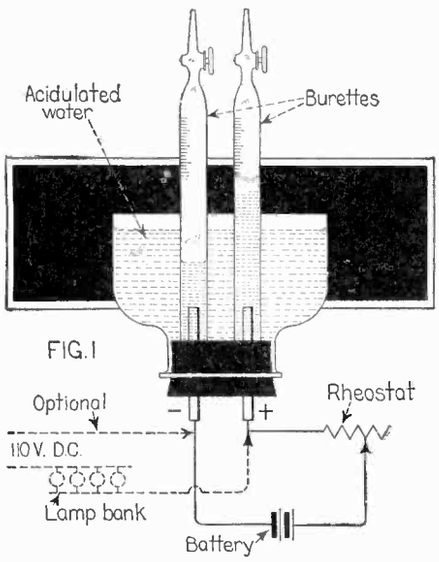


Fig. 1.—Hoffman's apparatus is easily made. The yellow dye, kanarin, can be made with the aid of it.

by means of electrolysis. A general statement can be made that all metals will pass toward the cathode or negative pole when electrolyzed, for the metals in solution have positive charges of electricity upon a portion of their atoms which are called cations, they being ions. So it is with copper, which collects on the negative electrodes in the electrolysis of copper solutions made by dissolving metallic copper in an acid.

A pretty experiment showing how a dye can be produced by electrolysis, or electrolytic oxidation, can be performed with the aid of a home-made Hoffman's apparatus for the electrolysis of water as shown in figure 1.

A bottle is cut off near its bottom by filing a mark around its circumference to a distance of about an inch, and a red hot rod bent in the shape of the bottle is touched to the file mark. Immersion in cold water will start the crack around the bottle. The two electrodes used are carbon rods obtained from flashlight cells. They pass through a stopper. Two burettes are placed over the electrodes as shown. The vessel is filled with water acidulated with sulphuric acid, the stop-cocks at the top being opened and the water sucked by means of a rubber tube, to the top of the stop-cocks, after which they are closed. The electrodes can be connected to a battery (storage) and a rheostat or 110 volts D.C. using a lamp bank resistance in series. On passing the current hydrogen will form in the burette over the negative pole and oxygen over the positive, or anode.

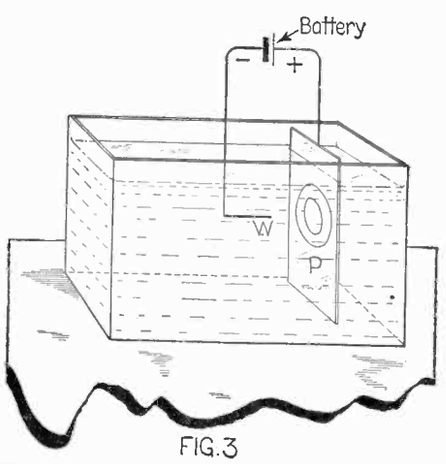


Fig. 3.—Metallochromes are easily produced and are of great beauty.

If the acid is replaced by a solution of 1 part potassium sulphocyanide in 5 parts of water and the current passed as before, hydrogen will be liberated as before, but there will be no formation of oxygen at the anode for the following reaction will take place:

$$6HCNS + H_2O = C_6H_8O_2N_4S_5 + H_2SO_4 + 2HNO_3$$

The reaction product, $C_6H_8O_2N_4S_5$ is kanarin, a yellow organic dye. The dye forms about the anode and after interrupting the current, can be scraped off the carbon anode, dissolved in alcohol, and cloth can be dyed with the solution formed. It is best to use 100 volts D.C. with several 16 C.P. lamps in parallel for this experiment.

Preparation of Magnesium

An ordinary clay bubble or tobacco pipe can be used for this metallic separation. A steel knitting needle should be passed through the stem so that its end will project into the bowl of the pipe. This will form the negative pole or cathode. The pipe should be held in a suitable clamp and a Bunsen burner placed beneath the bowl. The bowl is filled with a mixture of magnesium chloride, ammonium chloride and potassium chloride, prepared by dissolving 20 grams of magnesium chloride, 7.5 grams potassium chloride and 3 grams of ammonium chloride in water and evaporating the solution to complete dryness in an evaporating dish. The resulting salts are then introduced into the pipe bowl and the Bunsen burner is lighted so as to melt the mass. A carbon rod from a flashlight battery will serve as an anode and is introduced into the melt in the bowl. A current from a 110 volt D.C. current stepped down with lamps should be passed for about half an hour. When the current is then interrupted and the mass cooled, globules of metallic magnesium will be found to have formed about the steel needle, or cathode. They can be mixed with a small amount of potassium chlorate and ignited, producing the familiar flashlight effect.

Non-Electrolytic Deposition of Metals

Metals can be plated from a solution using two sheets of metals immersed in a solution of a metal and electrolyzing or passing a current, using the metal to be deposited as a solution and the object to be plated with the metal as the cathode or negative electrode. This it will be recalled, is the principle of the copper voltameter.

Metals will displace other metals from solutions without the use of the electric current. A sheet of iron placed in copper sulphate solution will become covered with metallic copper. The coating is not lasting however, its spongy state allowing it to be rubbed off quite readily.

Galvanite is the name applied to a paste consisting of:

Nickel ammonium phosphate	60 parts
Zinc dust	3 parts
Chalk	30 parts
Talc (powdered)	7 parts

This mixture, when rubbed with a *moistened* cloth over the object to be plated, will deposit a coating of nickel. The talc and chalk act as retarders for the chemical action and as polishing agents. The metal zinc is higher in the electromotive series or more

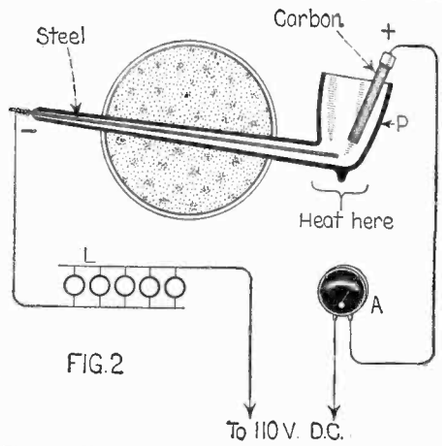


Fig. 2.—Using this simple set-up, metallic magnesium can be prepared from magnesium chloride. An ordinary clay bubble pipe is used as the reaction vessel.

positive than nickel, and displaces it from the solution, which is soaked up by the cloth and the nickel ammonium phosphate, deposits nickel by electrolysis or electric plating, on the metal which is rubbed with the saturated cloth.

Metallochromes

Using the experimental cell shown in figure 3, beautiful effects called metallochromes can be formed. The electrode (cathode) is a pointed wire, directed toward the anode, a sheet of copper. The following solution is used: 125 cc. water, 3 grams lead nitrate; 25 grams of sodium hydroxide in 125 cc. water. Mix the two solutions when ready for use. This forms sodium plumbate, a salt of plumbic acid.

Colored rings will be produced on the copper plate when the current is passing.

Nobili's Rings

Nobili's rings are a form of metallochrome and can be produced by laying a sheet of brightly polished iron on the bottom of a vessel containing a solution of lead

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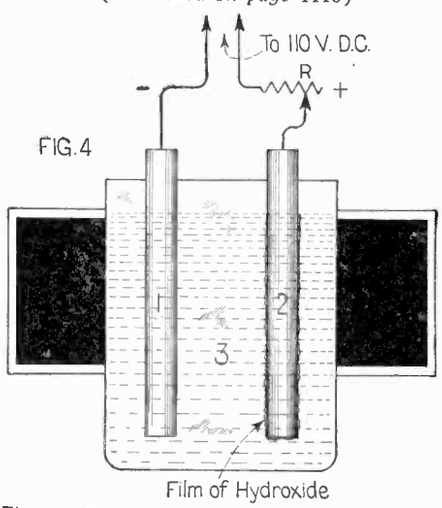
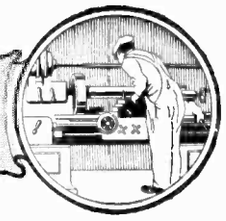


Fig. 4.—This electrolytic cell will produce a light when a direct current of 110 volts potential is passed through it, using a lamp bank resistance.

THE CONSTRUCTOR



Refrigeration in the Home

By L. K. WRIGHT, Refrigerating Engineer

BY following the present article closely any one, with a little mechanical inclination, can build his own plant at a nominal sum and enjoy freedom from the messy use of ice. Such a plant as described can be assembled for one hundred dollars or less.

Before attempting to build his plant the layman should understand the principles upon which refrigeration depends. Under pressure the refrigerant is in a liquid state and flows as such to the point where refrigeration is desired. At that place it passes through an expansion valve, which as its name implies, allows the liquid to expand into a gas which absorbs heat. This gas, laden with heat absorbed from the ice-box, is drawn back to the machine, comprest into a liquid and allowed to lose its load of heat in the condenser; the heat being transferred to and carried off by the cooling water. The refrigerant is then ready to repeat the same cycle, which it does an indefinite number of times with little or no loss.

The item that will give the builder the most work and concern is the compressor. An air compressor with a bore of from one to two inches will answer the purpose. Upon close examination it will be observed that there are several avenues by which the gas is likely to escape. A little patience, skill and ingenuity will remedy them in short order. The following remedies for faults in compressors may seem too numerous, but they are simply stated to cover the various makes of compressors.

The unloading device upon the pressure head will claim first attention. (Some compressors have this head cast solid without unloader.) Remove the unloading lever and have the opening carefully welded, care being taken to get no metal into the unloading valve, which might prevent it from closing. To facilitate welding and careful inspection the pressure head may be unbolted, after its position has been marked to insure proper replacement. Before resetting, clean the surfaces thoroughly and apply a gasket of thick drawing paper, free from cracks or cuts, dipped into shellac. Apply pressure to the head bolts evenly when resetting.

The blind side of the shaft, opposite the flywheel side, is remedied by cutting off any projection of the shaft, so that after planing smooth the face of the bearing, a piece of sheet iron can be bolted across the opening by means of studs. Before fastening permanently see that the shaft has clearance and that a well shellacked gasket of paper, or a seamless leaden gasket made from wire solder, is used. Leaden gaskets are best and may be used with assurance against leaks caused by vibration.

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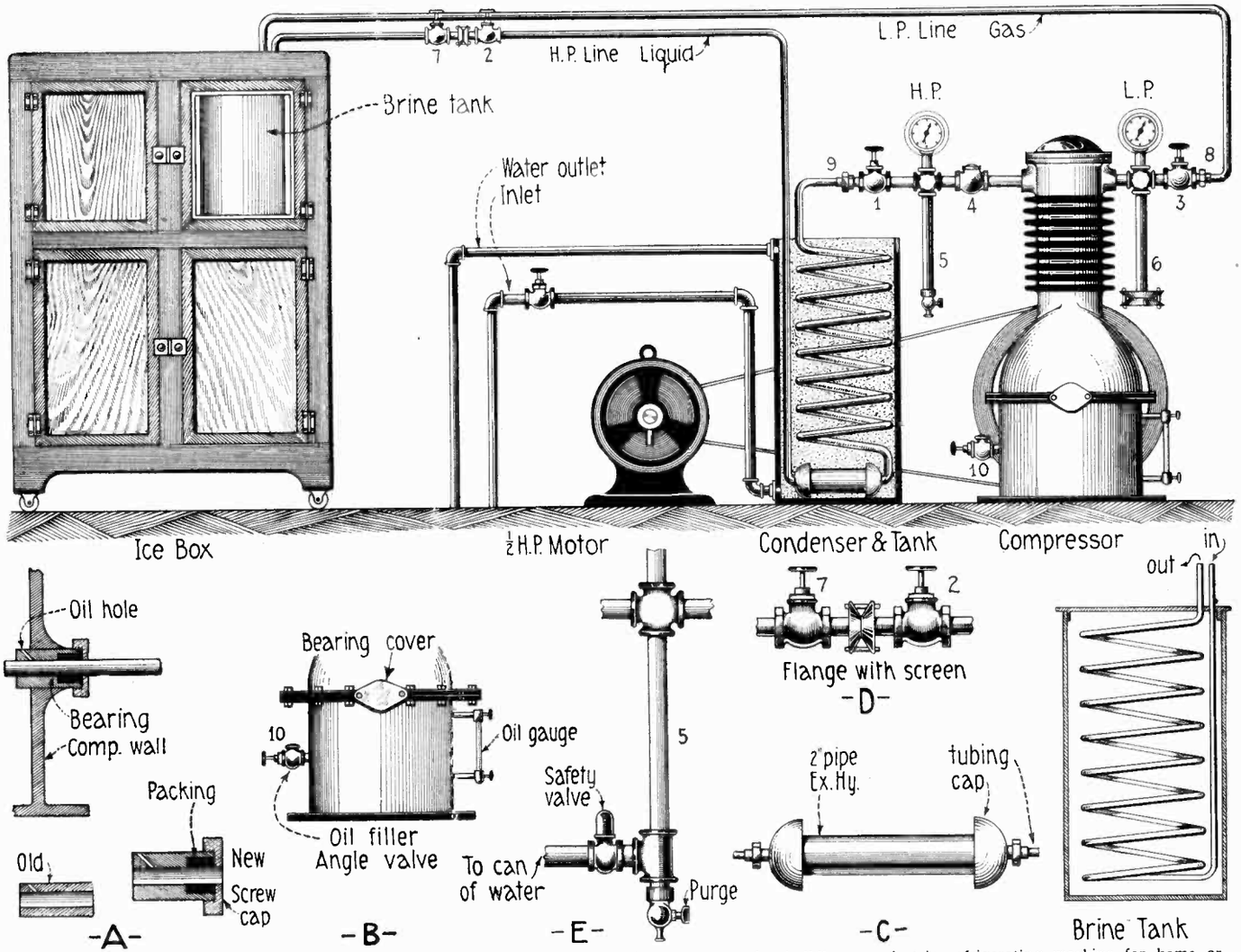
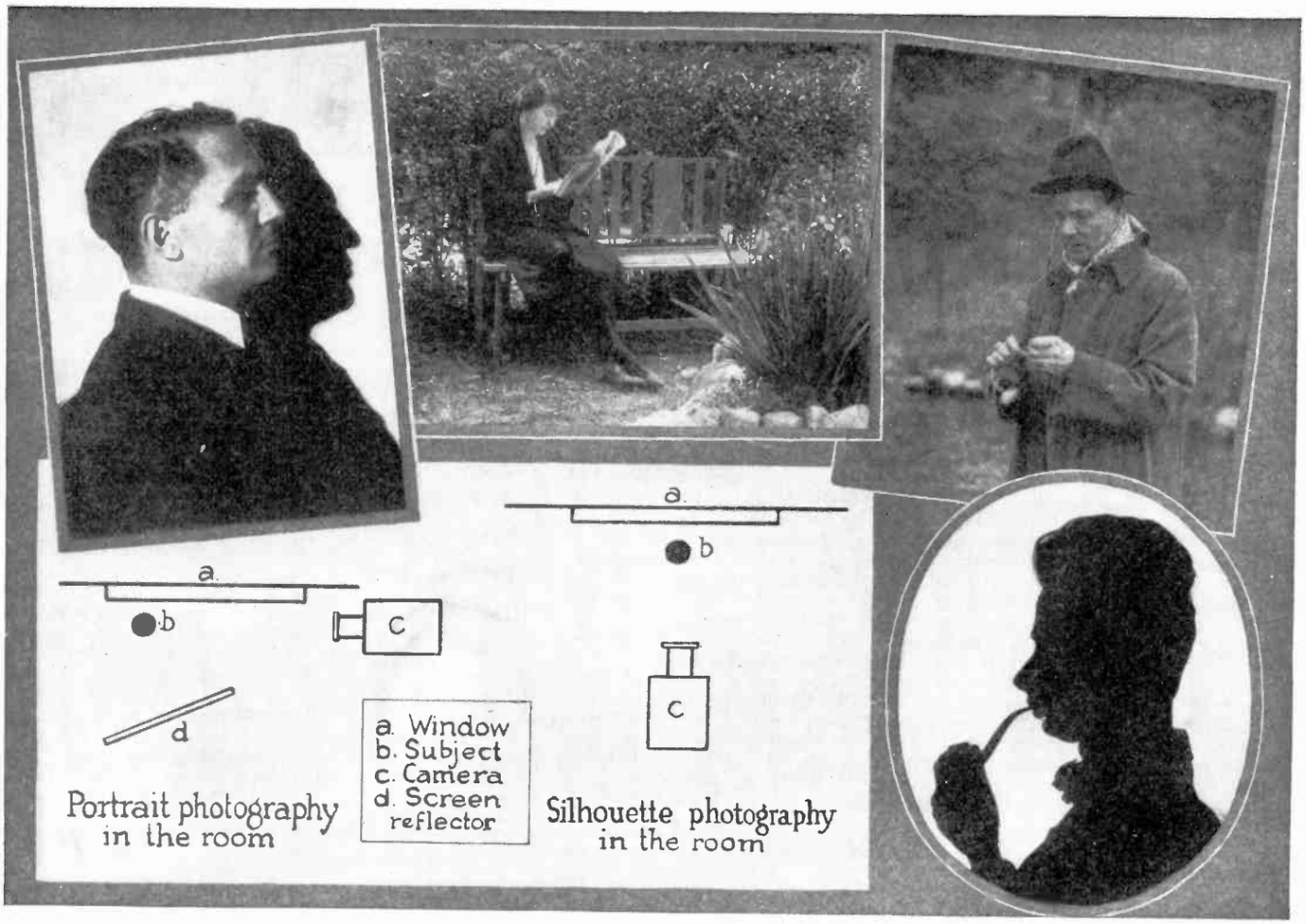


Complete details are given in the above illustration, and accompanying text by an expert, for building an electric refrigerating machine for home or laboratory use. As the commercial machines cost several hundred dollars in their complete form, and are, therefore, out of the reach of the average householder, this article will no doubt prove of extreme interest and value. The ice machine here shown, can be assembled for about $100.00 or less, as the author points out in his article.



The two diagrams above show how to arrange the camera, reflecting screen and subject, before the window for both portrait photography and silhouette photography. Several excellent examples are shown above of photo-portrait studies, including silhouette and shadow photography.

How to Use Your Camera

By Dr. ERNEST BADE

PART III—PORTRAIT PHOTOGRAPHY

A PERCEPTIBLE adverse influence has been felt for some years in portrait photography, the direct cause being traceable to the retoucher's brush. The photographic process is not so incomplete as to make this a necessity, in fact, no negative ought to be retouched. If it *is* done, it is a sign of the lack of photographic technic. Retouching spoils the negative, although it may often be well to fix smaller plate or film defects such as tiny holes, etc. These, when blackened, show white on the print, and it is this print which is most easily treated. Should the defective part consist of black spots and pin points, they can be removed by carefully rubbing with the point of a needle.

Artificiality in lighting effects, while taking poses, have practically been eliminated, because they tend to produce unnatural and forced facial expressions. Photos are desired, in fact demanded, which show life, individuality, character,—peculiarities destroyed by the retoucher's brush. The original negative should not be touched. All of the many knacks brought to bear upon it for the production of an artistic positive, are employed while enlarging, but mistakes both in lighting and developing, cannot be wholly rectified. The proper lighting, the emphasis placed upon certain parts and the repression of others which may detract from the value of the picture are problems which must be solved *before* the photo is taken. Pictures whose subjects are all out of focus are far from being artistic, although they are only too often considered as such.

The personal peculiaritics of the poser must be brought forth in portrait photography, otherwise it does not tell us anything it then being only a cold immobile reimpression of nature. Every landscape changes its character, it is different in the early morning hours than when the sun rides high in the heavens, far different in early afternoon than in the hours of twilight, different in summer and different in winter. And as nature has its own moods, so are the moods of man comparable to the seasons of the year. The only time a successful portrait can be taken is at a moment of relaxation and rest, then the character of the poser is easily read in his face. A self-conscious picture with a conventional grin is worthless, the face and the expression are distorted, it is a *mask* but not a *portrait*.

Groups and portraits are taken to the best advantage in an indirect light, such as can be found both in morning and afternoon hours, the rays then being lateral. When the sun is hidden behind a cloud, the light will also be perfect for this purpose, as no sharp shadows are cast. A picture taken in the open requires a careful selection of the background. If the latter is too sharp and distinct, with many high and low lights, the person will be lost in obscurity, it should be of the severest simplicity and be placed in the shadow.

If it is a portrait which is desired, then the background must be quiet, it should be of such nature that it lies between the highest lights and the deepest shadows. As a rule the light requirements are amply provided for in the modern dwellings with its large windows, especially if a very sensitive plate or film is used. Then an exposure of a few seconds is sufficient to secure good and well developed negatives. But here it is imperative to somewhat lighten the side of deepest shadow by reflectors of white paper or cloth. Mirrors are not so well adapted for this purpose as they reflect too much light making certain parts stand out too prominently.

Artificial lights, such as electric or gas mantle lights, are suitable for portraiture. But here it is essential that a very good lens, allowing much light to pass through it, is used and also the employment of more than one source of light is requisite. for only then can the hardness of the photo be softened. The lights must be placed quite near the person to be taken and so arranged that one illuminates the subject while the other softens the shadows. Care must be taken that the direct light from the lamps does not enter the lens of the camera. If the source of light is quite brilliant, an exposure of a few seconds will be sufficient. Such plates must be developed in a rapid developing bath.

(*Continued on page* 1106)

Electrostatic A.C. to D.C. Converters

By CLYDE J. FITCH

THE conversion of alternating currents into uni-directional currents of small amperage and at high voltage is most easily effected by means of the electrostatic converter—a combination of rectifiers and condensers. This type of converter is so easily and cheaply constructed that it is surprising it is not more popular, especially among the radio enthusiasts.

If a strip of aluminum and a strip of iron are immersed in a solution of sodium phosphate and connected to an alternating current circuit, a microscopically thin film of oxide forms on the aluminum strip. This film has the peculiar property of allowing current to flow through it in one direction, but not in the other direction. The current will flow from the solution through the film to the aluminum strip, but not from the aluminum strip through the film to the solution. This makes the active element of a very simple and reliable rectifier, and will be used in most of the following circuits.

Another important feature about the rectifying film is its high electrostatic capacity. The film is so thin that it forms an excellent condenser dielectric, for storing up an electric charge. The capacity of one square inch of this film is about 0.09 microfarad.

A simple condenser, of large capacity, that will stand a potential up to 150 volts can be made by immersing an aluminum plate and an iron strip in a solution of sodium phosphate; the aluminum plate constitutes one side of the condenser and the electrolyte constitutes the other side. The iron strip is merely an electric connection to the electrolyte. If the aluminum plate is 6" by 6" the condenser will have a capacity of about 6 microfarads. The aluminum plate is connected to the positive side of the line, and the iron strip to the negative side of the line, if used on a D.C. circuit. If the condenser is to be connected to an alternating current line two aluminum plates are used in place of one aluminum plate and one iron strip.

Figure 1 shows the simplest type of electrostatic converter. This converter consists of a rectifier and a condenser and they are connected in series to an alternating current line, with terminals brought out at A, B, and C. The direct current may be taken from either terminals A and B, or terminals B and C. The voltage across terminals B and C is equal to the maximum value of the alternating circuit voltage, neglecting losses; and if the capacity of the condenser is large and the amount of current withdrawn small, the potential will be practically constant. The voltage across terminals A and B is pulsating, the maximum value of which is equal to twice the maximum value of the alternating circuit voltage, and the minimum value is equal to zero.

The action of this converter may be explained as follows: Suppose the converter is connected to a 110 volt A.C. line, and the current of the first half cycle flows down the right hand wire. This will charge the condenser to the maximum value of the A.C. voltage, which in this case is $110 \times \sqrt{2}$ or 155 volts. The current of the next half cycle flows down the left hand wire, but this current cannot flow through the rectifier from the solution to the aluminum, opposite the direction indicated by the arrow, so the current flows from terminal A, through the external circuit to terminal B, and then through the condenser to the other side of the A.C. line. Therefore the condenser, which is charged to 155 volts, is discharged through the external circuit in series with the A.C. line, whose maximum voltage is 155, so that at every other half cycle the voltage across terminals A and B is 2×155 or 310 volts. The polarity of the terminals will be as indicated.

The actual D.C. voltage is about 87 per cent of the theoretical value; the losses are

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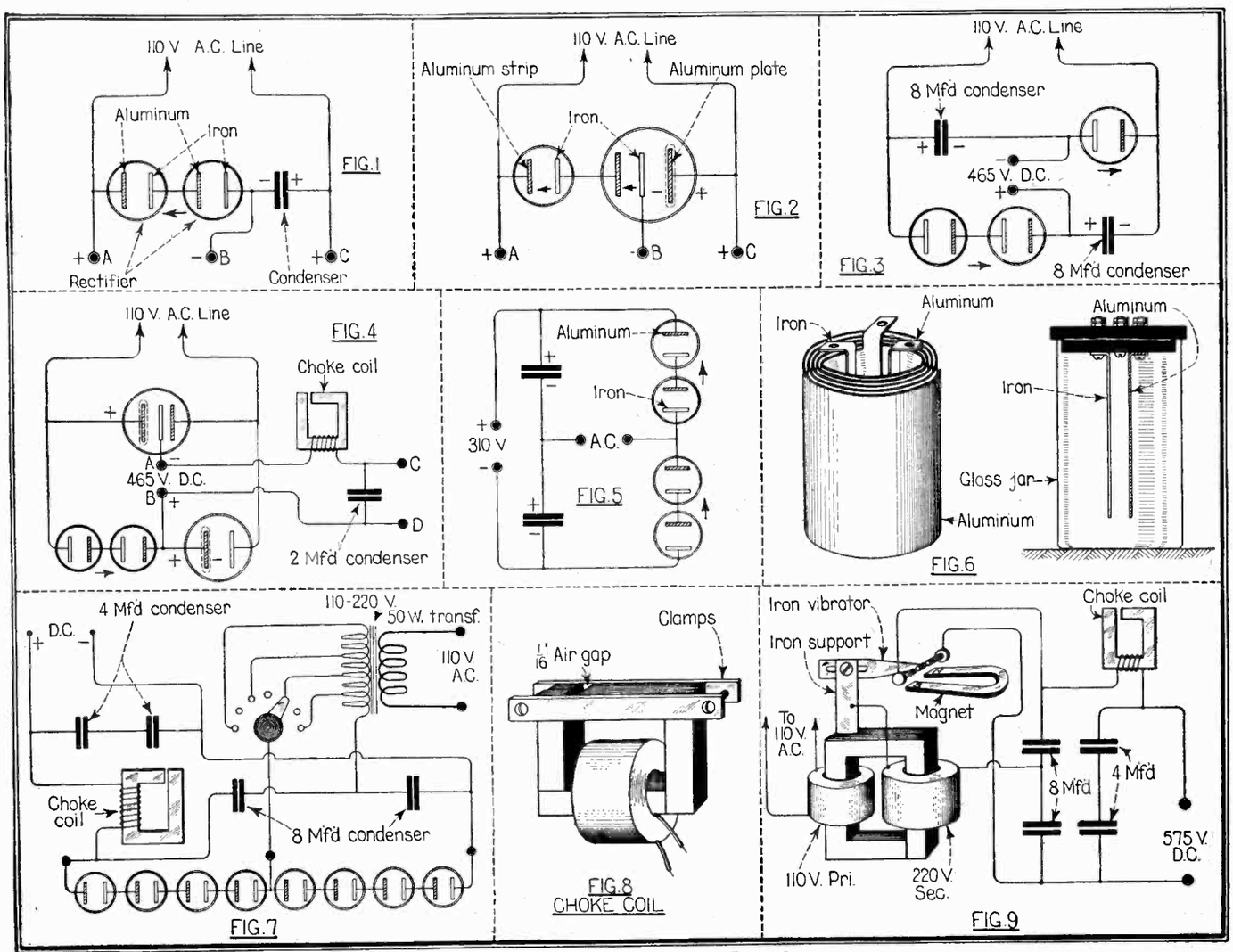


A number of interesting and novel circuit arrangements are shown above, for converting alternating currents into uni-directional currents of small amperage and high voltage, involving the use of the "electrostatic converter"—a combination of rectifiers and condensers. The rectifier units may be of the V. T. type, or electrolytic units employing aluminum and iron plates immersed in a suitable electrolyte, such as sodium phosphate. These circuits will be found valuable to radio men, and Mr. Fitch has used them for his radio set with gratifying results.

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $15.00

CAMERA DUPLICATOR

Ordinary duplicators for cameras work very well, but one which I recently built was found far more efficient than modern duplicators now found upon the market. A metal cap to fit the lens of the camera has two slots cut into it, as shown in the accompanying illustration. The barrel portion which fits over the lens is slotted, so that the cap can be secured rather firmly. Two small lugs are soldered to opposite ends of the barrel midway between the arched slots, and a vane or shutter is pivotally mounted between these lugs, so that it can be flipped to either one side or the other.

With equal exposures, first with the subject in front of the opening in the cap on one side, and then with the shield thrown over in the opposite direction opening the opposite side, the subject changing his position, photographs such as shown herewith, are possible. Notice particularly the fine definition in this photograph and the absence of a dividing line between the subjects. The device can be operated very speedily, and due to the fact that the vent is easily shifted, it is relatively impossible to disturb the camera on its tripod, as would be the case if the duplicator had to be turned around to make the picture. The diaphragm should be stopped down slightly for better results.

—Contributed by W. F. LENNOX.

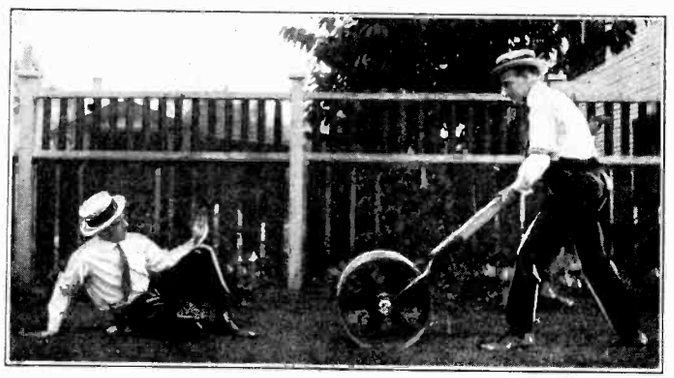
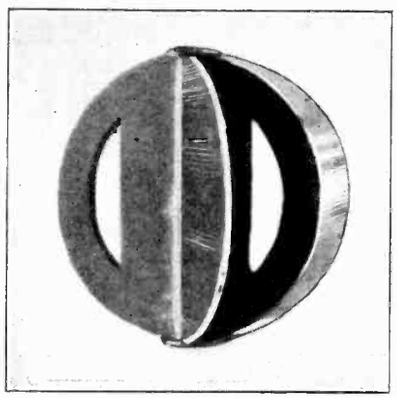


Photo at left shows remarkably clear double exposure made possible with the novel camera duplicator, here described by Mr. Lennox. Both of the figures in the picture represent the same man about to roll over himself with a lawn mower.

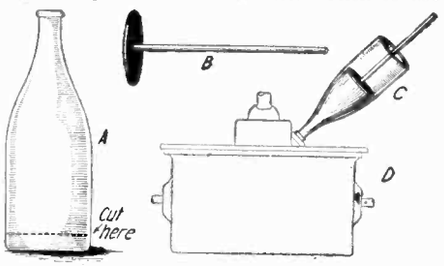


This picture shows the camera duplicator which fits over the lens. This duplicator results in very fine definition in the double exposure, as is evidenced by the photo reproduced above, the dividing line between the two half exposures being invisible.

SECOND PRIZE, $10.00

GREASE GUN

A round bottle of a size according to the choice of the user as in *A* is the first requirement. Take a glass-cutter and cut off as close to the bottom as possible, then make a plunger of wood as in *B* to fit as tight as possible in the bottle. Then to use the bottle as a grease gun fill the bottle with the hard oil and put the small end of the bottle in the place for the grease to be placed, then put the plunger in the bottle and push down thus forcing the grease out. To use it as a sausage stuffer do the same as in using the grease gun.



This home-made grease gun will be found handy around automobiles and other machinery.

This same bottle may be used as a funnel as in figure *D* also.

Contributed by WM. LINDEMAN.

THIRD PRIZE, $5.00

ROLL FILM DEVELOPER

Photography is one of my hobbies, and see-sawing films through the air is as tiresome to me as anyone else, if not more so, on account of the position of my developing table. So one afternoon, before developing, I arranged an apparatus such as shown in Fig. 1, out of my builder set, and hung it on a trolley-like arrangement over the developing table. The string-belt, which passed over the three pulleys terminated in two hooks, to which the film clips and film were fixed; one of these clips was weighted. It will take a bit of experimenting to find the best weight to use; I used a twenty-gram weight. It should be light enough, so that when the film is traveling down, the weight of the ascending film and clip just counterbalances it. This is so that when the film is released, it will not drop and splash in the tray, but slide down and slowly halt just as the other end is at its highest point. With this apparatus, only one hand is required, and that only moves in one direction.

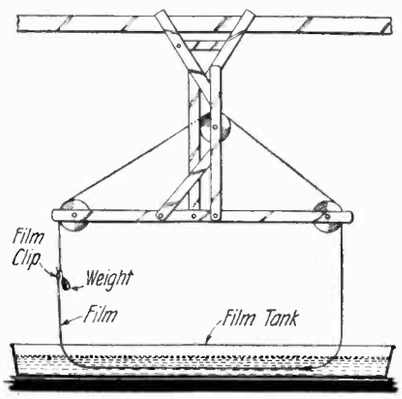


Fig. 1

One view of home-made device for developing roll films.

I tacked a small battery motor on the old frame, and fastened a movable lever with its idler pulley, as shown in Fig. 2, operating this on the same principle as the clutch on the old belt-drive motorcycles. I fitted the controlling arm with a string, trusting to a rubber band to pull it back. Pulling the string would connect the continuously running motor to the film-string, causing the film to walk right up, releasing the controlling string slightly would throw the motor out and Mr. Weight would accompany Mr. Film down again.

Contributed by CLARENCE P. SALMON.

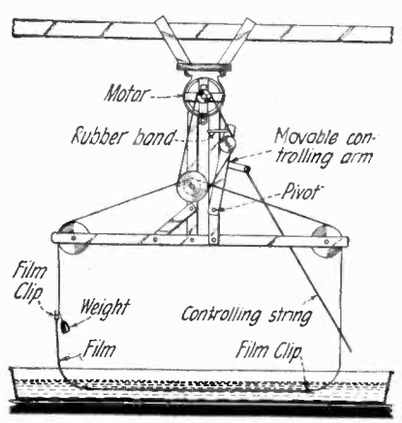
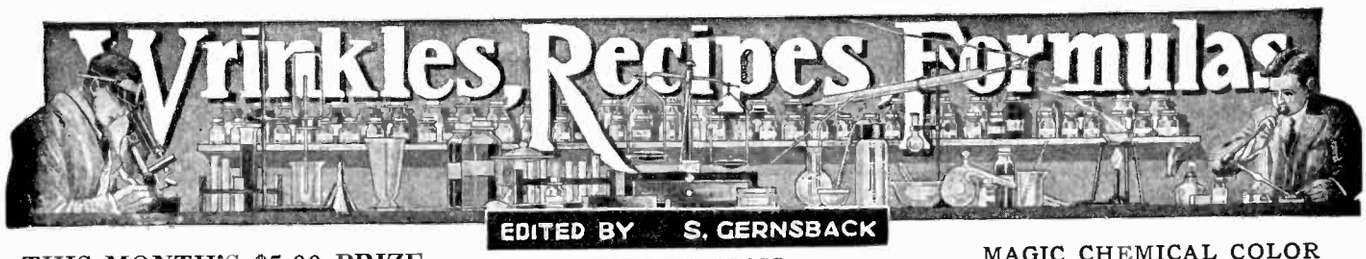


Fig. 2

Second view of home-made roll film developer, which is actuated by a small battery or other motor, in the manner shown. The motor drives the rocking arm through a belt, tightened or loosened by means of an idler pulley, operated by the controlling string shown.



THIS MONTH'S $5.00 PRIZE

HOW TO MAKE YOUR OWN SAL AMMONIAC

Without doubt most of the readers of this magazine have used the ordinary sal ammoniac battery in their experiments.

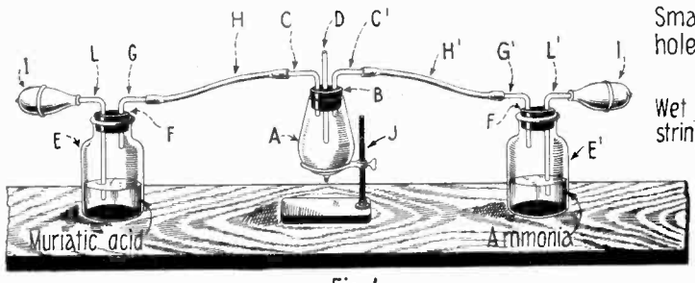


Fig. 1

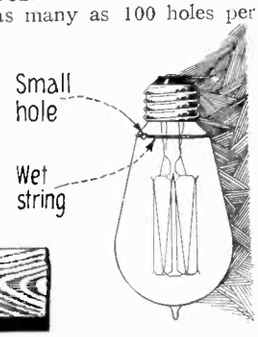


Fig. 2

With the simple apparatus set up as shown above, it is possible to make your own sal ammoniac. Diagram in Fig. 2 shows how to cut off base of incandescent lamp in order to make container A.

Some have possibly also made their own batteries, that is, everything except the battery compound. The following description will tell you how to make your own sal ammoniac.

In the diagram, Fig. 1 (A), is an incandescent lamp bulb with the plug removed. The plug may be removed as follows: File a small hole in the glass near the plug, which must be done cautiously, to admit the air. Then wind a wet string several times around the glass just above the place where the bulb is to be severed, as illustrated in Fig. 2. Then run a hot piece of metal around the lamp between the string and the plug. The glass will then crack in a straight line all the way round. With a slight blow, the plug will fall off.

In Fig. 1 (B), is a rubber stopper with three small holes (not too small), and C and C' are two bent glass tubes which pass through B. The two vapors enter the bulb through these. A straight glass tube D, passes through B, between C and C'. It should extend about three-quarters of the way down the bulb. This tube allows the excess air and gases, which are harmless, to escape. The bottles E, and E' contain muriatic acid and ammonia respectively. Of the other parts, F and F', are two-holed rubber stoppers, G and G' are two bent glass tubes which are connected to C and C' respectively by rubber tubes H and H', and L and L' are also two bent glass tubes, on one end of each there being attached a plumber's furnace bulb. The other ends dip almost to the bottom of the liquids.

A small stand for the lamp bulb may be made as follows: A piece of large gauge copper wire, about No. 8 or 10, is bent into a loop to fit the bottom of the bulb. Then bend the remaining piece at a right angle and insert the end in a base.

One thing is certain that to make the experiment work right, all joints must be tight. Now by pressing each of the plumber's bulbs simultaneously and with equal pressure, an equal amount of each of the gases enter the tube. As the gases mix in the bulb they unite to form sal ammoniac, which will gather on the sides and bottom of the glass in white flaky crystals. When the bulb is full, scrape it out and proceed as before.

Contributed by RAYMOND EKLUND.

DRILLING GLASS

I have seen in your magazine and others so many pitiful attempts to describe methods for drilling holes in glass that for sheer pity I am going to tell how it is done professionally. This is a trade secret but—radio youth must be served.

I have drilled as many as 100 holes per hour in opalite—so hard that an ordinary glass cutter will not touch it. Many holes are only one-quarter of an inch from corners and I *never* crack a glass—*while drilling*.

Nine-tenths of success depends on the drill and one-tenth on the manner in which it is used, both of which I describe.

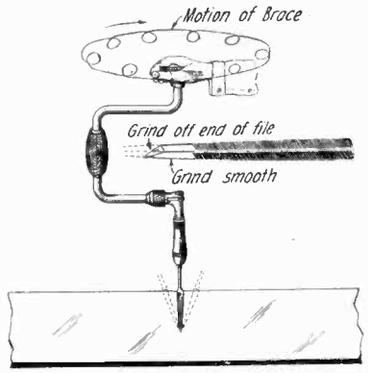


Illustration above shows how file is ground to make drill for use in boring holes through glass, also method of using brace and drill.

Procure a 3-cornered file and dress as per cut, on an emery wheel, turning very slowly and removing file very often, so the point will not burn and lose its temper.

This shape throws the point *off center*, which is the *successful* secret of the *drill*. Sharpen the bevel point often and merely touch up the long sides, on a fine oil stone. Fasten the drill in a common carpenter's brace, place the point on the glass in a drop of turpentine and *spin it* with the hand on top of the brace and the offset handle as a counterbalance. The *slower* you spin it the *faster* it cuts; you cannot use it in an electric drill.

While it is spinning, the hand describes a circle about one foot in diameter, which is the second secret, as this method makes the hole *larger* at the top and the off-set point takes care of the bottom in like manner, so your drill will *never bind*, which is the cause of breakage.

Incidentally, this drill is better for bakelite and hard rubber, etc., than a regular drill.

Contributed by W. M. ROCKWELL.

MAGIC CHEMICAL COLOR CHANGING

In a test tube half full of water, put about 2 c.c. of phenolphthalein solution. Exhibit this milky liquid to your audience. Then drop a good sized pinch of sodium carbonate in the solution, which turns it red. Now if the same amount of copper sulphate is dropped in, it turns purple; but if shaken a blue color results. A large pinch of Glauber's Salt (sodium sulphate) turns the blue to dark green. Next drop a good sized pinch of sodium bisulphide into it, and a brown color results. Then if that same quantity of tartaric acid is added, the brown turns to dark green. Add still another pinch of the acid and a beautiful light green is formed. A pinch of iron sulphate is added, but nothing happens. Then if a few crystals of potassium bichromate are dropped in the solution, nothing happens until the mixture is stirred, when it turns back to dark green again. It cannot be shaken because gas is liberated. The mixture is liable to boil over, so it is best to perform the tricks over a newspaper spread on the table to prevent soiling it.

Contributed by D. R. HOAG.

THE MAGIC KNIFE

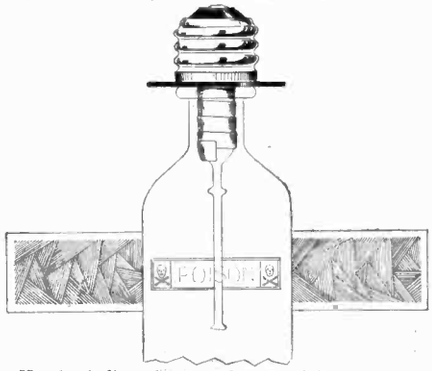
In a glass half full of water, put three grams of sodium bisulphate, and when this has been dissolved, put in another glass half full of water, three or four drops of phenolpthalein solution. Rub your arm with a sponge soaked in the first solution, and moisten the knife with the second solution. You are now ready for the experiment. Viciously (but carefully), slash at your arm, making sure that the flat part of the moistened knife comes in contact with your wet arm. After a few moments, the audience will see a reddish substance, like blood, covering the supposed slash.

Contributed by JOSE R. DEL GALLEGO.

IODINE DROPPER

A simple way to make an effectual dropper for the iodine bottle is to use an old electric light bulb for this purpose. Break all of the glass away with the exception of the central solid glass stem, and see that all the wires are removed from this. Now slip a rubber washer over the same, so that it fits against the screw plug tightly, and then wind several layers of friction tape around the top to act as a cork. With this dropper, wounds can be treated without soiling the hands.

Contributed by H. W. JACKSON.



Handy iodine dropper for the laboratory or home use, made from the base and glass stem of a discarded incandescent lamp, the glass being broken away with a pair of pliers.

RADIO DEPARTMENT

Talking Across the Atlantic

AN important demonstration of trans-oceanic radio telephony occurred Sunday evening, Jan. 14th, when H. B. Thayer, President of the American Telephone and Telegraph Company, speaking at the offices of the Company, 195 Broadway, New York City, was heard by a group of well-known electrical engineers and others assembled at New Southgate, a suburb of London, England. The transmission by radio telephone was declared by all who witnessed the test to be in every way satisfactory. The radio apparatus and system used in this test have been made possible by co-operation betwen the American Telephone and Telegraph Company and the Radio Corporation of America, and are the result of research and experimental work in the laboratories of the A. T. & T. Company and in the laboratories of the Radio Corporation of America and its associated companies.

In 1915, engineers of the A. T. & T. Co. succeeded in talking by radio telephone from the Naval Station at Arlington, Virginia, across the Atlantic to Paris, and the same messages were heard 5,000 miles to the westward at Honolulu. Since then great improvements have been made in the two arts of radio telephony and telephony. In the experiments which are now being conducted and those which are scheduled to follow, use is being made of these improvements.

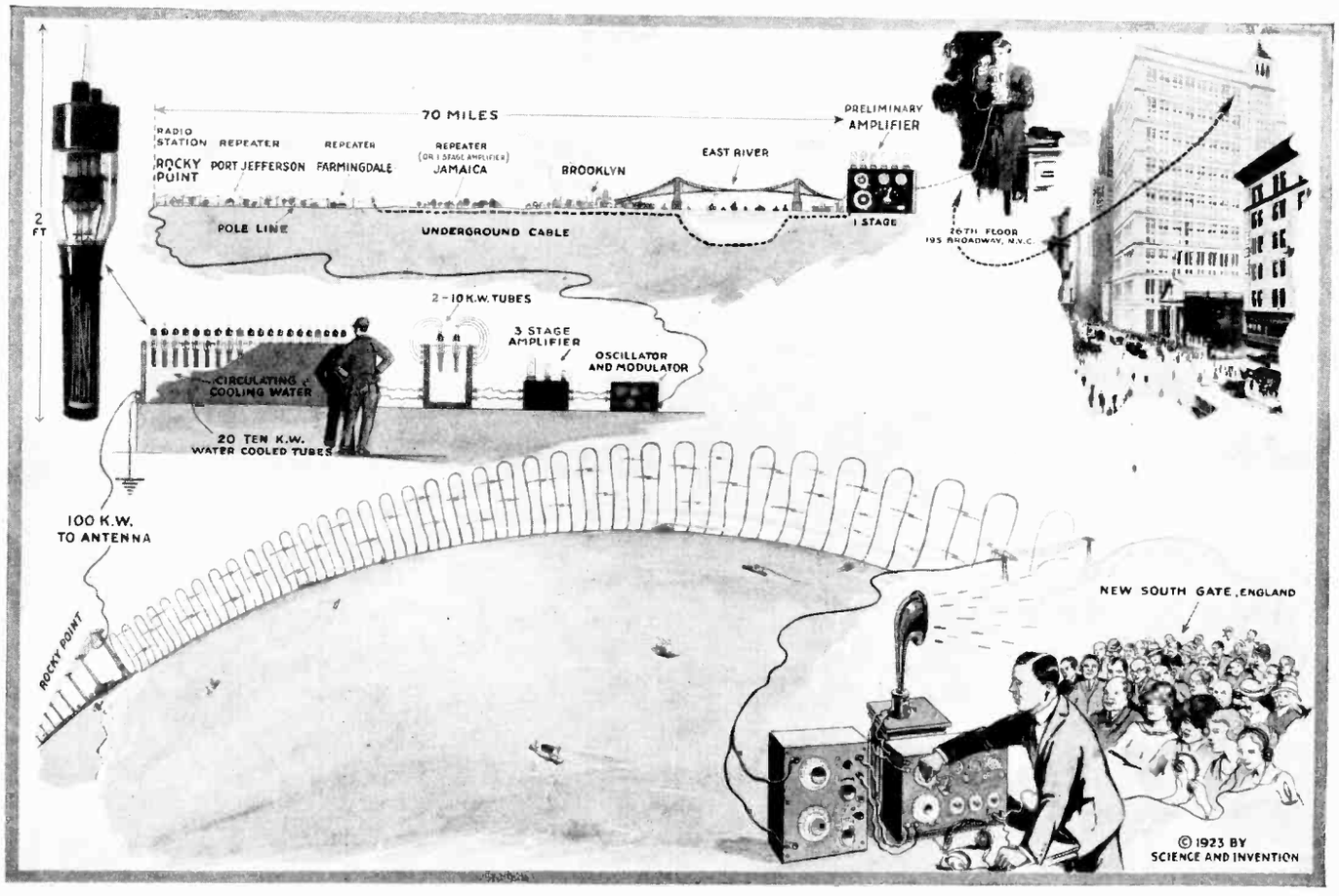
One of the developments which has been in progress since the telephone company's demonstration of trans-oceanic radio telephony in 1915 has to do with the perfection of high powered vacuum tubes. The tubes used in the present tests are characterized by a large external anode which is cooled by water. By virtue of water-cooling each tube can readily handle as much as 10 kilowatts of power.

In the present installation, which is located at the large station of the Radio Corporation of America, at Rocky Point, the final stage of amplification comprises a group of 20 of these tubes operating in parallel. The output of 100 kilowatts is delivered to the antenna and, due to a new system of radio transmission employed, is as effective as 300 kilowatts would be in the systems commonly used. In the systems commonly in use about two-thirds of the energy goes into waves other than those which comprise the message, these waves being needed by many of the receiving sets in use for detection of the message. The new system suppresses the waves which do not comprise the message and reception is accomplished by generating locally at the receiving set a small high frequency current, which corresponds in frequency to the suppressed waves.

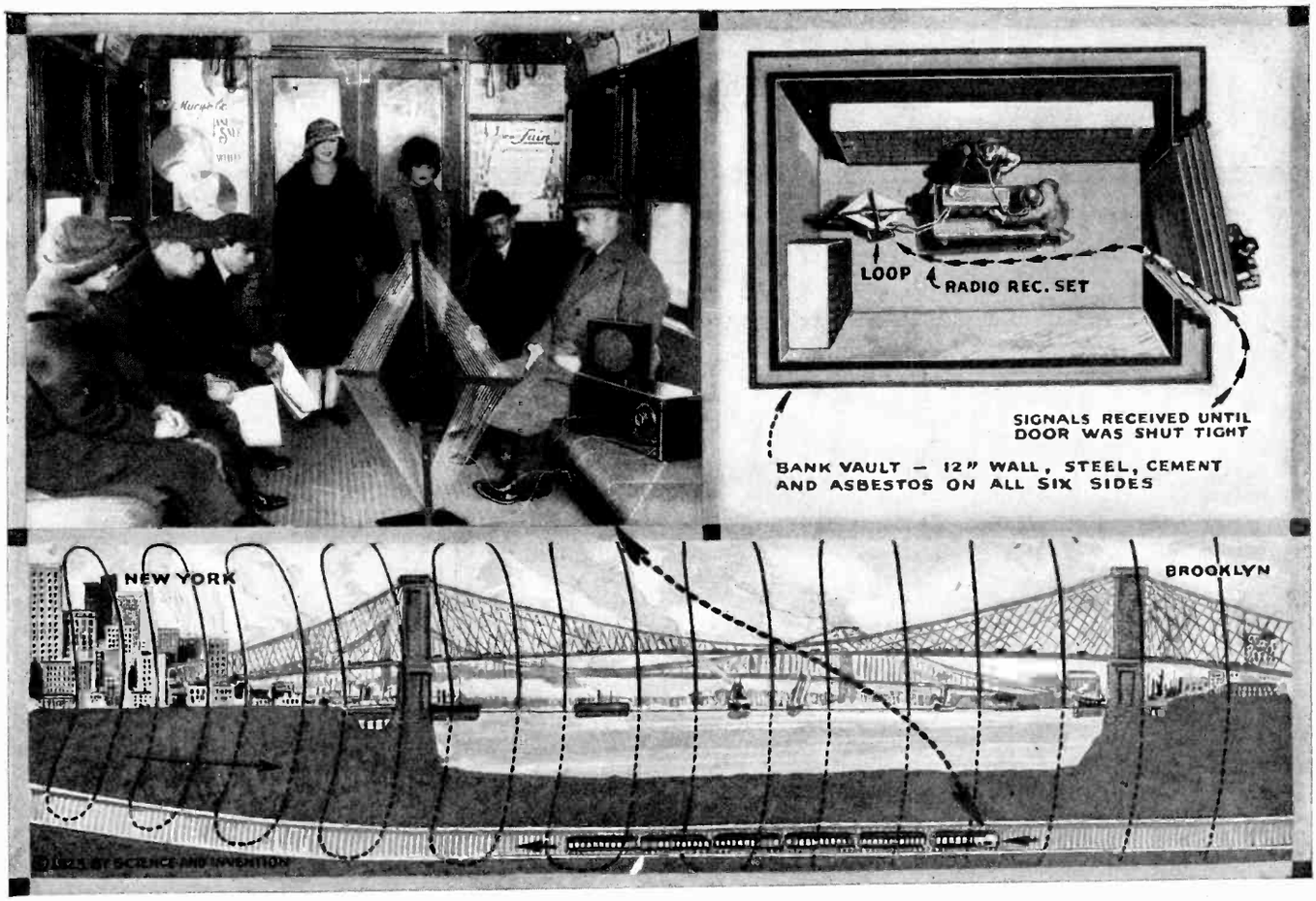
Just what is provided by the new system of radio transmission is clearly shown in our diagram which should be read from left to right. The speaker's voice supplies a band of speech waves extending from the frequency of about 200 to 5,000. A vacuum tube oscillator supplies a high frequency wave the so-called *carrier wave* which, for the purpose of illustration, we have taken at 50,000 cycles. Before modulation the speech wave and the carrier wave are entirely distinct. After modulation we no longer have any speech waves as such, but we have two new sets of high frequency waves, one ranging from 50,200 up to 55,000 cycles and the other from 49,800 down to 45,000. These two new sets of high frequency waves are known as the side bands.

In the usual radio telephone transmitter both side bands as well as the carrier wave are radiated out into the ether. Approximately, we may say that in these systems two-thirds of the high frequency energy is assigned to the carrier wave and one-sixth to each of the side bands.

(*Continued on page* 1133)



When the human voice was projected across the Atlantic the other day, from the twenty-sixth story of the American Telephone and Telegraph Company's building, in New York City, to a building located at New Southgate, England, the powerful vacuum tube apparatus illustrated above, was brought into action by the weak voice currents of the speakers in New York City. Return speech from England to America was not demonstrated, as the proper apparatus had not been shipped across the ocean in time, but a number of important and interesting tests were made in the transmission from America to England. The various links in the combination wire and wireless circuits, are clearly shown in the photo-diagram herewith, thanks to the courtesy of the company who made this remarkable feat possible.



The photograph at left shows the actual receiving apparatus and loop aerial employed in successful reception tests of radiophone broadcast concerts, on tube train while under East River, passing from Brooklyn to New York City. The ground waves are shown as well as the space waves above the ground and water.

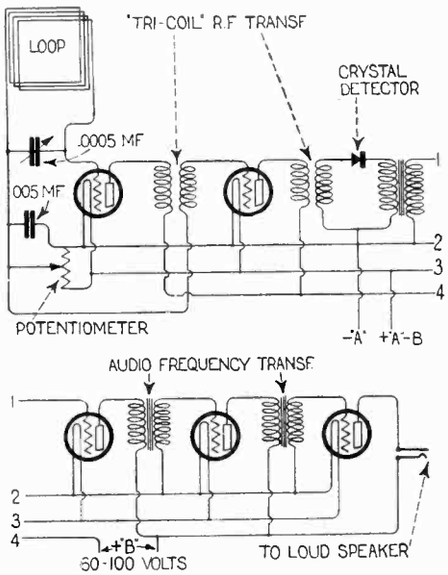
Receives Radio Broadcast Under River

A SUCCESSFUL demonstration of the practicability of receiving radio messages underground, despite intervening steel construction and interference due to induction from other electrical apparatus, was made recently in the subway. Not only were messages received all along the line of the subway tunnel, but part of the concert being broadcasted by WEAF, at the station at 24 Walker Street, New York City, was clearly heard in the middle of the tube under the East River, half way between Manhattan and Brooklyn.

The radio receiving set, which is the invention of John Clyde Davidson, a radio engineer, was placed on the rear platform of a regular train, which started at Atlantic Avenue, Brooklyn, and ran to the other end of the line in the Bronx and back again. The door leading to the rear platform was closed and, as head phones were used for receiving, few, if any, of the passengers knew that the test was in progress.

A loop aerial four feet high and two feet wide was used in the receiving set, which, although only eighteen inches long and seven inches wide, was equipped with a radio and audio frequency circuit. W. H. Kinlock, chief telephone and lighting engineer for the Interborough; F. E. Heger, his assistant; E. L. Bragien, a radio expert of Manhattan, and David H. Engelson and Jesse Fishel, were present at the test, which was in charge of the inventor.

Mr. Kinlock said that the test was very satisfactory and that near-by broadcasting stations could be heard with perfect clearness in the tunnel when the conditions in it were favorable. He said that there was considerable interference by induction from passing trains, as well as from the motors on the train carrying the set.



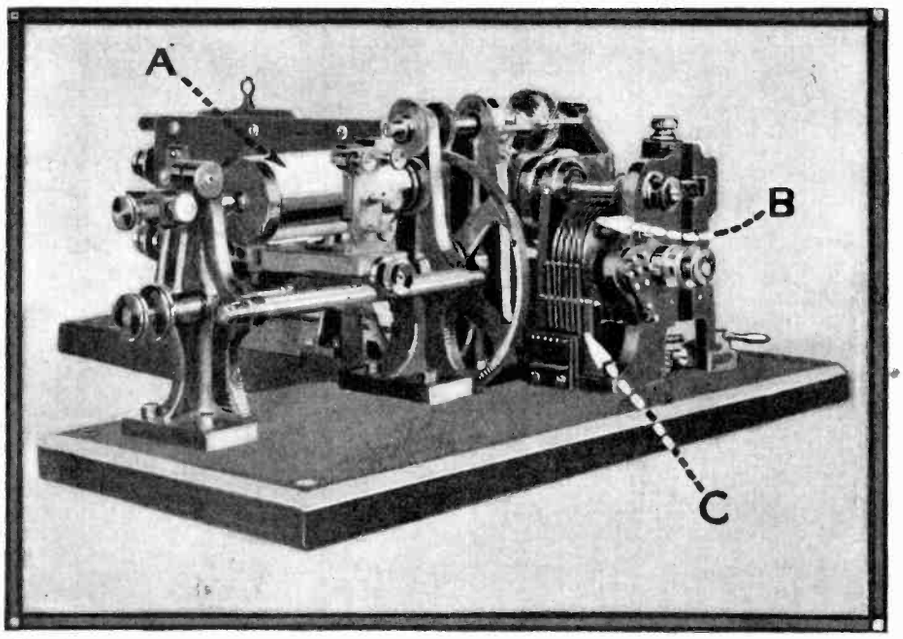
Hook up of radio frequency and audio-frequency V. T. amplifiers, as well as crystal detector used in receiving radio broadcast concerts in tube train under river.

A little later on a very interesting test was made in a large sealed vault of the Interborough Rapid Transit Company, when the same receiving set, a diagram of connections of which is given herewith, was successful in picking up radiophone broadcast messages inside the steel walled room, up until the point where the heavy safe-style door was almost closed. The radiophone music and talk proceeded until the opening in the door would just permit a piece of writing paper to be placed between it and the door frame. When the door was finally sealed and locked, the radio music ceased.

Off hand, it would have seemed that even with the steel vault door open, there would have been sufficient absorption by the steel walls to prevent the operation of the radio receiving set within it. This philosophy would also seem to have come into effect in the subway experiments, where the receiving set was practically enclosed with the steel shell of the car, and also within the steel and concrete subway tube. It is possible, of course, in the subway experiments under the river, that induction currents or waves were carried along through the subway from land by the two running rails, the insulated third rail, or possibly by the pipes and wires running along through the tube, and that the radio set on board the train picked up waves by induction from these rails or pipes.

Secrecy in Radio at Last

By A. P. PECK



The photograph above shows the Crypto apparatus, and "A," the cylinder upon which is mounted the photograph or message to be transmitted. "B" denotes the Crypto discs, and "C," the pawls which close contacts as the discs revolve.

FOR years the development of radio has been hindered by the fact that messages sent out could be picked up by anyone equipped with a receiving set. Obviously this was a disadvantage in commercial enterprises, as well as in times of war. Various subterfuges, such as high speed transmission and reception by machine, have been used with greater or lesser success, but it has been left to M. Edouard Belin to solve this problem, and he has done it in a very simple, yet positive manner.

M. Belin is the inventor of the well known apparatus for the transmission of photographs by wire, and his *Crypto* has been applied to this work. The *New York World* has purchased exclusive rights to the apparatus for transmission of photographs by wire, and will use it extensively in their work.

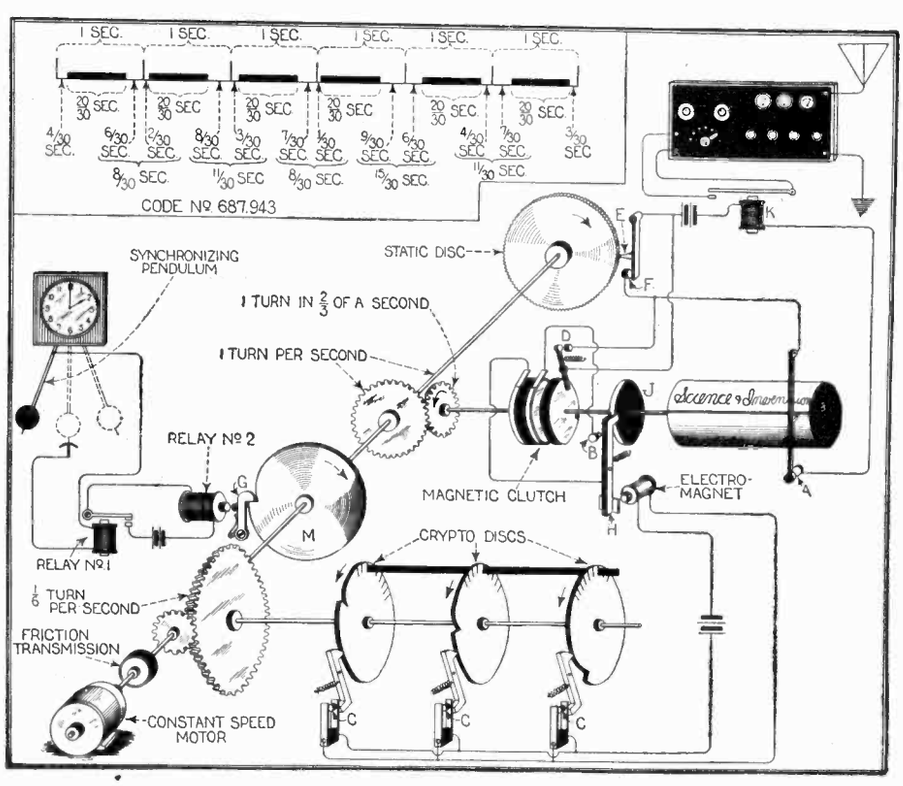
The Crypto cannot be applied to ordinary radio communication, but it can serve its purpose in this work by transmitting a photograph or fac-simile of the message by Belin's process, and using the "Crypto in connection therewith. In the standard apparatus that does not use the Crypto, the transmitting and receiving cylinders have to rotate in perfect synchronism. "This is obtained," writes Arthur Benington of the editorial staff of the *World*, "by making the receiving cylinder revolve a minute fraction of a second slower than the sending cylinder. At the end of each revolution, the latter stops, and a current of the opposite direction to that formerly employed, is sent out for the same fraction of a second. By means of this current the rotations of the two cylinders are synchronized. Thus, at the beginning of the next second, both the transmitting and receiving cylinders will be in perfect synchronism." While it takes some time to describe this action, still the reader must realize that it all takes place in a very small fraction of a minute. Since such perfect synchronism is necessary, the cylinders are controlled by electric chronometers at each end of the line. When the operator at the transmitting station desires to communicate, he sends out automatically, by means of his chronometer, dots corresponding with seconds. These are picked up by the other operator, and his chronometer is automatically set in absolute synchronism with that at the transmitting station. All this accuracy is necessary, for, if there is the slightest amount of lag in either the transmitter or the receiver at any time, the resultant message will be a mere jumble of dots.

This synchronism between the two stations is made use of by M. Belin in his Crypto or to quote Mr. Benington, "the anti-capturer". As explained to the writer by M. Belin in a recent interview, the Crypto regulates the revolutions of the cylinders in such a way that while the transmitting cylinder is revolving, the receiving cylinder is revolving also, and when the former stops for a fraction of a second, the latter does the same. The intervals of rotation which, themselves, are always of the same length, are interspersed with *periods of quiet*. These latter can be readily controlled, so that thousands of different "codes" are possible.

The Crypto consists in the main of six discs mounted upon an axle about 1/12 of

(*Continued on page* 1134)

A simplified diagram of the Belin apparatus for the transmission of photographs by wire or radio, together with the "Crypto," is here given. For greater simplification only three of the six Crypto discs are shown. The main shaft which is turned by a motor, connects through a friction transmission with a gear which drives the Crypto discs; a controlling wheel; the gear which turns the cylinder; and also a "static disc" which sends out manufactured interference so as to prevent reception of the message in case anyone should possibly stumble upon a method of translating it. This is labelled "static disc." By means of the synchronizing clock and its attendant relays and battery, the speed of rotation of the disc M and consequently of its shaft, is kept in absolute synchronism with that in the receiving station. The disc M revolves one turn in 59/60ths of a second, but it is held until the end of that second by the tooth G, whereupon it is released by relay No. 2. The Crypto discs are driven at a speed of 1/6th revolution per second, whereupon each disc controls one revolution of the cylinder, by means of the contacts C; the battery and the electro-magnet. The cylinder is driven through the magnetic clutch at a speed of one turn in 2/3rds of a second. By means of the lever H and a slot in the disc J, in connection with the contact B, the magnetic clutch is opened and closed. By means of the contact D, which closes when the clutch is closed, the static disc or interference manufacturer is short-circuited and the actual message or photograph is sent by means of the relay marked K to the radio transmitter. When the clutch is opened, the contact F is opened and closed by the indentations on the static disc, sending out independent signals to create interference. At these periods the contact A is closed because of the fact that the contact on the message is resting in an indentation in the cylinder. In the insert is shown a schematic diagram illustrationg graphically the periods of rotation of the cylinder upon which is mounted the photograph to be transmitted, together with the spaces of varying lengths between these periods.



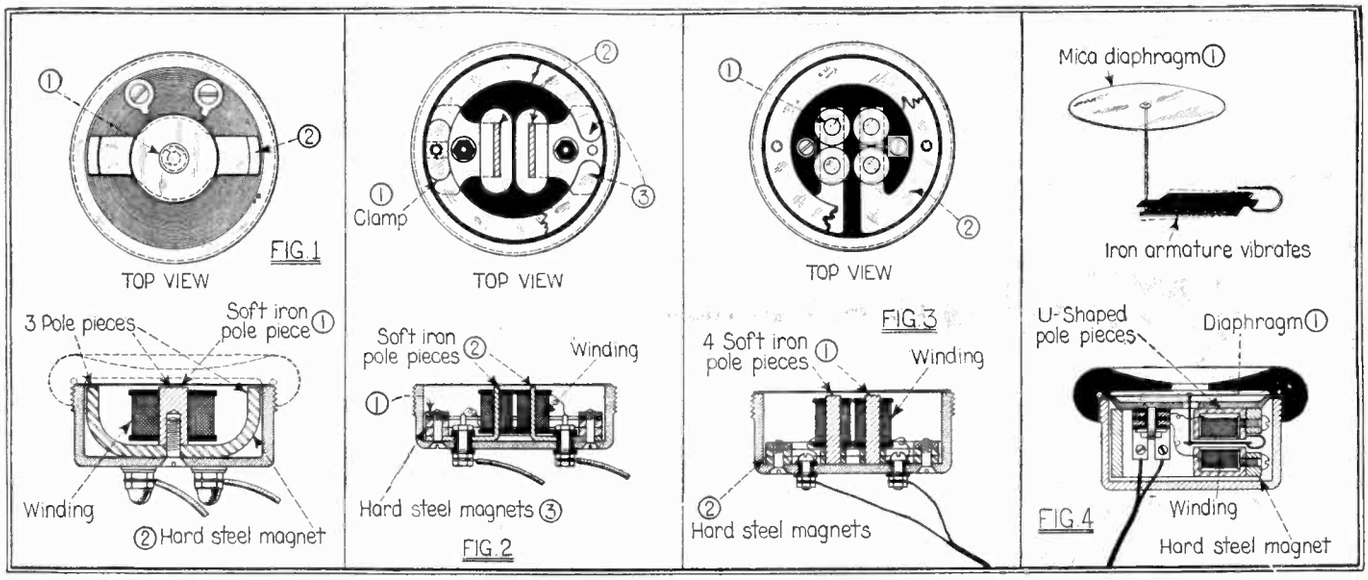


Fig. 1 at left shows one of the latest type radio receivers, having three poles with a magnet coil wound on the center one, giving a very even and well distributed pull on the diaphragm. Fig. 2 shows the "insides" of a well-known double-pole type radio receiver, the two poles being of opposite polarity. Fig. 3 shows one of the newer types of radio receivers having four poles of alternate magnetic polarity. A very even and powerful pull is obtained from this design, and more ampere-turns in a given space are possible, so the makers claim. Fig. 4 shows the "works" of the famous Baldwin receiver, so widely used in building loud-talkers, etc. This phone, owing to the lever arrangement connecting its diaphragm with the light iron armature, suspended in the center of the magnet coil, has a decided amplifying effect.

Radio for the Beginner

By ARMSTRONG PERRY

HOW TO SELECT A HEAD SET

MY first telephone was a single 75-ohm ear-piece that cost seventy-five cents plus half a dollar for a leather-covered steel spring to hold it on my head. I still use it sometimes for comparison with others. With from fifty to one hundred feet of antenna wire, properly installed, the usual ground connection through a steam radiator or water pipe, and a crystal detector I can hear most of the local broadcasts in any of the several cities where I have tried it. If the room is quiet I can hear the music, speech and code with satisfactory distinctness. Such an outfit costs less than ten dollars even at the present prices and it would satisfy, at least temporarily, any boy of ten or twelve who was not discouraged by the contempt that persons who are able to own better apparatus sometimes show to others less fortunate.

When I reached a point where I wanted something better I bought a double head set of 3000 ohms resistance, paying $5.50. The same general type of phone is produced by a number of manufacturers. The diaphragm is metal. It is actuated by a magnet which can be seen by unscrewing the cap and removing the diaphragm. This set has given good service for several years without appreciable wear. Its only serious fault is that the head band is so constructed that it invariably pulls my hair when I try to adjust it to my head or take it off.

Then there came a time when I wanted the best phone regardless of price. The testimony of everyone I asked favored a certain phone with a mica diaphragm. I purchased a double head set for twelve dollars, a price that was promptly increased as soon as the general public went in for radio. I found that this pair would bring in stations that I could not hear at all with less sensitive phones. The reason seems to be that the diaphragm is thinner and therefore more easily vibrated, and that the pull of the magnet is applied through mechanical members that help to produce an amplitude of vibration much greater than usual. The manufacturer's claim that this phone gives as much increase of signal strength as one stage of audio frequency amplification is apparently true, though I have not tested it with mathematical accuracy. This phone is heavier than some others and that is a disadvantage when it is worn for three or four hours at a stretch, because the weight is tiresome until you get used to it.

The up-and-down adjustment is a great improvement over that on the cheaper phone and it has been adopted by a number of manufacturers. A rod attached to the ear-piece slides in a hole in a piece of metal attached to the head band. The pressure of the springs that hold the ear pieces against the ears is sufficient to keep the rod stationary wherever it is placed. Either ear piece can be moved up or down with one hand in an instant. Some other phones using similar head bands and attachments have setscrews for fastening the ear pieces at the desired height. This may be an advantage when the phones are being used principally by one person and the operator wants to put them on and off frequently, for it saves a moment of readjustment each time they are put on.

The head bands are bent into a small circle so that the set can be shipped in a smaller box than would be necessary if they were more extended. Not knowing that the springs could be bent without injury I suffered more or less from the tight pressure of the ear pieces on my skull. An operator showed me that by working the springs carefully, bending them a very little at a time at each spot along their whole length and avoiding a sharp bend at any one point, I could adjust them so that they would be neither uncomfortably tight nor too loose.

During the past year I have tried several of the new phones. Most of them use a 1¾-inch metal diaphragm and magnets differing but slightly in construction and application from those of my second pair. There are sometimes noticeable differences in results that seem to be due to better or poorer engineering or workmanship. A carelessly constructed phone usually reveals its character to the eye if it is examined closely but of course a test under the beginner's home conditions is the surest means of discovering what it will do.

One pair, bearing a foreign trademark, has diaphragms 2¼ inches in diameter and between the diaphragm and the part, on which it rests, is a thin metal ring. The music or speech heard through this set gives the impression of being somewhat weaker than it is when phones with smaller diaphragms are used, but it has roundness and sweetness that none of the others can equal.

Now in the selection of phones, as in the selection of any other part of the equipment, the beginner needs to consider what use they will have. Usually the manufacturer and dealer rate a phone by its resistance in ohms, which depends upon the material, size and length and material (unfortunately) of the wire in the electro-magnet that actuates the diaphragm. The 75-ohm phone may not respond at all to a weak current that will produce satisfactory audibility in the phone with a mica diaphragm. On the other hand I made one test in which a fifty-five cent phone gave just as good results on code signals from a high power station near at hand as the pair that I paid sixteen dollars for. If what I wanted to hear came entirely from the high power station I would save the fifteen forty-five. Also, if there were young children in the house, I would provide them with a cheap and strongly constructed phone rather than to

(*Continued on page* 1135)

Some of the Interesting Articles Appearing in the March Issue of RADIO NEWS

Experiments With the Two Plate Condenser Antenna. By John C. Warner.

A New Non-Interfering Detector Tube.

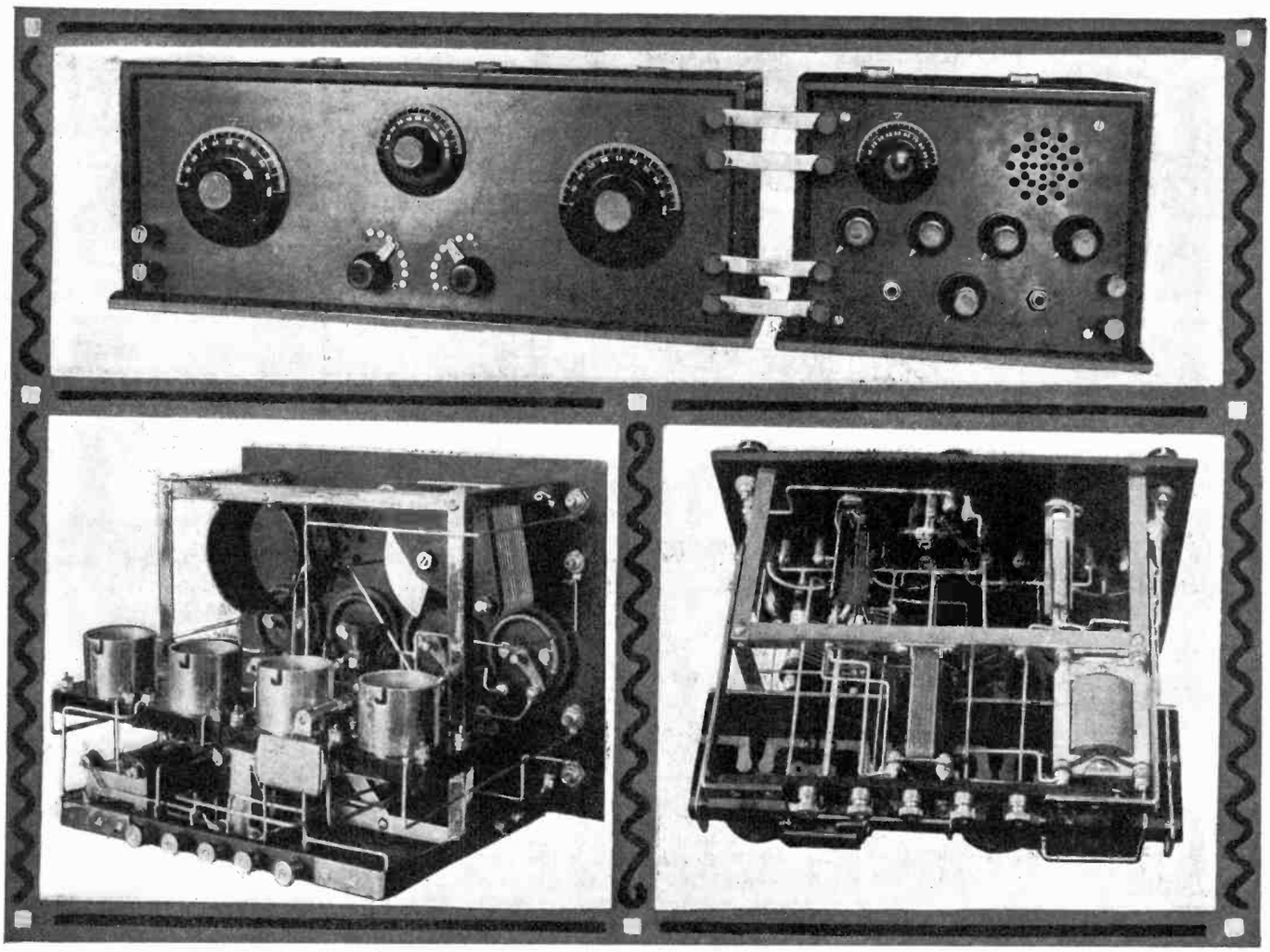
The Radio Flivver. By Stanley Edgar.

A Selective Multi-Range Regenerative Receiver. By Kenneth Harkness.

Broadcast Reception and Receivers. By John Bront.

Electron, Electric Waves and Wireless Telephony. By Dr. J. A. Fleming.

The Construction of a Loop Aerial. By D. R. Clemons.



Top photograph shows amplifier described below connected to a standard three circuit tuner. Lower left: General rear view of amplifier. Lower right: Bottom view of amplifier showing transformer and socket mountings.

An Amplifier for Your Present Tuner

By BERT T. BONAVENTURE

RADIO frequency amplification at present is quite the rage, and not without reason is it so. Many, no doubt, would like to build an amplifier for use in conjunction with their present tuner, that would incorporate at least one stage of radio frequency amplification. It is with pleasure that the writer submits the following design for such an amplifier. It is the last word in compactness, occupying a panel space of but 10 by 7 inches and extends only 7 inches deep. The one stage of radio frequency amplification is of the tuned plate impedance type, recognized as the most efficient method of radio frequency amplification. The compactness in no way detracts from the efficient working of the amplifier, as the layout is such that leads have been kept very short. Ruggedness and efficiency have been the keynotes in this construction and design. The general appearance can be judged from the accompanying photographs.

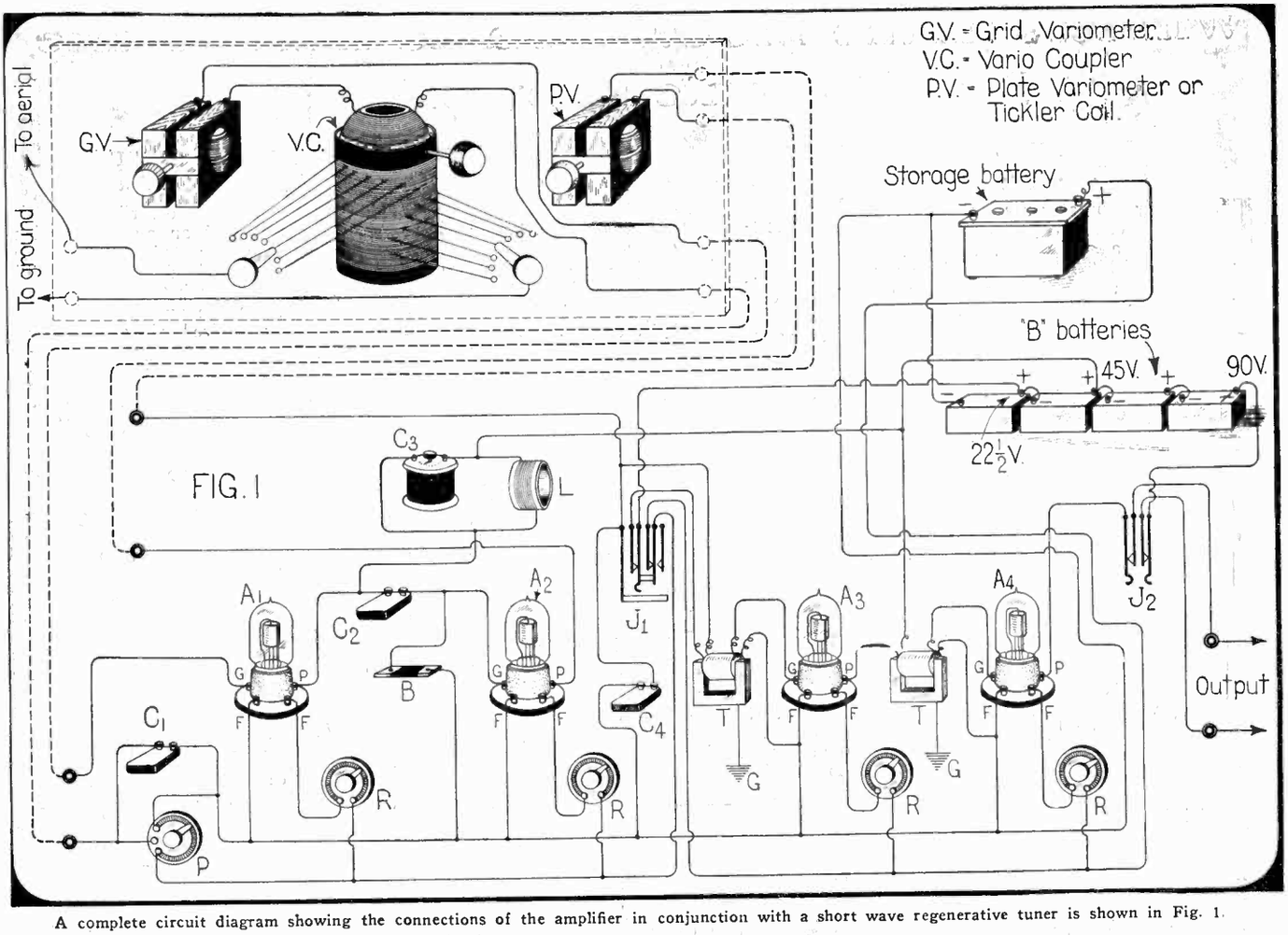
Below is listed such apparatus as was used in the construction of this outfit. No specific makes of apparatus can be recommended for purely ethical reasons, but it cannot be too strongly recommended that only the best of materials be used in the assembly. Cheap material may please the eye, but invariably such apparatus ceases to give good service in a remarkably short space of time. The writer has had several unsatisfactory experiences of this nature with the now famous New York "gyp" dealers, and has decided that dependability over-balance low cost by far.

Apparatus Required

1 Bakelite panel, 7 by 10 by $\frac{3}{16}$ inches.
4 Sockets, preferably of the panel mounting type.
4 Rheostats, also panel mounting.
1 Potentiometer (200 to 400 ohms).
2 Audio frequency amplifying transformers.
1 23 Plate variable condenser.
3 Mica condensers (.001, .005, and .00025 microfarads).
1 Double contact filament control jack.
1 Double contact jack.
1 Grid leak (value varying with tube used; usually 2 megohms for a Radiotron tube).
11 Binding posts.
4 feet $\frac{3}{8}$-inch angle brass.
1 Strip of bakelite, $\frac{3}{16}$ by $\frac{1}{2}$ by 8 inches.
4 Lengths of bus bar wire.
1 Bakelite tube, $2\frac{5}{8}$ inches diameter by $1\frac{1}{2}$ inches long.
Miscellaneous brass stock.

Before starting with our actual construction, let us examine the circuit we are going to use, as illustrated in Fig. 1. It will be seen that only two jacks are used, one in the detector circuit and one in the second stage of audio frequency amplification. When the telephone receiver terminals are plugged into the first or detector jack, the filaments of the two amplifier tubes on the right are extinguished, as they are not in use. When the second jack is plugged into, the entire power of the amplifier is being used. If the plug is removed from this jack, the current is transferred to the output terminals to which the loud speaker is connected. It is the opinion of the writer that a jack in the first stage audio is not worth the trouble of wiring and the extra cost, the call for its use being limited. If signals are too loud on two stages, the tuner can be thrown slightly out of resonance. For controlling the oscillations inherently present in a circuit where both grid and plate circuits are tuned, the potentiometer is used. An additional binding post is provided for the last stage so that it may be possible to put higher voltages on the plate of the last tube.

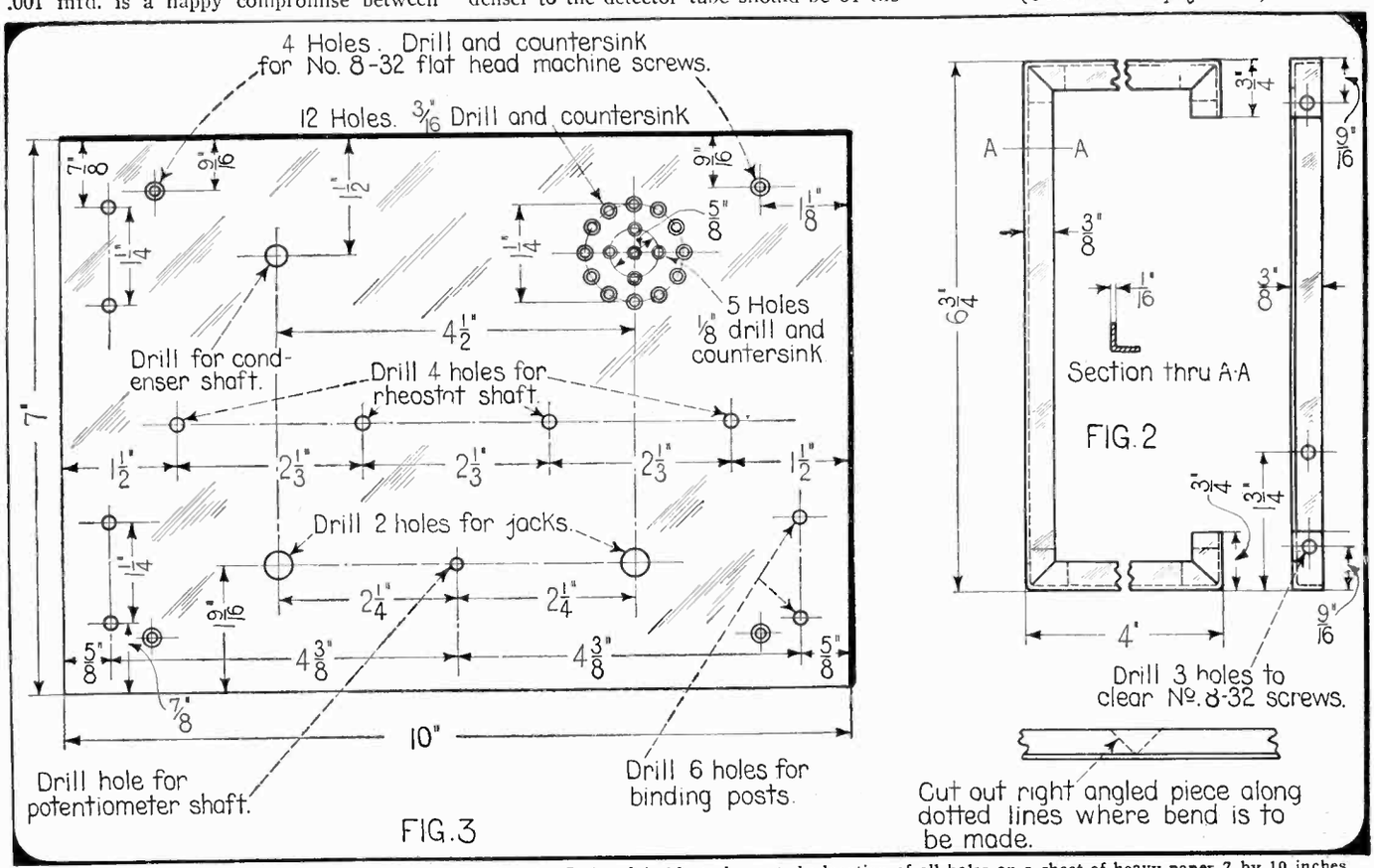
The by-pass condenser around the primary of the first stage transformer should be of such a value as to offer radio frequency currents a very low impedance path but to offer a high impedance to audio frequency currents, forcing them to go through the winding of the transformer. If the value of the condenser is too large, audio



A complete circuit diagram showing the connections of the amplifier in conjunction with a short wave regenerative tuner is shown in Fig. 1.

frequency currents will be passed in addition to the radio frequency currents: if too small, not enough radio frequency current can pass. It has been found that a value of .001 mfd. is a happy compromise between these two extremes. Around the potentiometer, a .0005 mfd. condenser is quite suitable, as no audio frequency currents are present in this circuit. The coupling condenser to the detector tube should be of the order of .00025 mfd. A hard amplifier tube (U. V. 201 or similar types) should be used in the first socket, a detector tube in the second, and amplifier tubes in the last

(*Continued on page* 1130)



Complete panel layout for the amplifier is shown in Fig. 3. It is advisable to lay out the location of all holes on a sheet of heavy paper 7 by 10 inches. This template can then be pasted on the panel and the holes drilled through both. When the panel has been completely drilled this template can be scraped off and a grain finish put on the panel. Fig. 2 shows the dimensions of the brass brackets used to support the various instruments.

Winners in the $100.00 Radio Interference Preventer Contest

PRIZE WINNERS

FIRST PRIZE
$50.00 in gold, Mr. J. Brydson, P. O. Box 314, Austin, Texas.

SECOND PRIZE
$20.00 in gold, Mr. Caesar De Carlo, 898 Gravesend Ave., Brooklyn, N. Y.

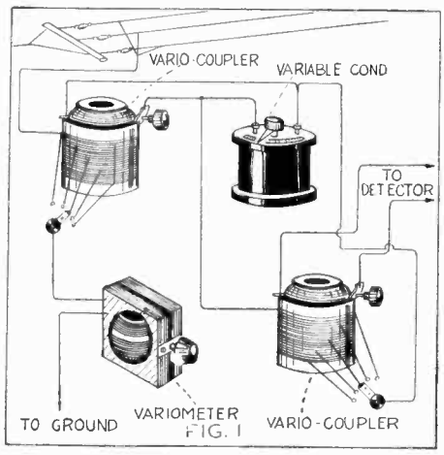
THIRD PRIZE
$15.00 in gold, Mr. E. J. Fancher, Gilboa, N. Y.

FOURTH PRIZE
$10.00 in gold, Mr. C. Kenard Eser, 33 N. Linwood Ave., Baltimore, Md.

FIFTH PRIZE
$5.00 in gold, J. E. Martin, 75 Allen Road, Beckenham, Kent, England.

FIRST PRIZE
By J. Brydson

THE only apparatus necessary for this very selective tuner is two vario-couplers, a variometer, and a .001 M.F. variable condenser. These are connected up as shown in the accompanying diagram, the two leads marked "To



The first prize winning circuit shown above, is of the "wave filter" type.

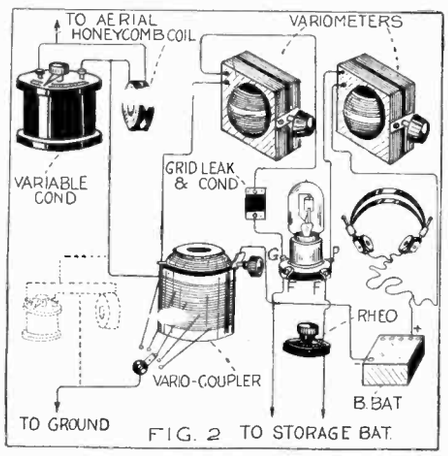
Detector" being connected either to a crystal detector and fixed condenser or a regular audion detector unit. Sharp tuning is accomplished in two ways with this circuit, one by means of the filter action of the two vario-couplers, and the other by the close regulation of inductance in the primary circuit of the first coupler, which is given by the variometer.

After the coupling is once adjusted, the 360 and 400 meter stations may be separated by manipulation of the variometer and the variable condenser, with practically no variation of the coupling in either vario-coupler.

SECOND PRIZE
By Caesar De Carlo

The apparatus described below and illustrated herewith, has given excellent results when used by the writer in connection with a standard short wave regenerative set containing a vario-coupler and two variometers. It is of the wave-trap type and consists of a .001 M.F. variable condenser, and a D.L.-75 or D.L.-100 honeycomb cell.

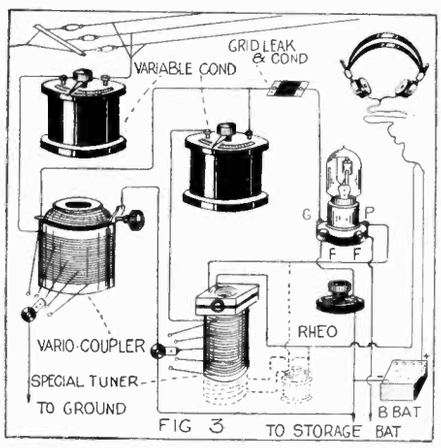
The 75 turn coil is used on wave lengths from 250 to 450 meters, and the larger one



The "wave trap" circuit, which won second prize, is shown in Fig. 2.

for wave lengths of 450 to 700 meters. Two different circuits may be used with this apparatus, one being in series with the antenna and the other across the primary of the vario-coupler. The former is shown in solid lines, and the latter in dotted lines in the diagram given herewith.

The writer has always found it advisable to connect the rotating plates of the condenser to the aerial lead-in. If the wave-trap does not work the first time, reverse the coil connections across the condenser, but do not change the condenser leads.



A specially constructed tuner is used in the third prize circuit to obtain selectivity, and is shown in Fig. 3.

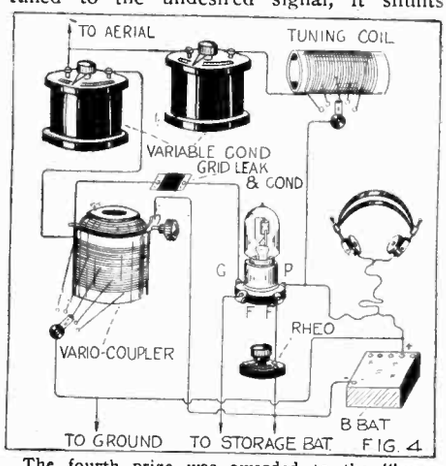
THIRD PRIZE
By E. J. Fancher

A .0005 variable condenser is used in connection with a coil wound on the same sized tube and with the same number of turns as the primary of the vario-coupler. This coil is placed on end, and a variometer connected in series with the plate laid on its side on top of it, so as to provide an inductive coupling between the two. If no plate variometer is used, the coil may be wound on one end of a longer tube, on the other end of which is wound 50 turns of No. 24 D.C.C. wire, tapped at about the 30th, 35th, 40th, 45th and 50th turns. There should be a space of about ½ inch between the two windings. In this case, a variable condenser with a capacity of .0005 should be shunted across the plate coil, as no provision is made for varying the inductance as in the case of a variometer. The latter connection is indicated in dotted lines in the accompanying diagram.

With this circuit, the writer could tune out a broadcasting station in Schenectady which is very close to his home, and receive from points as far distant as Chicago.

FOURTH PRIZE
By C. Kenard Eser

The selective tuner described by the writer, makes use of an auxiliary inductance and capacity connected from the aerial lead-in to the plate of the detector tube. This provides a shunt through the phones to the ground, and when the auxiliary circuit is tuned to the undesired signal, it shunts



The fourth prize was awarded to the "by-pass" circuit shown in Fig. 4.

that signal directly to the ground, the radio frequency current not affecting the receivers.

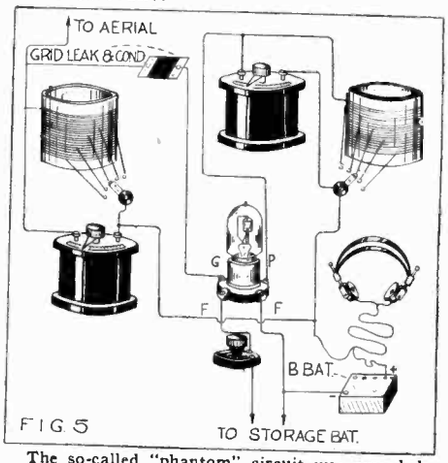
The tapped inductance coil is made approximately the same as the primary of the vario-coupler, and the connections are made as shown: a .001 M.F. condenser being used in series with the antenna, and another one of the same capacity in series with the auxiliary inductance.

FIFTH PRIZE
By J. E. Martin

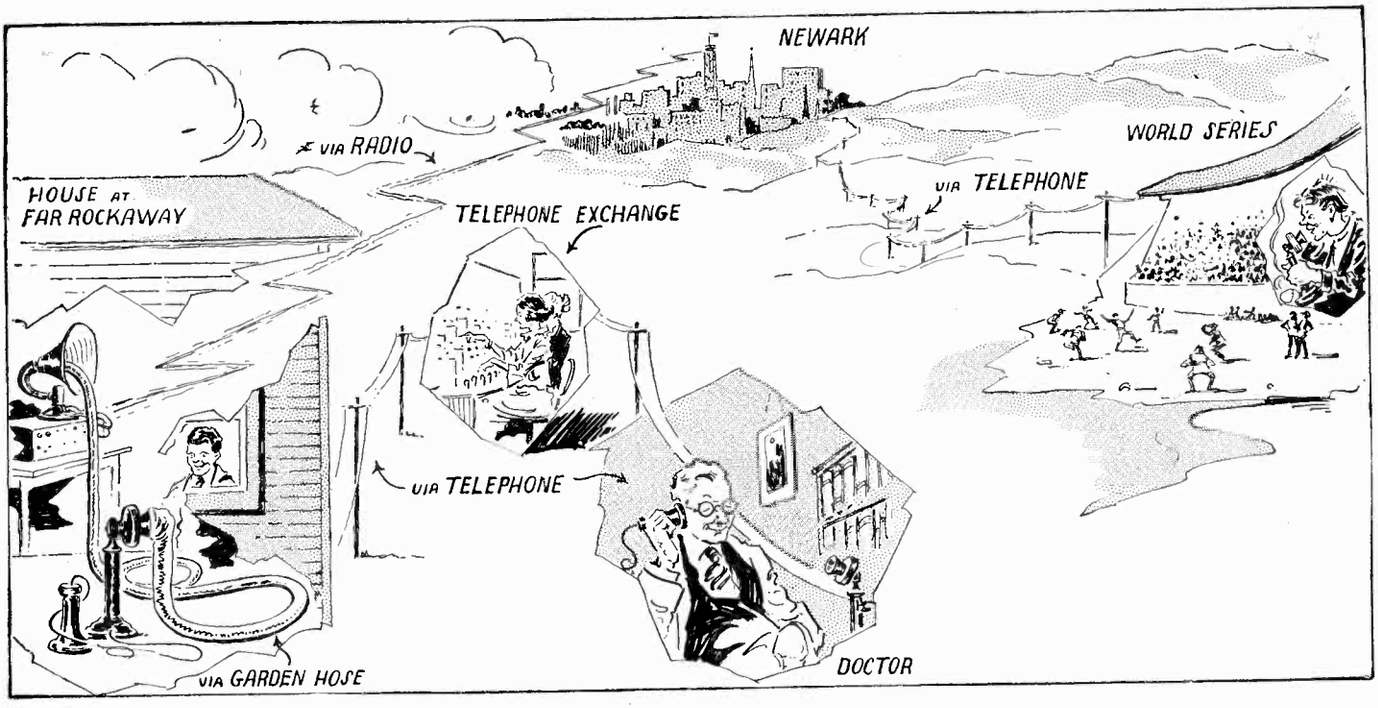
The inductance A consists of 80 turns of *Litz* wire, wound on a tube 3½ inches in diameter, and tapped every tenth turn. The condenser in shunt with this coil has a capacity of .0015 M.F.

The inductance marked B consists of a tube 3½ inches in diameter, wound with 64 turns of *Litz* and tapped every 3-1/3 turns. The condenser used in connection with this coil has a capacity of .0005 M.F.

The writer found it advantageous in tuning to control both circuits at the same time, one with each hand, with the filament of the tube burning fairly brightly. The tuning is continued very slowly until the carrier wave is heard, whereupon the filament is turned down to normal brilliancy, and the set tuned more carefully.



The so-called "phantom" circuit was awarded fifth prize, and is shown above in Fig. 5. The data on the inductances used are given in the text.



Garden Hose Saves Day for Radio

WHEN the radio returns of the World Series baseball games were being broadcasted, at least one unique turn was given this event, recent information indicates. As is generally known, the voice of the broadcaster was transmitted from the Polo Grounds, New York City, to Newark, New Jersey, where the wireless broadcasting was done.

One of the directors of a New York radio company was giving a "radio baseball party" at his home in Far Rockaway, when the telephone bell rang. It appears that Dr. Richard H. Hoffman, a well known New York physician and one of the director's friends, had also been "listening in" to the radio returns at his own home. His storage battery ran down.

In haste, he hurried to 'phone his friend to inquire what to do. The radio corporation director offered to assist him, and this is how it was done.

Instead of continuing to "listen in" on one loud speaker horn, a second was connected in series. Then the gardener brought in the lawn hose, which saved the day. One end of the hose was stuffed down the throat of the loud speaker, and the other fastened to the mouth-piece of the land-telephone. "Central" set the connection to the good doctor's home telephone, and Dr. Hoffman, listening to the receiver of his land-telephone, was able to hear every play.

$100.00 Prize "Binding Post" Contest

WE announce herewith a new contest open to everyone except manufacturers of such devices, whether they are readers of this magazine or not, and for which we offer $100.00 in gold in five prizes for the simplest and most efficient binding post designs. Strange as it may seem, there is still a lot of room for improvement in the realm of binding posts. Some of the commercial products in simple binding posts are shown in the accompanying illustration.

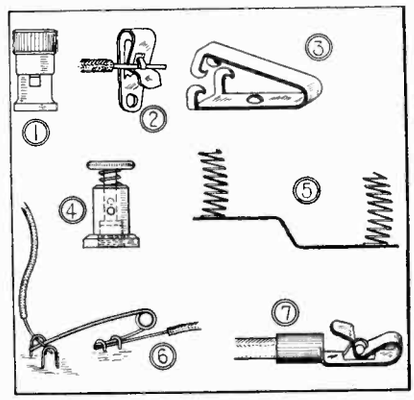
As shown in the accompanying illustration, there are several forms of spring binding posts, millions of which have been sold at a goodly profit to the maker. However, with this class of binding posts, in general, the fingers are often hurt depressing the spring member, so as to engage the wire.

A novel type of binding post patented by H. Gernsback is that incorporating a spring-actuated top member, which slides down within the post, producing an alignment of the apertures, allowing the wire to be passed through the holes in both stationary and moving members. When pressure is released on the top member, the spring forces it upward and the wire is tightly gripped. Another binding post which has met with considerable favor, is that in which the top shell-like member screws downward and clamps the wires in the slot. This is also shown in the illustration.

FIVE PRIZES IN "SIMPLEST BINDING POST" CONTEST

First Prize	**$50.00**	**in gold**
Second "	**20.00**	"	"
Third "	**15.00**	"	"
Fourth "	**10.00**	"	"
Fifth "	**5.00**	"	"

Total, $100.00

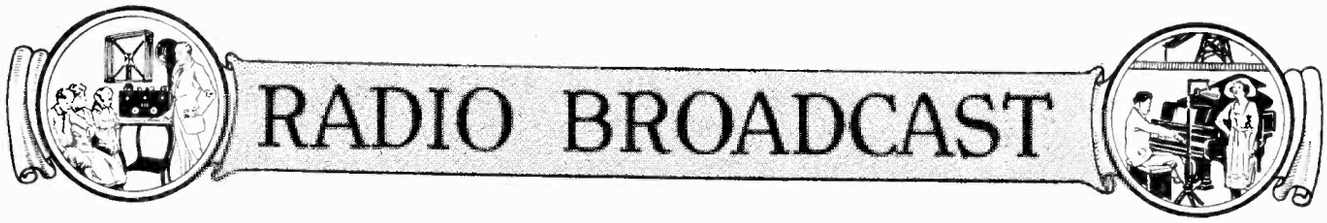


Various styles of spring binding posts.

The other day we saw a new spring binding post possessing the advantage of being flat, so that no matter how hard one might push on it, it would not pinch or injure. This binding post has a double set of hook-like jaws, and the wire is passed through it; as soon as the pressure is released the wire is gripped tightly and cannot jar loose. A simple home-made spring binding post is also shown in the picture which the editor once constructed from a safety pin and four staples. Some time ago there appeared on the automobile accessory market a battery connector fitted with spiral spring terminals, which were intended to be forced over the binding post, so as to grip it tightly.

There is a reasonable possibility that, if some of these binding posts prove as good as we anticipate, it will be possible for the editors to make arrangements for the designers to get in touch with several companies, who are interested in obtaining new devices of this type to manufacture for the commercial market.

A short description of about 100 words or so, will be amply sufficient together with a clear drawing or else a model of the binding post. Make drawings in ink and typewrite descriptions if possible, on separate sheets. This contest closes at noon, May 10th. Should two contestants submit the same idea, the same prize will be paid to both. Address all communications to Editor, Simplest Binding Post Contest, in care of this publication.



Complete List of Broadcast Stations in United States

REVISED AND CORRECTED TO JANUARY 2, 1923

All stations operate on 360 meters except as below.

Those with * on 400; † on 485; o in back of any sign indicates "only," thus †o means 485 meters only.

Call	*Name*	*City and State*
KDKA	Westinghouse Elec. & Mfg. Co.,	East Pittsburgh, Pa.
†KDN	Leo. J. Meyberg Co.,	San Francisco, Cal.
KDPM	Westinghouse Elec. & Mfg. Co.,	Cleveland, Ohio
KDPT	Southern Electrical Co.,	San Diego, Cal.
†KDYL	Telegram Publishing Co.,	Salt Lake City, Utah
KDYM	Savoy Theatre	San Diego, Cal.
KDYO	Carlson & Simpson	San Diego, Cal.
†KDYQ	Oregon Inst. of Technology,	Portland, Ore.
KDYS	Great Falls Tribune,	Great Falls, Mont.
KDYV	Cope & Cornwell Co.,	Salt Lake City, Utah
KDYW	Radio Dept. Smith Hughes Machinery Co.	Phoenix, Ariz.
KDYX	Honolulu Star Bulletin,	Honolulu, T. H.
KDYY	Rocky Mountain Radio Corp.,	Denver, Colo.
KDZA	Arizona Daily Star	Tucson, Ariz.
KDZB	Frank E. Siefert	Bakersfield, Cal.
KDZE	The Rhodes Co.	Seattle, Wash.
KDZF	Automobile Club of Southern California	Los Angeles, Cal.
KDZG	Cyrus Pierce & Co.	San Francisco, Cal.
†KDZH	Fresno Evening Herald	Fresno, Cal.
KDZI	Electric Supply Co.	Wenatchee, Wash.
KDZK	Nevada Machinery & Elec. Co.,	Reno, Nev.
KDZL	Rocky Mountain Radio Corp.,	Ogden, Utah
KDZM	E. A. Hollingsworth	Centralia, Wash.
KDZP	Newbery Electric Corp.,	Los Angeles, Cal.
KDZQ	Wm. D. Pyle Motor Generator Co.,	Denver, Colo.
KDZR	Bellingham Publishing Co.,	Bellingham, Wash.
KDZT	Seattle Radio Association,	Seattle, Wash.
KDZW	Claude W. Gerdes	San Francisco, Cal.
KDZX	Glad Tidings Tabernacle,	San Francisco, Cal.
KDZZ	Kinney Bros. & Sipprell,	Everett, Wash.
KFAC	Glendale Daily Press	Glendale, Cal.
KFAD	McArthur Bros. Mercantile Co.,	Phoenix, Ariz.
KFAE	State College of Washington,	Pullman, Wash.
KFAF	Western Radio Corp.	Denver, Colo.
KFAJ	University of Colorado.	Boulder, Colo.
KFAN	The Electric Shop	Moscow, Idaho
KFAP	Standard Publishing Co.	Butte, Mont.
KFAQ	City of San José	San José, Cal.
KFAR	Studio Lighting Service Co.,	Hollywood, Cal.
KFAS	Reno Motor Supply Co.	Reno, Nev.
KFAT	S. T. Donohue	Eugene, Ore.
†KFAU	High School	Boise, Idaho
KFAV	Abbot Kinney Co.	Venice, Cal.
KFAW	Register-Radio-Den-Radiophone,	Santa Ana, Cal.
†KFAY	Virgin Radio Service	Medford, Ore.
KFAZ	C. H. Weatherill	Reedley, Cal.
KFBB	F. A. Buttrey & Co.	Havre, Mont.
KFBC	Normal Heights Station (W. K. Azbill)	San Diego, Cal.
KFBD	Mercantile Trust Co.	Hanford, Cal.
KFBE	R. H. Horn (Cline's Electric Shop)	San Luis Obispo, Cal.
KFBG	First Presbyterian Church,	Tacoma, Wash.
KFBH	Thomas Musical Co.	Marshfield, Ore.
†KFBK	Kimball-Upson Co.	Sacramento, Cal.
KFBL	Leese Bros.	Everett, Wash.
KFBM	Cook & Foster & Astoria Hardware Co.	Astoria, Ore.
KFBN	Borch Radio Corp. (Portable),	Cal.
KFBO	Savage Electric Co.	Prescott, Ariz.
KFBS	Trinidad Gas & Electric Co. and Chronicle News	Trinidad, Colo.
KFBU	The Cathedral (Bishop Thomas),	Laramie, Wyo.
KFBV	Clarence O. Ford,	Colorado Springs, Colo.
†KFC	Northern Radio & Electric Co.,	Seattle, Wash.
KFCB	Nielsen Radio Supply Co.,	Phoeniz, Ariz.
KFCC	Auto Supply Co.	Wallace, Idaho
KFCD	Salem Electric Co.	Salem, Ore.
KFCF	Frank A. Moore	Walla Walla, Wash.
KFCH	Electric Service Station, Inc.,	Billings, Mont.
KFCK	Colorado Springs Radio Co.,	Colorado Springs, Colo.
†oKFCL	Los Angeles Union Stock Yards,	Los Angeles, Cal.
KFCM	Richmond Radio Shop.	Richmond, Cal.
KFCQ	Motor Service Station, (Norman R. Hood)	Casper, Wyo.
KFDA	Adler's Music Store	Baker, Ore.
KFDB	John D. McKee	San Francisco, Cal.
KFDC	Radio Supply Co. (E. B. Craney).	Spokane, Wash.
KFDD	St. Michaels Cathedral	Boise, Idaho
KFDF	Wyoming Radio Corp.	Casper, Wyo.
KFDH	University of Arizona	Tucson, Ariz.
KFDJ	Oregon Agricultural College,	Corvallis, Ore.
KFDL	Knight-Campbell Music Co.,	Denver, Colo.
KFEB	City of Taft	Taft, Cal.
KFEC	Meier & Frank Co.	Portland, Ore.
KFED	Billings Polytechnic Inst.,	Polytechnic, Mont.
KFEI	Guy Greason	Tacoma, Wash.
KFEP	Radio Equipment Co.	Denver, Colo.
KFFA	Dr. R. O. Shelton	San Diego, Cal.
KFFE	Eastern Oregon Radio Co.,	Pendleton, Ore.
KFGG	Astoria Budget	Astoria, Ore.
KFGH	Stanford University,	Stanford University, Cal.
KFHJ	Fallon Co.	Santa Barbara, Cal.
KFI	Earle C. Anthony, Inc.,	Los Angeles, Cal.
KFV	Foster-Bradbury Radio Store,	Yakima, Wash.
KFZ	The Doerr Mitchell Elec. Co.,	Spokane, Wash.
KGB	Wm. A. Mullins Electric Co.,	Tacoma, Wash.
KGG	Hallock & Watson Radio Service,	Portland, Ore.
KGN	Northwest Radio Mfg. Co.,	Portland, Ore.
KGO	Altadena Radio Laboratory,	Pasadena, Cal.
KGU	Marion A. Mulroney,	Honolulu, Hawaii
*oKGW	Portland Morning Oregonian,	Portland, Ore.
KGY	St. Martins College	Lacey, Wash.
†KDH	C. F. Aldrich Marble & Granite Co.,	Colorado Springs, Colo.
*†oKHJ	Times Mirror Co.	Los Angeles, Cal.
KHQ	Louis Wasmer	Seattle, Wash.
KJC	Standard Radio Co.	Los Angeles, Cal.
KJJ	The Radio Shop	Sunnyvale, Cal.
KJQ	C. O. Gould	Stockton, Cal.
KJR	Vincent I. Kraft (operated by North-west Radio Service).	Seattle, Wash.
KJS	Bible Institute of Los Angeles,	Los Angeles, Cal.
KLB	J. J. Dunn & Co.	Pasadena, Cal.
KLN	Monterey Electric Shop,	Del Monte, Cal.
KLP	Colin B. Kennedy Corp.	Los Altos, Cal.
KLS	Warner Bros.	Oakland, Cal.
KLX	Oakland Tribune	Oakland, Cal.
†KLZ	Reynolds Radio Co.	Denver, Colo.
KMC	W. W. Lindsay, Jr.	Reedley, Cal.
†KMJ	San Joaquin Light & Power Corp.,	Fresno, Cal.
KMO	Love Electric Co.	Tacoma, Wash.
KNJ	T. W. Smith	Eureka, Cal.
†KNJ	Roswell Public Service Co.,	Roswell, N. Mex.
KNN	Bullock's	Los Angeles, Cal.
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash.
KNV	Radio Supply Co.	Los Angeles, Cal.
KNX	Electric Lighting Supply Co.,	Los Angeles, Cal.
†oKOA	Young Mens Christian Assoc.,	Denver, Colo.
†KOB	New Mexico College of Agriculture and Mechanic Arts,	State College, N. Mex.
KOG	Western Radio Electric Co.,	Los Angeles, Cal.
KON	Holzwasser, Inc.	San Diego, Cal.
KOP	Detroit Police Dept.	Detroit, Mich.
KPO	Hale Bros.	San Francisco, Cal.
KQI	University of California.	Berkeley, Cal.
KQP	Hood River News (Radio Shop of Hood River)	Hood River, Ore.
KQV	Doubleday Hill Elec. Co.,	Pittsburgh, Pa.
KQW	Chas. D. Herrold	San José, Cal.
KQY	Stubbs Electric Co.	Portland, Ore.
KRE	Maxwell Electric Co.	Berkeley, Cal.
*†oKSD	Post Dispatch	St. Louis, Mo.
KSL	The Emporium	San Francisco, Cal.
KSS	Prest & Dean Radio Co.,	Long Beach, Cal.
KTW	First Presbyterian Church,	Seattle, Wash.
†KUO	San Francisco Examiner,	San Francisco, Cal.
KUS	City Dye Works & Laundry Co.,	Los Angeles, Cal.
KUY	Coast Radio Co., Inc.	El Monte, Cal.
KVQ	Sacramento Bee (Jos. McClatchy Co.)	Sacramento, Cal.
KWG	Portable Wireless Telephone Co.,	Stockton, Cal.
†KWH	Los Angeles Examiner,	Los Angeles, Cal.
KXD	Herald Publishing Co.	Modesto, Cal.
KXS	Braun Corp.	Los Angeles, Cal.
KYI	Bakersfield Californian,	Bakersfield, Cal.
†KYJ	Leo J. Meyberg Co.	Los Angeles, Cal.
KYQ	Electric Shop	Honolulu, Hawaii
*†oKYW	Westinghouse Elec. & Mfg. Co.,	Chicago, Ill.
KYY	Radio Telephone Shop,	San Francisco, Cal.
KZC	Public Market & Dept. Stores Co.,	Seattle, Wash.
†KZM	Preston D. Allen	Oakland, Cal.
†KZN	The Deseret News,	Salt Lake City, Utah
KZV	Wenatchee Battery & Motor Co.,	Wenatchee, Wash.
KZY	Atlantic & Pacific Radio Supply Co.,	San Francisco, Cal.
WAAC	Tulane University	New Orleans, La.
WAAD	Ohio Mechanics Institute,	Cincinnati, Ohio
†WAAF	Chicago Daily Drover's Journal,	Chicago, Ill.
WAAH	Radio Dept. Commonwealth Elec-tric Co.	St. Paul, Minn.
WAAJ	Eastern Radio Institute.	Boston, Mass.
†WAAK	Gimbel Bros.	Milwaukee, Wis.
WAAL	Anderson Beamish Elec. Co.,	Minneapolis, Minn.
WAAM	I. R. Nelson Co.	Newark, N. J.
†WAAN	University of Missouri.	Columbia, Mo.
†WAAP	United Electric Co.	Wichita, Kans.
WAAQ	New England Motor Sales Co.,	Greenwich, Conn.
WAAS	Georgia Radio Co.	Decatur, Ga.
†WAAW	Omaha Grain Exchange.	Omaha, Nebr.
WAAX	Radio Service Corp.	Crafton, Pa.
WAAY	Yahrling-Rayner Music Co.,	Youngstown, Ohio
WAAZ	Hollister-Miller Motor Co.,	Emporia, Kansas
†WAH	Midland Refining Co.,	El Dorado, Kansas
WBAA	Purdue University,	West Lafayette, Ind.
WBAB	Andrew J. Potter	Syracuse, N. Y.
WBAD	Sterling Electric Co.,	Minneapolis, Minn.
WBAF	Fred M. Middleton.	Moorestown, N. J.
†WBAG	Diamond State Fibre Co.,	Bridgeport, Pa.
WBAH	The Dayton Co.	Minneapolis, Minn.
WBAJ	The Marshall Gerken Co.	Toledo, Ohio
WBAN	Wireless Phone Corp.	Paterson, N. J.
WBAO	James Millikin University,	Decatur, Ill.
*†oWBAP	Wortham-Carter Pub. Co.,	Fort Worth, Texas

Call	Name	City and State
WBAU	Republican Publishing Co.,	Hamilton, Ohio
†WBAV	Erner & Hopkins	Columbus, Ohio
WBAW	Marietta College	Marietta, Ohio
WBAX	John H. Stenger, Jr.,	Wilkes-Barre, Pa.
*oWBAY	American Tel. & Tel. Co.,	New York, N. Y.
WBL	T & H Radio Co.	Anthony, Kansas
WBS	D. W. May, Inc.	Newark, N. J.
†WBT	Southern Radio Corp.	Charlotte, N. C.
WBU	City of Chicago	Chicago, Ill.
*oWBZ	Westinghouse Elec. & Mfg. Co.,	Springfield, Mass.
WCAB	Newburgh Daily News,	Newburgh, N. Y.
WCAC	John Fink Jewelry Co.,	Fort Smith, Ark.
WCAD	St. Lawrence University.	Canton, Ohio
*oWCAE	Kaufman & Baer Co.	Pittsburgh, Pa.
WCAG	Daily States Pub. Co.,	New Orleans, La.
WCAH	Entrekin Electric Co.	Columbus, Ohio
†WCAJ	Nebraska Wesleyan University,	University Place, Nebr.
WCAK	Alfred P. Daniel	Houston, Texas
WCAL	St. Olaf College	Northfield, Minn.
WCAM	Villanova College	Villanova, Pa.
WCAO	Sanders and Stayman Co.,	Baltimore, Md.
†WCAP	Central Radio Service	Decatur, Ill.
WCAQ	Tri-State Radio Mfg. & Supply Co.,	Defiance, Ohio
WCAR	Alamo Radio Elec. Co.,	San Antonio, Texas
WCAS	Wm. Hood Dunwoody Industrial Institute	Minneapolis, Minn.
†oWCAT	S. Dakota School of Mines,	Rapid City, S. Dak.
†WCAU	Philadelphia Radiophone Co.,	Philadelphia, Pa.
WCAV	J. C. Dice Electric Co.,	Little Rock, Ark.
†WCAW	Quincy Electric Supply Co.,	Quincy, Ill.
WCAX	University of Vermont,	Burlington, Vt.
WCAY	Kesselman O'Driscoll Co.,	Milwaukee, Wis.
WCAZ	Robt. E. Compton and Carthage College	Carthage, Ill.
WCE	Findley Electric Co.,	Minneapolis, Minn.
WCK	Stix Baer & Fuller Co.	St. Louis, Mo.
†WCM	University of Texas	Austin, Texas
†WCN	Clark University	Worcester, Mass.
*†oWCX	The Detroit Free Press,	Detroit, Mich.
†oWDAC	Illinois Watch Co.	Springfield, Ill.
†WDAE	Tampa Daily Times	Tampa, Fla.
*†oWDAF	Kansas City Star	Kansas City, Mo.
WDAG	J. Laurance Martin	Amarillo, Texas
†WDAH	Mine & Smelter Supply Co.,	El Paso, Texas
†WDAI	Hughes Electrical Corp.,	Syracuse, N. Y.
†WDAJ	Atlanta & West Point R. R. Co.,	College Park, Ga.
WDAK	The Hartford Courant,	Hartford, Conn.
†WDAL	Florida Times-Union.	Jacksonville, Fla.
WDAO	Automotive Elec. Co.	Dallas, Texas
WDAP	Midwest Radio Central, Inc.,	Chicago, Ill.
WDAQ	Hartman Riker Elec. & Machine Co.,	Brownsville, Pa.
WDAR	Lit Bros.	Philadelphia, Pa.
WDAS	Samuel A. Waite	Worcester, Mass.
WDAU	Slocum & Kilburn,	New Bedford, Mass.
WDAV	Muskogee Daily Phoenix,	Muskogee, Okla.
WDAX	First National Bank.	Centerville, Iowa
†WDAY	Fargo Radio Service Co.,	Fargo, N. Dak.
WDM	Church of the Covenant,	Washington D. C.
WDT	Ship Owners Radio Service,	New York, N. Y.
WDV	John O. Yeiser, Jr.	Omaha, Nebr.
WDY	Radio Corp. of America,	Roselle Park, N. J.
WDZ	J. L. Bush	Tuscola, Ill.
WEAA	Fallian & Lathrop	Flint, Mich.
†WEAB	Standard Radio Equipment Co.,	Fort Dodge, Iowa
†WEAC	Baines Electric Service Co.,	Terre Haute, Ind.
WEAD	Northwest Kansas Radio Supply Co.,	Atwood, Kansas
WEAE	Virginia Polytechnic Inst.,	Blacksburg, Va.
*oWEAF	Western Electric Co.	New York, N. Y.
WEAG	Nichols-Hineline-Bassett Laboratory,	Edgewood, R. I.
†WEAH	Wichita Board of Trade & Lander Radio Co.	Wichita, Kansas
WEAI	Cornell University	Ithaca, N. Y.
WEAJ	University of So. Dakota,	Vermillon, S. Dak.
WEAK	Julius B. Abercrombie.	St. Joseph, Mo.
WEAM	Borough of No. Plainfield,	North Plainfield, N. J.
†WEAN	Shepard Co.	Providence, R. I.
†WEAO	Ohio State University,	Columbus, Ohio
†WEAP	Mobile Radio Co.	Mobile, Ala.
WEAR	Baltimore American & News Publishing Co.	Baltimore, Md.
WEAS	Hecht Co.	Washington, D. C.
WEAT	John J. Fogarty	Tampa, Fla.
WEAU	Davidson Bros. Co.	Sioux City, Iowa
WEAV	Sheridan Electric Service Co.,	Rushville, Nebr.
WEAW	Arrow Radio Laboratories,	Anderson, Ind.
†WEAX	T. J. M. Daly	Little Rock, Ark.
WEAY	Will Horwitz, Jr.	Houston, Tex.
WEB	Benwood Co.	St. Louis, Mo.
†WEH	Midland Refining Co.	Tulsa, Okla.
†WEV	Hurlburt-Still Electrical Co.,	Houston, Tex.
†WEW	St. Louis University	St. Louis, Mo.
†WEY	Cosradio Co.	Wichita, Kansas
*†oWFAA	Dallas News-Dallas Journal,	Dallas, Tex.
WFAB	Carl F. Woese	Syracuse, N. Y.
WFAC	Superior Radio Co.	Superior, Wis.
WFAD	Watson Weldon Co.	Salina, Kansas
WFAF	H. C. Spratley Radio Co.,	Poughkeepsie, N. Y.
WFAG	The Radio Engineering Laboratory,	Waterford, N. Y.
WFAH	Electric Supply Co.	Port Arthur, Texas
WFAJ	Hi-Grade Wireless Instrument Co.,	Ashville, N. C.
WFAM	Times Publishing Co.	St. Cloud, Minn.
†WFAN	Hutchinson Electric Service Co.,	Hutchinson, Minn.
WFAQ	Missouri Wesleyan College & Cameron Radio Co.	Cameron, Mo.
WFAS	United Radio Corp.	Fort Wayne, Ind.
†WFAT	Daily Argus Leader,	Sioux Falls, So. Dak.
WFAU	Edwin C. Lewis	Boston, Mass.
†WFAV	University of Nebraska.	Lincoln, Nebr.
WFAW	Miami Daily Metropolis.	Miami, Fla.
WFAY	Daniels Radio Supply Co.,	Independence, Kansas
†WFAZ	South Carolina Radio Shop,	Charleston, So. Car.
*†oWFI	Strawbridge & Clothier,	Philadelphia, Pa.
WGAB	QRV Radio Co.	Houston, Tex.
WGAD	Spanish American School of Radio-telegraphy	Ensenada, P. R.
WGAH	New Haven Electric Co.,	New Haven, Conn.
WGAJ	W. H. Gass	Shenandoah, Iowa
WGAK	Macon Electric Co.	Macon, Ga.
WGAL	Lancaster Elec. Supply & Construction Co.	Lancaster, Pa.
WGAM	Orangeburg Radio Equipment Co.,	Orangeburg, So. Car.
WGAN	Cecil E. Lloyd	Pensacola, Fla.
WGAQ	Glenwood Radio Corp.,	Shreveport, La.
†WGAR	Southwest American.	Fort Smith, Ark.
WGAS	The Ray-Di-Co. Organization,	Chicago, Ill.
WGAT	American Legion, Dept. of Nebraska,	Lincoln, Nebr.
WGAU	Marcus G. Limb	Wooster, Ohio
WGAW	Ernest C. Albright	Altoona, Pa.
WGAX	Radio Electric Co.	Washington Court House, Ohio
WGAY	Northwestern Radio Co.,	Madison, Wis.
WGAZ	South Bend Tribune.	South Bend, Ind.
†WGF	The Register & Tribune,	Des Moines, Iowa
†WGI	American Radio & Research Corp.,	Medford Hillside, Mass.
WGL	Thos. F. J. Howlett.	Philadelphia, Pa.
*oWGM	Atlanta Constitution	Atlanta, Ga.
†WGR	Federal Telephone & Telegraph Co.,	Buffalo, N. Y.
†WGV	Interstate Electric Co.,	New Orleans, La.
*†oWGY	General Electric Co.,	Schenectady, N. Y.
†WHA	University of Wisconsin,	Madison, Wis.
WHAA	State University of Iowa,	Iowa City, Iowa
†WHAB	Clark W. Thompson (Fellman's Dry Goods Co.)	Galveston, Tex.
WHAC	Cole Bros., Electric Co.,	Waterloo, Iowa
†WHAD	Marquette University,	Milwaukee, Wis.
WHAE	Automotive Electric Service Co.,	Sioux City, Iowa
WHAF	Radio Electric Co.	Pittsburgh, Pa.
WHAG	University of Cincinnati,	Cincinnati, Ohio
WHAH	Hafer Supply Co.	Joplin, Mo.
WHAI	Radio Equipment & Mfg. Co.,	Davenport, Iowa
WHAK	Roberts Hdwe. Co.,	Clarksburg, W. Va.
WHAL	Lansing Capital News.	Lansing, Mich.
†WHAM	University of Rochester,	Rochester, N. Y.
WHAO	Frederic A. Hill	Savannah, Ga.
WHAP	Otta and Kuhns	Decatur, Ill.
WHAQ	Semmes Motor Co.	Washington, D. C.
WHAR	Paramount Radio & Elec. Co.,	Atlantic City, N. J.
†WHAS	Courier-Journal and Louisville Times,	Louisville, Ky.
WHAV	Wilmington Electrical Specialty Co., Inc.	Wilmington, Del.
WHAW	Pierce Electric Co.	Tampa, Fla.
WHAY	The Huntington Press,	Huntington, Ind.
*oWHAZ	Rensselaer Polytechnic Inst.,	Troy, N. Y.
*†oWHB	Sweeney School Co.	Kansas City, Mo.
WHD	West Virginia University,	Morgantown, W. Va.
WHK	Radiovox Co. (Warren R. Cox),	Cleveland, Ohio
WHN	Ridgewood Times Publishing Co.,	Ridgewood, N. Y.
†WHU	Wm. B. Duck Co.	Toledo, Ohio
†oWHW	Stuart W. Seeley.	East Lansing, Mich.
WIAB	Joslyn Automobile Co.	Rockford, Ill.
†WIAC	Galveston Tribune	Galveston, Texas
WIAD	Ocean City Yacht Club,	Ocean City, N. J.
WIAE	Mrs. Robert E. Zimmerman,	Vinton, Iowa
WIAF	Gustav A. De Cortin.	New Orleans, La.
WIAH	Continental Radio & Mfg. Co.,	Newton, Iowa
WIAI	Heer Stores Co.	Springfield, Mo.
WIAJ	Fox River Valley Radio Co.,	Neenah, Wisc.
†WIAK	Daily Journal-Stockman.	Omaha, Neb.
WIAO	School of Engineering & Wisconsin News.	Milwaukee, Wis.
WIAQ	Chronicle Publishing Co,	Marion. Ind.
WIAR	Paducah Evening Sun	Paducah, Ky.
WIAS	Burlington Hawkeye & Home Electric Co.	Burlington, Iowa
WIAT	Leon T. Noel	Tarkio, Mo.
WIAU	American Trust & Savings Bank,	Le Mars, Iowa
WIAV	New York Radio Laboratories,	Binghamton, N. Y.
WIAW	Saginaw Radio & Electric Co.,	Saginaw, Mich.
WIAX	Capitol Radio Co.	Lincoln, Nebr.
WIAY	Woodward & Lothrop,	Washington, D. C.
WIAZ	Electric Supply Sales Co.,	Miami, Fla.
WIK	K & L Electric Co.	McKeesport, Pa.
WIL	Continental Electrical Supply Co.,	Washington, D. C.
†WIP	Gimbel Bros.	Philadelphia, Pa.
†WIZ	Cino Radio Mfg. Co.	Cincinnati, Ohio
WJAB	American Radio Co.	Lincoln, Nebr.
WJAC	Redell Co.	Joplin, Mo.
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas
†WJAE	Texas Radio Syndicate,	San Antonio, Texas
WJAF	Muncie Press-Smith Electric,	Muncie, Ind.
WJAG	Norfolk Daily News.	Norfolk, Nebr.
WJAJ	Y. M. C. A.	Dayton, Ohio
†WJAK	White Radio Laboratory,	Stockdale, Ohio
WJAL	Victor Radio Corp.	Portland, Me.
WJAM	D. M. Perham.	Cedar Rapids, Iowa
WJAN	Peoria Star-Peoria Radio Sales Co.,	Peoria, Ill.
WJAP	Kelley-Duluth Co.	Duluth, Minn.
WJAQ	Capper Publications.	Topeka, Kan.
WJAR	Outlet Co. (J. Samuels & Bro.),	Providence, R. I.
WJAS	Pittsburgh Radio Supply Co.,	Pittsburgh, Pa.
WJAT	Kelley-Vawter Jewelry Co.,	Marshall, Mo.
WJAU	Yankton College	Yankton, So. Dak.
WJAX	Union Trust Co.	Cleveland, Ohio
WJAZ	Chicago Radio Laboratory,	Chicago, Ill.
WJD	Richard H. Howe	Granville, Ohio
WJH	White & Boyer Co.	Washington, D. C.
WJK	Service Radio Equipment Co.,	Toledo, Ohio
WJX	De Forest Radio Telephone & Telegraph Co.	New York, N. Y.
WJZ	Westinghouse Elec. & Mfg. Co.,	Newark, N. J.
†WKAA	H. F. Paar (Republican Times),	Cedar Rapids, Iowa
WKAC	Star Publishing Co.	Lincoln, Nebr.
WKAD	Charles Looff (Crescent Park),	East Providence, R. I.
WKAF	W. S. Radio Supply Co.,	Wichita Falls, Texas
WKAG	Edwin T. Bruce, M.D.,	Louisville, Ky.
WKAH	Planet Radio Co.	West Palm Beach, Fla.
WKAK	Okfuskee County News,	Okemah, Okla.
WKAL	Gray & Gray	Orange, Texas
WKAN	Alabama Radio Mfg. Co.,	Montgomery, Ala.
WKAP	Dutee W. Flint	Cranston, R. I.
WKAQ	Radio Corp. of Porto Rico.,	San Juan, P. R.
WKAR	Michigan Agricultural College,	East Lansing, Mich.
WKAS	L. E. Lines Music Co.,	Springfield, Mo.
WKAV	Laconia Radio Club.	Laconia, N. H.
WKAW	Turner Cycle Co.	Beloit, Wis.
WKAX	William A. MacFarland,	Bridgeport, Conn.
WKAY	Brenau College	Gainesville, Ga.
WKAZ	Landau's Music & Jewelry Co.,	Wilkes-Barre, Pa.
WKC	Joseph M. Zamoiski Co.,	Baltimore, Md.
†WKN	Riechman Crosby Co.	Memphis, Tenn.
†WKY	WKY Radio Shop,	Oklahoma City, Okla.
WLAC	North Carolina State College,	Raleigh, N. C.

Call	Name	City and State
WLAF	Johnson Radio Co.	Lincoln, Nebr.
*†oWLAG	Cutting & Washington Radio Corp.,	Minneapolis, Minn.
WLAH	Samuel Wordworth	Syracuse, N. Y,
†WLAJ	Waco Electrical Supply Co.,	Waco, Texas
WLAK	Vermont Farm Machine Corp.,	Bellows Falls, Vt.
WLAL	Tulsa Radio Co.	Tulsa, Okla.
WLAM	Morrow Radio Co.	Springfield, Ohio
WLAN	Putnam Hardware Co.	Houlton, Me.
WLAO	Anthracite Radio Shop.	Scranton, Pa.
WLAP	W. V. Jordon	Louisville, Ky.
WLAQ	A. E. Schilling	Kalamazoo, Mich.
WLAR	Mickel Music Co.	Marshalltown, Iowa
WLAS	Central Radio Supply Co.,	Hutchinson, Kansas
WLAT	Radio Specialty Co.	Burlington, Iowa
WLAV	Electric Shop	Pensacola, Fla.
WLAW	Police Dept. of New York City,	New York, N. Y.
WLAX	Putnam Electric Co.	Greencastle, Ind.
WLAY	Northern Commercial Co.,	Fairbanks, Alaska
WLAZ	Hutton & Jones Electric Co.,	Warren, Ohio
†WLB	University of Minnesota.	Minneapolis, Minn.
†WLK	Hamilton Mfg. Co.	Indianapolis, Ind.
†WLW	Crosley Mfg. Co.	Cincinnati, Ohio
WMAB	Radio Supply Co.	Oklahoma, Okla.
WMAC	J. Edw. Page (Clive B. Meredith),	Cazenovia, N. Y.
WMAD	Atchinson County Mail,	Rock Port, Mo.
WMAF	Round Hills Radio Corp.,	Dartmouth, Mass.
WMAG	Tucker Electric Co.	Liberal, Kans.
WMAH	General Supply Co.	Lincoln, Nebr.
†WMAJ	Drovers Telegram Co.,	Kansas City, Mo.
WMAK	Norton Laboratories.	Lockport, N. Y.
WMAL	Trenton Hardware Co.	Trenton, N. J.
†WMAM	Beaumont Radio Equipment Co.,	Beaumont, Texas
WMAN	Broad St. Baptist Church,	Columbus, Ohio
WMAP	Utility Battery Service.	Easton, Pa.
WMAQ	The Fair Corp. & Chicago Daily,	Chicago. Ill.
WMAR	Waterloo Electrical Supply Co.,	Waterloo, Iowa
†WMAT	Paramount Radio Corp.,	Duluth, Minn.
†WMAV	Alabama Polytechnic Inst.,	Auburn, Ala.
WMAW	Wahpeton Electric Co.,	Wahpeton, N. Dak.
WMAX	K & K Radio Supply Co.,	Ann Arbor. Mich.
WMAY	Kingshighway Presbyterian Church.	St. Louis. Mo.
WMAZ	Mercer University	Macon, Ga.
WMB	Auburn Electrical Co.	Auburn, Me.
†WMH	Precision Equipment Co.,	Cincinnati, Ohio
WMU	Doubleday-Hill Electric Co.,	Washington, D. C.
WNAB	Park City Daily News.	Bowling Green, Ky.
WNAC	Shepard Stores	Boston, Mass.
WNAD	Oklahoma Radio Engineering Co.,	Norman, Okla.
†WNAF	Enid Radio Distributing Co.	Enid, Okla.
WNAG	Rathert Radio & Electric Shop,	Cresco, Iowa
WNAH	Wilkes-Barre Radio Repair Shop,	Wilkes-Barre, Pa.
WNAJ	Benson Co.	Chicago, Ill.
WNAK	Manhattan Radio Supply Co.,	Manhattan, Kan.
WNAL	R. J. Rockwell	Omaha. Nebr.
WNAM	Ideal Apparatus Co.	Evansville, Ind.
WNAN	Syracuse Radio Telephone Co.,	Syracuse, N. Y.
WNAP	Wittenberg College.	Springfield, Ohio
WNAQ	Charleston Radio Electric Co.,	Charleston, S. C.
WNAR	C. C. Rhodes	Butler, Mo.
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Tex.
WNAT	Lennig Bros. Co.	Philadelphia, Pa.
WNAV	Peoples Telephone & Telegraph Co.,	Knoxville, Tenn.
WNAW	Peninsular Radio Club,	Fort Monroe, Va.
WNAX	Dakota Radio Apparatus Co.,	Yankton, S. D.
WNAY	Ship Owner's Radio Service,	Baltimore, Md.
WNJ	Shotton Radio Mfg. Co., Inc.,	Albany, N. Y.
WNO	Wireless Telephone Co. of Hudson County, N. J.	Jersey City, N. J.
WOAA	Dr. Walter Hardy	Ardmore, Okla.
WOAB	Valley Radio	Grand Forks, N. D.
WOAC	Maus Radio Co.	Lima, Ohio
WOAD	Friday Battery & Elec. Co.,	Sigourney, Iowa
WOAE	Midland College	Fremont, Nebr.
WOAF	Tyler Commercial College,	Tyler, Texas
WOAG	Apollo Theatre	Belvedere, Ill.
WOAH	Palmetto Radio Corp.	Charleston, S. C.
WOAI	Southern Equipment Co.,	San Antonio, Tex.
WOAJ	Ervine Electrical Co.	Parsons, Kan.
WOAK	Collins Hdwe. Co.	Frankfort, Ky.
WOAL	Wm. E. Woods.	Webster Groves, Mo.
WOAN	Vaughn Conservatory of Music,	Lawrenceburg, Tenn.
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.
WOAP	Kalamazoo College.	Kalamazoo, Mich.
WOAQ	Portsmouth Radio Assoc.,	Portsmouth, Va.
WOAR	Henry P. Lundskow	Kenosha, Wis.
WOAS	Bailey's Radio Shop,	Middletown, Conn.
WOAT	Boyd M. Hamp.	Wilmington, Del.
WOAU	Sowder Bolling Piano Co.,	Evansville, Ind.
WOAV	Second Battalion, 112th Inf., P.N.G.,	Erie, Pa.
WOAW	Woodmen of the World.	Omaha, Nebr.
WOAX	Franklyn J. Wolff (Monument Pottery Co.)	Trenton, N. J
WOAY	John M. Wilder.	Birmingham. Ala.
WOAZ	Penick Hughes Co.	Stamford, Texas
*†oWOC	Palmer School of Chiropractic,	Davenport, Iowa
WOE	Buckeye Radio Service Co.,	Akron. Ohio
WOH	Hatfield Electric Co.	Indianapolis, Ind.
†WOI	Iowa State College.	Ames, Iowa
WOK	Arkansas Light & Power Co. (Pine Bluff Co.).	Pine Bluff. Ark.
*†oWOO	John Wanamaker.	Philadelphia, Pa.
†WOQ	Western Radio Co.	Kansas City, Mo.
*oWOR	L. Bamberger & Co.	Newark, N. J.
†WOS	Missouri State Marketing Bureau,	Jefferson City, Mo.
†WOU	Metropolitan Utilities District.	Omaha, Nebr.
†WOZ	Palladium Printing Co.	Richmond, Ind.
†WPA	Fort Worth Record.	Fort Worth, Tex.
WPAA	Anderson & Webster Elec. Co.,	Wahoo, Nebr.
WPAB	Pennsylvania State College.	State College, Pa.
WPAC	Donaldson Radio Co.	Okmulgee, Okla.
WPAD	W. A. Wieboldt & Co.	Chicago, Ill.
WPAF	Peterson Radio Co.	Council Bluffs. Ia.
WPAG	Central Radio Co.	Independence, Ill.
†oWPAH	Wisconsin Department of Markets.	Waupaca, Wis.
WPAJ	Doolittle Radio Corp.,	New Haven, Conn.
†WPAK	North Dakota Agricultural College,	Agricultural College., N. D.
WPAL	Superior Radio & Tel. Equipment Co.,	Columbus, Ohio
WPAM	Auerbach & Guettel.	Topeka, Kans.
WPAP	Theodore D. Phillips.	Winchester, Ky.
WPAQ	General Sales & Engineering Co.,	Frostburg, Md.
WPAR	R. A. Ward	Beloit, Kans.
WPAS	J. & M. Electric Co.	Amsterdam, N. Y.
WPAT	St. Patricks Cathedral.	El Paso, Texas
†WPAU	Concordia College.	Moorhead. Minn.
WPAV	Paul Tinetti & Sons.	Laurium, Mich.
WPAW	Radio Installation Co.,	Wilmington, Del.
WPAX	S W Radio Co. (J. R. Shumate, Jr.),	Thomasville, Ga.
WPE	Central Radio Co.	Kansas City, Mo.
WPG	Nushawg Poultry Farm,	New Lebanon, Ohio
WPI	Electric Supply Co.	Clearfield, Pa.
WPJ	St. Joseph College.	Philadelphia, Pa.
WPM	Thomas J. Williams,	Washington, D. C.
WPO	United Equipment Co.	Memphis, Tenn.
WQAA	Horace A. Beale, Jr.	Parkesburg, Pa.
WQAB	Sonthwest Missouri State Teachers College	Springfield, Mo.
WQAC	E. B. Gish	Amarillo, Tex.
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.
WQAK	Appel-Higley Electric Co.,	Dubuque, Iowa
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.
WQAQ	West Texas Radio Co.	Abilene, Texas
WQAY	Gaston Music & Furniture Co.,	Hastings. Nebr.
WRAA	Rice Institute	Houston, Texas
WRAN	Black Hawk Electrical Co.,	Waterloo, Iowa
WRAR	Jacob C. Thomas.	David City, Nebr.
WRAU	Amarillo Daily News.	Amarillo, Tex.
WRAY	Radio Sales Corp.	Scranton, Pa.
WRK	Doron Bros. Elec. Co.	Hamilton, Ohio
WRL	Union College	Schenectady, N. Y.
WRM	University of Illinois.	Urbana, Ill.
WRP	Federal Institute of Radio Telegraphy	Camden, N. J.
†WRR	City of Dallas, Police & Fire Signal Dept.	Dallas, Texas
WRW	Tarrytown Radio Research Laboratory	Tarrytown, N. Y.
WSAJ	Grove City College.	Grove City, Pa.
WSAS	Bureau of Markets. State Dept. of Agr.	Lincoln, Nebr.
WSAT	Plainview Electric Co.	Plainview, Tex.
WSAV	Clifford W. Vick Radio Const. Co.,	Houston, Texas
*†oWSB	Atlanta Journal	Atlanta, Ga.
WSL	J & M Electric Co.	Utica. N. Y.
WSN	Ship Owners Radio Service, Inc.,	Norfolk. Va.
WSX	Erie Radio Co.	Erie, Pa.
†WSY	Alabama Power Co.	Birmingham, Ala.
WTAC	Penn Traffic Co.	Johnstown. Pa.
WTAU	Ruegg Battery & Electric Co.,	Tecumseh, Nebr.
WTAW	Agricultural & Mechanical College,	College Stations, Tex.
†oWTG	Kansas State Agricultural College,	Manhattan, Kansas
WTP	George M. McBride.	Bay City, Mich.
WWAC	Sanger Bros.	Waco, Texas
WWAD	Wright & Wright, Inc.,	Philadelphia, Pa.
WWAX	Wormser Bros.	Laredo, Texas
WWB	Daily News Printing Co.	Canton, Ohio
WWI	Ford Motor Co.	Dearborn, Mich.
*†oWWJ	Detroit News.	Detroit, Mich.
WWL	Loyola University.	New Orleans, La.
WWT	McCarthy Bros. & Ford.	Buffalo, N. Y.
WWZ	John Wanamaker.	New York, N. Y.

Would You Answer These Queries for Two Cents

The following is a letter, copied word for word as received from a reader, and addressed to the *Question and Answer Department*. The reader very kindly enclosed a 2-cent stamp for the return of this information. The letter was received on a Wednesday. Note when he expected a reply.

"Dear Sir:

Will you kindly send me all information of what I am asking. I would like that you would send me drawings and instructions on making the following things about Radio. A varicoupler of the best type, a variometer, also best type, audion and vacuum tube socked, Filament and other type rheostats. variable condenser and Fixed cond., .00025 microfarads. can phone receivers be made, if so send me drawing of a good receiver. also a good receiver with instructions to make all parts to set. The set which can receive from 3,000 miles or less, also show me how to hook up both sets not in Radio symbol but in simple pictures. And how to mount on a panel. Send me some of the best drawings of high tuning arristers. And instructions how to make and hook up with sets, a loud-speaker, a detector amplifier, all kinds of knobs and swithes, a frequency transformer, a few types of vernier condensers. a few types of loop aerials, amplifier set 3 stages to 4. drawings and instructions variable plate Battery (22½) volts. Phone con. .002 microfarads or more. Tell me a way to make fiber or baklite dials. What is "spaghetti" insulation?

As though this were not sufficient, the writer continues on another page as follows:

Dear Sir:

I am writing this second letter because I had not enough space on the other paper. I would like If you would send me the drawings and instructions and hook-ups on these things I describe, a telegraph set (morse) and and telephone also a Wirless telegraph set and wireless telephone set. and a Detector microphone. Is it possible to make a dynamo or electric motor at home. If so send me the drawings and instructions how to make them. I will be pleased with all the answers at my house on FRIDAY if possible. I give much thanks for all answers.

Yours truly,

P. S. also send me how to make a small crystal set. hook-up and parts to make and how to make the parts at small expense."

Faint cry from the Editorial sanctum: "Quick, Watson! the needle!"

But seriously—what this reader needs is a text book. May we suggest the new book by Mr. H. Gernsback, "Radio For All,"

Radio Oracle

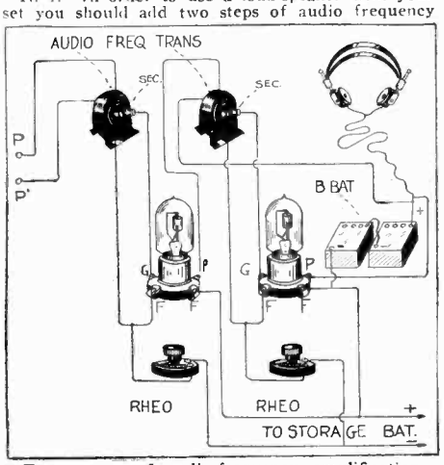
In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25c is made for all questions where a personal answer is desired.

TWO STAGE AUDIO FREQUENCY AMPLIFIER

(116) Carl W. Chase, Amsterdam, N. Y., writes that he has an audion detector which gives very good results when used with a loose-coupler for tuning. He asks:

Q. 1. Will you kindly give me a hook-up of the amplification appliances necessary to add to this set so that the signals may be heard with a loud-speaker?

A. 1. In order to use a loud-speaker with your set you should add two steps of audio frequency



Two stages of audio-frequency amplification may be added to any receiving set, by using the circuit shown above.

amplification. A circuit diagram of the same is given herewith.

CONDENSER CAPACITIES

(117) Frank A. Hackert, Bellingham, Minn., asks:

Q. 1. What capacity should the condensers enumerated below have for use in a short wave regenerative set consisting of a vario-coupler and a variometer? Series antenna condenser, secondary condenser, and grid and phone condensers.

A. 1. The following condenser capacities may be used with your short wave regenerative tuner.

Condenser in series with aerial .001 M. F.
Condenser across secondary .001 M. F.
Grid condenser .00025 M. F.
Phone condenser .0165 M. F.

Q. 2. Is it necessary to use a rheostat to control the filament current and a potentiometer to control the plate voltage of a vacuum tube?

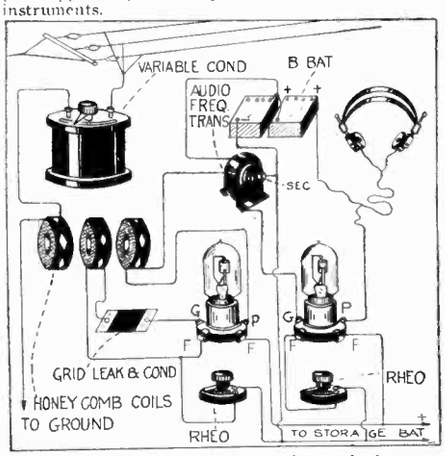
A. 2. A rheostat must be used to control the filament of your tube for best results, and a potentiometer is desirable, but not absolutely necessary to control the "B" batteries.

DETECTOR AND ONE STAGE AMPLIFIER

(118) Edward Claus, Pittsfield, Ill., asks for a circuit diagram of the following apparatus, together with any necessary additional apparatus. One variable condenser, three honeycomb coils, two vacuum tubes, two 22½ volt "B" batteries, a 6 volt storage battery, two sockets, two rheostats, grid leak and condenser, and phones.

A. 1. In order to use the apparatus you mention you will need one more variable condenser and one amplifying transformer.

We are giving herewith a circuit diagram of your apparatus, including the two above mentioned instruments.



A three honeycomb coil circuit employing a one stage amplifier, is shown above. Greater selectivity can be obtained by shunting the secondary coil with a variable condenser.

REGENERATIVE TUNER

(119) Carl Boehle, Bay City, Texas, says that he has a receiving set consisting of a variable condenser, a vario-coupler, an audion detector, and two stages of audio-frequency amplification. He asks:

Q. 1. How should I hook these instruments up, with the addition of a variometer, so as to have a regenerative set?

A. 1. We would advise you to use the circuit diagram published on page 56 of the May, 1922, issue of SCIENCE AND INVENTION, the only change necessary being that you insert a variometer in the plate circuit of the detector tube. In other words, disconnect the plate from the primary of the first transformer, and connect the latter to one side of the variometer. Connect the other side of the variometer to the plate, and you will have a regenerative circuit. This circuit, however, can be greatly improved by inserting another variometer in the grid circuit of the detector tube.

RADIO-FREQUENCY AMPLIFICATION

(120) C. E. Blair, Jr., Laramie, Wyoming, wants to know:

Q. 1. Is it possible to apply radio-frequency amplification to a short wave regenerative set?

A. 1. Radio-frequency amplification may be applied to any sort of regenerative tuner by placing the radio-frequency amplification before the tuner and connecting the input of the first tube of radio-frequency to each side of a tuning coil, one side of which is connected to the ground, and the other side of which is connected to a variable condenser, which in turn is connected to the antenna. The output of the radio-frequency amplifiers is connected directly to the aerial and ground binding posts on the regenerative tuner. If there is a variable condenser embodied in the tuner in series with the antenna lead, this should be short-circuited, or in some other way eliminated entirely from the circuit. It may be found to advantage to connect this condenser across the primary coil of the tuner proper.

ANTENNA AND RECEIVING RANGE QUERIES

(121) B. A. Hoduct, Memphis, Tenn., inquires:

Q. 1. Would an antenna 300 feet long answer satisfactorily for the reception of radiophone broadcast?

A. 1. A 300 foot antenna would be much too long for 360 meter reception, and we would advise you to cut it down to about 100 feet.

Q. 2. How far could I hear with the above antenna and a short wave regenerative tuner used in connection with a single audion tube?

A. 2. Your consistent receiving radius with a single tube should be 60 to 75 miles for radiophone.

Q. 3. Would a loading coil increase the range of this set?

A. 3. The addition of a loading coil to the above set would not add to the receiving range in the least, but would merely increase the wave length.

RECEIVING RANGE

(122) Rex Holmes, Princeton, Mo., refers to a set described in a back issue of this journal which consists of a tuner and an audion detector. He asks:

Q. 1. Can this set be used successfully to receive from a transmitting station located 125 miles from my home?

A. 1. With the set you mention you might possibly be able to receive over a distance of 125 miles, but we would advise you to use at least one step of audio frequency amplification.

Q. 2. Of what use is the rheostat in the filament circuit of the vacuum tube?

A. 1. The rheostat in the circuit is used to regulate the amount of current passing through the filament of the tube.

DIFFICULTY IN RECEPTION

(123) Lyman Hanes, Minneapolis, Minn., asks:

Q. 1. Can you explain what is causing the difficulty in receiving wireless telephone messages from Chicago, Milwaukee and Duluth in Minneapolis?

A. 1. Not knowing anything about the local conditions in Minneapolis, nor the kind of receiving apparatus used, it is impossible for us to say just why you are not able to receive messages from Chicago, Milwaukee and Duluth.

You must realize that there are many factors entering into the reception of radiophone messages, some of which are local topographical conditions, type and location of antenna used, and the quality and sensitiveness of the receiving set.

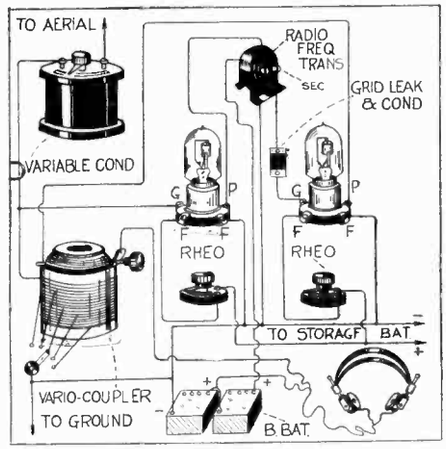
If there is any particular type of apparatus which you have in mind, and you will give us more details, we will be only too glad to help you as far as possible.

ONE STAGE RADIO FREQUENCY AMPLIFIER

(124) Malcolm B. Boyse, Bradford, Mass., requests:

Q. 1. Will you please give me a circuit diagram for a vario-coupler, a variable condenser, one step of radio frequency amplification and an audion detector?

A. 1. We give herewith the required diagram.



A circuit diagram of a tuner and one stage of radio-frequency amplification, together with an audion detector, is shown above.

LOUD TALKER QUERIES

(125) E. Paul Hunt, Orrick, Mo., wants to know:

Q. 1. How much and what size wire should be used for winding the field coils of a double pole loud talker similar to a Magnavox?

A. 1. Three pounds of No. 17 S. C. C. wire should be used on each core for the field coils, and the moving coil should consist of 18 feet of No. 38 S. S. C. or enameled wire.

Q. 2. What size diaphragm would you recommend for this loud-talker, and what material and thickness?

A. 2. A 3-inch diaphragm should give very satisfactory results, and we would advise you to try making it from sheet iron .006 inch to .007 inch thick.

Q. 3. Could a standard audio-frequency amplifier transformer be used as the step-down transformer with this loud-talker?

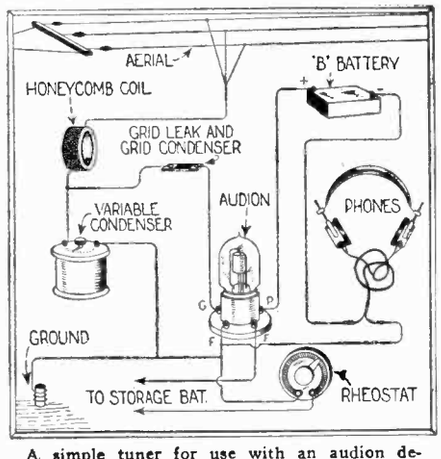
A. 3. You might try using an audio transformer in connection with this loud-speaker, but we would also suggest that you write to the Magnavox Company regarding the purchase of a different type of transformer suitable for use in this connection.

SINGLE HONEYCOMB COIL TUNER

(126) Harold T. Jones, Oshkosh, Wis., asks:

Q. 1. How can I hook up a single honeycomb coil with a variable condenser so as to make an efficient receiving tuner?

A. 1. We give herewith the diagram as requested. The "B" battery should have a voltage of 22½, and the tube should be a "soft" or detector tube.



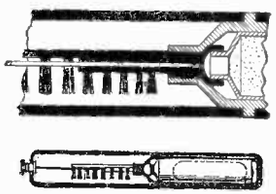
A simple tuner for use with an audion detector, is shown herewith. The size of the honeycomb coil can be varied according to the wave length it is desired to receive.

LATEST PATENTS

Fountain Toothbrush

(No. 1,436,883, issued to Charles J. Koepke)

This inventor has developed the fountain toothbrush idea considerably. He employs a casing with a



suitable slot therein (to permit the introduction of the fingers) to house a tooth paste tube. This casing is provided with a threaded portion at its neck, into which the tooth paste tube is screwed after the cap has been removed. From the opposite end of this a rod containing the bristles of the toothbrush projects, and immediately below this an elongated tube may be found through which the tooth paste is to ooze when pressure is exerted upon the tube. An outer casing surrounds the previously mentioned casing, which is also provided with a slot, so that when partially rotated, the fingers may be introduced through the two slots now in juxtaposition with each other. A cap covering the bristles, also contains a needle adapted to fit into the tube through which the tooth paste is to pass. Working this pointed wire back and forth, dislodges any tooth paste which may have caked while the brush was lying idle.

Swimmer's Motor

(No. 1,433,563, issued to Lyman P. Osterhout)

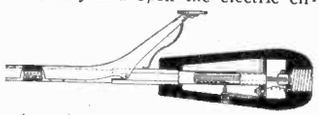
This is undoubtedly one of the cheapest swimming devices which

has been designed up to the present time. It consists of a belt surrounding the body of the swimmer, with an inflatable buoyant cushion at its lower point, which also acts as the retainer for a bearing post, through which bearing a propeller shaft passes. The second buoyant float has erected upon it a driving gear and a right angle transmission gear, fastened directly to the propeller shaft. By means of this apparatus comparatively great speed can be obtained by an unskilled swimmer.

Electric Circuit Breaker

(No. 1,438,308, issued to George F. Hunter)

In this electric curling iron, the resistance element is contained within the iron casing which extends downward into the handle of the iron. This causes the temperature within the handle to rise considerably, which in so doing acts on the thermostatic bar, and when the heat is high enough causes this to bend outwardly and open the electric cir-

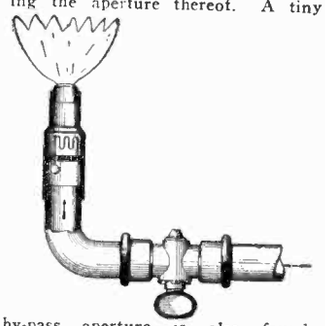


cuit. As soon as the temperature of the iron drops down again, the circuit is closed and the iron continues to heat. The inventor states that this same system could be employed for electric flat irons, ovens, etc., but in our opinion such a procedure would cause an arc to form between the contacts, as the circuits were being opened. A quick acting thermostat would be necessary.

Reducing Valve

(No. 1,437,437, issued to Luigi Mombaruzzo)

If a law were passed to make it compulsory to employ gas valves of the nature described herewith, we can be sure that accidents resulting in the loss of life from gas leakage would be rare. People contemplating suicide will have to do so by deliberately removing the tip of the gas burner. Within the tip, one end of a metallic thermostat bar is found. One end of this bar is secured to a partition and suspended from the other end is a ball which, when the thermostatic metal is cold, fits into a recess in the partition, closing the aperture thereof. A tiny

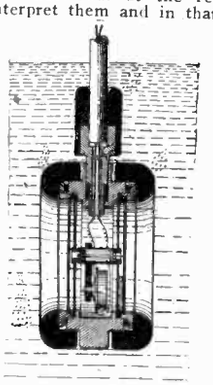


by-pass aperture is also found, through which gas escapes at all times when the main cock is turned on. In order to light the burner, gas permitted to escape through the tiny by-pass is lit; the heat transmitted to the thermostat opens the valve fully.

Submarine Signaling Apparatus

(No. 1,440,361, issued to Frank Lloyd Hopwood)

A double casing containing a diaphragm for each portion of the casing, that is, four diaphragms in all, also houses a microphone connecting to the ship by means of cables and to the receiving instruments. Sounds in the water can now be picked up by the microphone and an individual at the receiver can interpret them and in that way

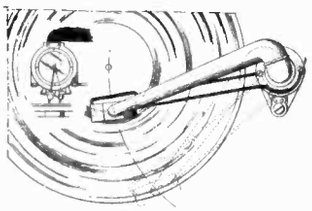


determine the nature of the ship causing the sounds. By varying the distance between the diaphragms, not only is the sensitivity and the tuning varied, but by different adjustments of the two sides the directional effect of the instrument is obtained. The space between the diaphragms may be filled with liquid or some jelly-like material. Screws permit the area in which the microphone lies to be broadened or contracted, causing the different properties of the microphone to be brought out for better tuning and sharpness of signals.

Polyphone Sound Box

(No. 1,438,642, issued to John Graham)

This invention is ingenious be-

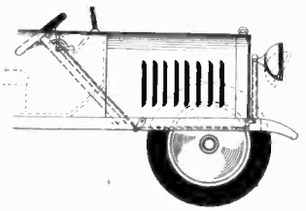


cause of the fact that the inventor employs two sound boxes connected to the same tone arm, each of which is provided with its own stylus. Both of these stylus' fitting into the same groove in the record, reproduce the music therefrom, but due to the fact that there are two diaphragms acted upon each by the same energy, much louder music is claimed for the device. In order that one stylus shall follow the other into the same groove in the record, the inventor employs two arms which orientate the sound box, the latter rotating upon the tone arm.

Control Mechanism for Headlights

(No. 1,433,080 issued to Edward B. Kaylor)

An automobile provided with the usual headlights, has these headlights so arranged that they may be tipped downwardly or directed straight ahead. Rods connect both headlights with a cross-arm, and thence by means of right angle levers and rod

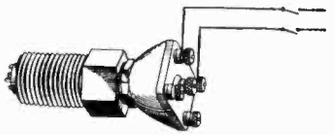


extensions to a controlling clutch, operating about a notched sector securely fastened to the steering wheel of the automobile. For driving on city streets, the headlights of the automobile are directed downward, so that the rays of light which may be brilliant at all times (eliminating entirely the use of the dimmer), flood the ground in front of the vehicle with a pure light. None of the rays are permitted to pass out even on a horizontal plane. When the headlight is raised the beam is directed straight ahead as usual.

Spark Plug

(No. 1,441,397, issued to William H. Chard and William F. Hills)

This specification gives the description of an unusually novel departure from the ordinary run of spark plugs, for internal combustion engines. The inventor proposes to run preferably five rods through insulating material, such as porcelain, in such a manner that one of the

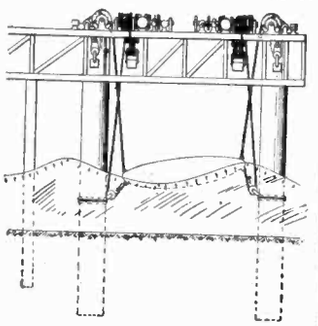


rods will constitute the center electrode, and the other four will be arranged around this center. A T-shaped piece of metal connects two of the outside binding posts together and grounds them. One or both of the remaining two outside posts are then connected to wires leading to the ignition system. By this method an intensifying spark plug is produced, the spark leaping from one of the outside posts to the center and thence to a post on the opposite side, viz., to the ground. In a plug of this nature, the possibility of its fouling is supposed to be practically eliminated.

Wave Power Motor

(No. 1,439,849, issued to Edward D. Stodder)

In this patent (the principle of which has been explained in an article appearing several years ago in this journal), the inventor provides for a series of piers or columns of

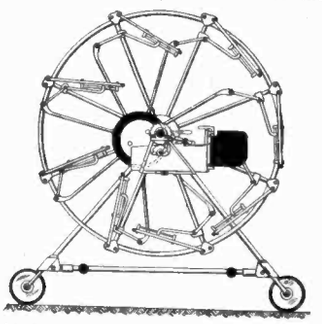


concrete or steel. Floats are secured between these, the floats have a limited lateral movement, but are permitted to ride up and down in comparative freedom. All actions of the waves are taken into consideration, that is, not only is the gravitational influence employed, but the lifting action of the wave is also used to actuate drums. These drums in turn operate air compressors which store the energy for driving turbines and electrical generators, and the horizontal effect produced by steep waves is also employed in developing power

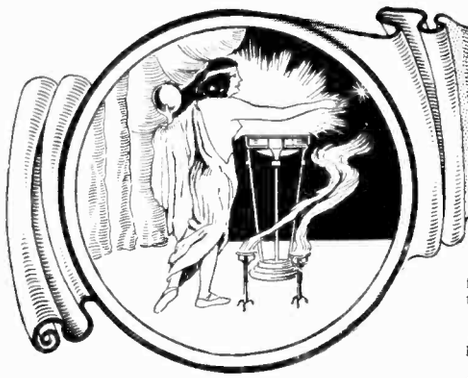
Aerial Vessel

(No. 1,432,209, issued to Robert C. Rimmer)

In this airplane, the propellers are arranged in the form of paddles much the same as in side-wheel steamships. The orientation of the



blades is accomplished by means of a cam located off center, which acting upon rollers and thence through intermediary levers, causes the fan blades to assume certain definite positions relative to the desired movements of the airplane. The inventor of this device claims to have built a working model, which has experimentally proved that flight can be accomplished by a machine of his design. These same paddles also permit the airplane to be directed ahead or astern, depending upon the location of the cams, and their effect on the revolving blades.



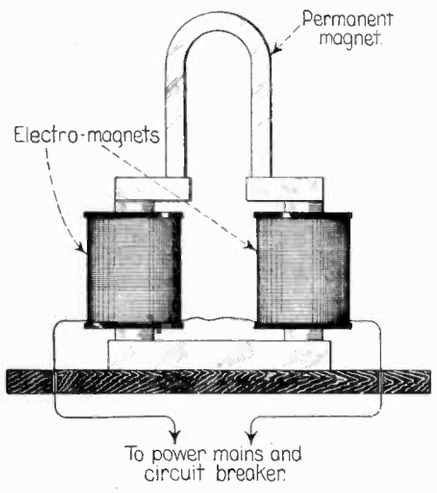
THE ORACLE

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

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to the 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.

MAKING PERMANENT MAGNETS

(1411) B. L. Rites, Asheville, N. C., inquires:



The method of magnetizing permanent horse-shoe magnets is shown above.

Q. 1. How are permanent horse-shoe magnets magnetized in quantities?

A. 1. Any large sized electro-magnet, operating on a heavy direct current, may be used for this work. We are giving you a diagram herewith showing how the permanent magnets should be placed, one at a time. It is advisable that the direct current supplied to the large magnets be interrupted rapidly.

ELECTROLYTIC RECTIFIER

(1412) John M. Ramsey, Detroit, Mich., asks:

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

A. 1. To all practical intents and purposes, the resistance of such a solution is practically negligible. Its resistance is about 1½ ohms varying with the temperature. It is for this reason that in using the electrolytic rectifier, it is absolutely necessary that some suitable form of resistance be inserted in series with the rectifier and the source of alternating current, as otherwise the fuses will blow out. A resistance of about 20 ohms, capable of carrying 5 amperes, is necessary when charging a 6-volt storage battery at a 5 ampere rate, while about 15 ohms, capable of carrying 8 amperes, should be employed for an 8 ampere rate.

CONVERTING GASOLINE SAD IRON TO ELECTRIC

(1413) Henry Rodenmayer, Clermont, Fla., asks:

Q. 1. How can I convert a gasoline sad iron into one operated by electricity?

A. 1. To convert a gasoline sad iron into an electric iron, it will be necessary to remove the burner on the inside of the same, and line the iron with asbestos. Then go to any electrical supply store, and purchase a heating grid, such as is sold for renewals in electric irons, and place the same within the iron you have. Two flexible leads, well insulated by asbestos, are brought out from the iron, and the job is done.

VOLTAGE DROP

(1414) Louis T. Roberts, New Orleans, La., asks:

Q. 1. What would be the voltage drop over a line consisting of two No. 10 B. & S. gauge copper wires one mile long, the current being 4 amperes at 110 volts?

A. 1. The two lines of No. 10 copper wire stretching for a distance of a mile, will create a drop in potential of about 10 volts, provided that the lines are insulated.

HARDENING LEAD

(1415) J. Bartlett, East Toronto, Canada, inquires:

Q. 1. Can soft lead be made hard by dipping it in a chemical solution?

A. 1. There is no method of hardening lead by dipping it into a chemical solution. There is said to be a secret process by means of which lead may be made hard enough to be used in making knives, and other instruments requiring a hard metal. We have no information on this process, however, as the inventor has kept it an absolute secret.

STEEL SUPPORTING ARM

(1416) Chas. E. Burrell, Shamokin, Pa., says: I would like to make an arm of steel 50 feet long to support a weight of 500 pounds with absolute safety. One end is to work up and down in a groove, and the other end is to be supported by a wire rope. He asks:

Q. 1. Can you tell me how to construct this arm of steel, and how heavy must it be?

A. 1. The arm of steel which you describe will depend entirely on the construction and cross bracing. You will find that a latticed steel arm will be much lighter than a solid steel arm in a derrick similar to the one you describe. This latticed steel arm sufficiently cross-braced and welded or riveted, will not be so hard on the bearings.

We would suggest that you communicate with various concerns regarding breaking and bending stresses on steel girders. Also request that they figure on various types of arms, such as T-arms, I-beams, triangular cross-braces, and four-sided cross-braced arms. They will give you all of the figures available.

Articles in March "Practical Electrics"

New Theory of Magnetism

Electrical Pumps
By F. R. Kingman

Home Battery Charger

Three Brush Automobile Generator. By H. Highstone

Motor Without Visible Field

Planting Vines by Electricity

CHEMICAL IGNITION

(1417) Thos. A. Caplen, Detroit, Mich., inquires:

Q. 1. Is there any chemical substance which will, when lightly rubbed, produce a hot flame without any disagreeable fumes or odors?

A. 1. There is no chemical substance, to our knowledge, which will give a hot flame when lightly rubbed, without producing any disagreeable fumes. Phosphorous will produce a high degree of heat when ignited by rubbing. It is dangerous to work with continually as the white phosphorous attacks the osseous system.

HANDLING DYNAMITE

(1418) Clarence Chittenden, Perry, Iowa, says: I have been told that dynamite has been known to explode when punching a hole in the cartridge for the insertion of the cap and fuse. He asks:

Q. 1. Has an authentic case of such an explosion ever been reported?

A. 1. We do not know of any case where dynamite exploded when punching the hole in the stick for the cap and fuse. In fact, a well known explosive manufacturing company, in their directions for using dynamite, show the holes being punched with the end of the handle of a cap crimper or with a wooden awl.

ATMOSPHERIC POTENTIALS

(1419) A. Chapple, Vancouver, B. C., Canada, asks:

Q. 1. If the electrical potential of the air varies according to the height, would not a charge collect upon a metal plate placed at a height, and would not a current flow from this along a wire to the ground, or vice versa? If this is so, why could we not place a vibrator in the connecting wire, and so get a pulsating current from the air?

A. 1. The experiments you mention have been tried time and again, but it has not been found practical to draw electricity from the air by the method you suggest, because the amounts obtainable vary considerably in strength and regularity. An example of drawing electricity from the air may be seen in any large radio station. For instance, at the station of the American Telephone & Telegraph Company in New York City, it is possible at times to draw sparks 1 inch long from the lightning switch when the same is left open. This is because of the static electricity which has collected on the antenna.

COLLECTING MOISTURE FROM THE AIR

(1420) M. A. Raymond, Washington, D. C., wants to know:

Q. 1. How may the moisture which is contained in the form of vapor in the air of a room, having a humidity of approximately 75 to 90 degrees, be collected?

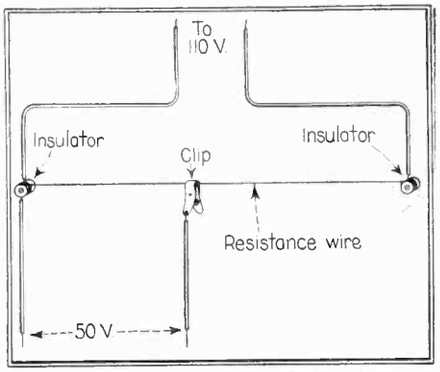
A. 1. Since you did not give us definite information as to the size of the room in which you wish to extract the moisture from the air, we can only give you suggestions. For instance, place a quantity of calcium chloride in each of four porcelain dishes, and place them in various parts of the room. The calcium chloride will absorb moisture from the air, and if you wish to abstract the water from the same, you may do so by placing the chemical in a retort and heating it, collecting and condensing the water vapor given off. This will probably be the simplest way to obtain the results you desire.

REDUCING VOLTAGE

(1421) A. A. Rynkiewicz, Techny, Ill., says: I have some wire, the resistance of which is 125 ohms per foot. He asks:

Q. 1. How can I make use of this wire to reduce 110 volts to 50 volts?

A. 1. If you will stretch one foot of wire between two insulators, then take off a tap near the center as illustrated, you will be able to reduce 110 volts A. C. to 50 volts. Eleven inches of the wire might be used, whereupon every inch would constitute a tap delivering 10 volts. With this arrangement the regulation of the voltage is very simple, but very little current would be available, due to the high resistance, and the microscopic thinness of the wire.



A potential of one hundred and ten volts may be reduced to fifty volts by the method shown above. Very little current will be delivered on the fifty volt side, owing to the small wire used in this case.

DATA ON THE SOLAR SYSTEM

(1422) G. A. Steinmiller, Chicago, Ill., wants to know:

Q. 1. Can you give me the following information on the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune? Their diameters, distance from the sun, time required for one revolution around the sun, and time required for one revolution on their axes.

A. 1. We give herewith the desired information, in which the length of the year represents the time required for one revolution around the sun, and the length of day, the time required for one revolution on the axis. The measures of time given are the standard hour, day and year of the earth.

Name	Diameter	Distance from sun
Mercury	3,030 miles	36,000,000 miles
Venus	7,700 miles	67,200,000 miles
Earth	7,917.6 miles	92,900,000 miles
Mars	4,230 miles	141,500,000 miles
Jupiter	86,500 miles	843,300,000 miles
Saturn	73,000 miles	886,000,000 miles
Uranus	31,900 miles	1,781,900,000 miles
Neptune	34,800 miles	2,791,600,000 miles

Name	Length of year	Length of day
Mercury	88 days	88 days
Venus	225 days	uncertain
Earth	365 days	24 hours
Mars	687 days	24½ hours
Jupiter	12 years	10 hours
Saturn	29½ years	10¼ hours
Uranus	84 years	uncertain
Neptune	165 years	uncertain

Q. 2. Has there ever been, or will there ever be, a time when all the planets will be on one side of the sun and in a straight line?

A. 2. To the best of our knowledge, there has been no time when all the planets were in a straight line, nor do we believe that such a thing is possible, due to the varied speeds of rotation around the sun, and inclinations of the planes of the ecliptics.

DETECTING DIAMONDS WITH X-RAYS

(1423) H. S. Bash, Kenton, Ohio, asks:

Q. 1. How is a fluoroscope used in detecting diamonds which are being stolen and carried out of the mines by workmen in the diamond fields?

A. 1. One of the methods used for detecting the theft of diamonds at the mines, is to examine the workmen with X-rays. Of course, a fluoroscope is used to make the X-ray image visible, and this is the type as is used in any regular X-ray work.

Q. 2. Will a fluoroscope display activity when acted upon by diamonds?

A. 2. No.

THE HECTOGRAPH

(1424) J. C. Chess, Des Moines, Iowa, asks:

Q. 1. Can you give me complete directions for making a hectograph?

A. 1. We are giving the desired information herewith: Melt together one part of glue, two parts of water, and four parts of glycerin, all by weight, evaporating some of the water, and tempering the mixture with more glue or glycerin, as the season or climate requires. The mass, when of proper consistency, which can be ascertained by cooling a small portion, is poured into a shallow pan and allowed to stand. Clean glue must be used, or the mixture must be strained, and air bubbles must be removed by skimming the surface with a piece of cardboard.

A variation of this formula is:

Gelatin	10 oz.
Water	40 oz.
Glycerin	120 oz.
Barium sulphate	8 oz.

Q. 2. What kind of ink is best for use with the above?

A. 2. The best ink for use with a hectograph is purple aniline ink, prepared especially for this purpose. This may be made as follows:

Methyl violet	2 parts
Alcohol	2 parts
Sugar	1 part
Glycerin	4 parts
Water	24 parts

Dissolve the violet in the alcohol mixed with the glycerin; dissolve the sugar in the water, and mix both solutions.

COATING COPPER WITH MERCURY

(1425) K. Faulkener, Winnipeg, Manitoba, Canada, asks:

Q. 1. What is the best way to coat copper with a silver covering of mercury?

A. 1. To coat copper with mercury you should first clean the surface of the copper thoroughly with weak nitric acid and then rub the quick silver on the clean surface until the desired finish is obtained.

Q. 2. Can this finish be made permanent?

A. 2. It will be impossible to "set" this finish and if you wish to obtain a permanent silvered surface, you must electro-plate the copper article with silver.

ELECTRIC SIGNALS

(1426) Wm. D. Foster, Mamaroneck, N. Y., asks:

Q. 1. How can I raise, electrically, two or four vertical levers, two at once, or four at once, to a horizontal position, the levers being about 4 inches long, each lever having a small light at the outer end? I want each of the lights to show just before raising the levers.

A. 1. What you suggest could be very easily done by means of movable core solenoids which could be used to raise the arms of the signals, the particular ones to be raised being selected by means of a switch. Small circuit-closers could be arranged to operate in connection with the solenoids, so that just as the solenoids start to raise the levers, the light will light, and as the lever rises further, the light will go out. The size and amount of wire used on the solenoids will depend upon the current used, and can easily be determined by experiment.

FOUCAULT'S EXPERIMENT

(1427) M. Brieger, Montreal, Canada, asks:

Q. 1. Will you kindly explain what the experiment involving Foucault's pendulum consisted of?

A. 1. We quote from Flammarion's ASTRONOMY FOR AMATEURS. "The magnificent experiment of Foucault at the Pantheon, just renewed under the auspices of the Astronomical Society of France, demonstrates the rotary motion of the Earth to all beholders. A sufficiently heavy ball (28 kilograms, about 60 pounds), is suspended from the dome of the edifice by an excessively fine steel thread. When the pendulum is in motion, a point attached to the bottom of the ball marks its passage upon two little heaps of sand arranged some yards away from the center. At each oscillation this point cuts the sand, and the furrow gets gradually longer to the right hand of an observer placed at the center of the pendulum. The plane of the oscillations remains fixed, but the Earth revolves beneath, from West to East. The fundamental principle of this experiment is that the plane in which any pendulum is made to oscillate, remains invariable even when the point of suspension is turned. This demonstration enables us in some measure to see the Earth turning under our feet."

Combination of Weights

(1428) Everett Thomas, Casper, Wyo., asks:

Q. 1. If a live fish, weighing 2 pounds is placed in a vessel containing enough water for it to swim in, will the vessel weigh 2 pounds heavier than it did without the fish? Please explain.

A. 1. If a live fish, weighing 2 pounds is placed in a vessel containing enough water to allow the fish to swim, and supposing that the vessel weighs ten pounds, with the water contained within it, when the fish is introduced, the vessel will weigh twelve pounds, the reason being that a floating body sinks until it displaces its own weight of the liquid in which it floats.

If this displaced liquid could flow out of the vessel freely, so that the same level would be maintained, the weight of the vessel and contents would not increase.

Perpetual Motion(?)

(1429) J. Stiriss, New York City, says: Imagine a machine that is actuated by power derived from a chemical compound, which needs but a little water, say a pint a day, to compensate for evaporation only, the chemical itself supplying power and lasting indefinitely. He asks:

Q. 1. Would such a device be perpetual motion?

A. 1. When you figure on a machine actuated by power from a chemical compound, and state that only a little water is added to compensate for evaporation, such evaporation could be prevented by enclosing the device completely. It will not be perpetual motion.

Losses in Allowing Coal to Stand

(1430) Nathan Truman, Bainbridge, N. Y., asks:

Q. 1. Will ordinary anthracite coal in chestnut or stove size, deteriorate in heat producing power on being kept in an open bin in a cellar for a period of eighteen months?

A. 1. The percentage of loss under the circumstances is very slight if coal is left in a dry bin in a cellar.

It is reported that coal submerged in sea water gives a greater number of B. T. U.s than if left in the open air or if burnt immediately after being taken from the coal mines. There are no accurate figures which can be given because different tests will produce different efficiencies even though the coal is taken from the same shipment.

Changing the Color of Man

(1431) Edgar D. Walker, Chicago, Ill., wants to know:

Q. 1. If there has ever been performed an operation on a person of colored origin, in order to make him have a white skin.

A. 1. An attempt to change the color of a man by means of glandular extirpations has never taken place. Medically we know that there are certain glands whose secretions cause pigmentation of the skin. If these glands could be removed prior to birth, it is quite probable that we could get a lack of color not only in the pigmented layer of the skin, but also in the hair, eyebrows, nails, and all other parts of the body which are a direct outgrowth of the ectoderm.

We also know that certain diseased conditions bring on a marked pigmentation of the skin, and that if these conditions are alleviated, the skin pigmentation disappears. Although the effect of which you speak has been theorized upon, we do not know of any attempts that have been made upon either animals or man in an effort to change the color of the skin.

Perhaps some experiments with the electric needle tending to bleach the pigmented skin layer, following the technique used in the removal of birth marks, would be effective in changing the color of an individual.

Fire Resisting Cement

(1432) Ray J. Cook, Fort Worden, Wash., requests:

Q. 1. Can you give me directions for making asbestos cements?

A. 1. Ground asbestos may be made into a cement which will stand a high degree of heat by simply mixing it with a solution of sodium silicate. By subsequent treatment with a solution of calcium chloride, the mass may be made insoluble, silicate of calcium being formed.

A cement which will stand a high degree of heat, and be suitable for cementing glass, porcelain, and other vessels intended to hold corrosive acids, may be made as follows:

Asbestos	2 parts
Barium Sulphate	3 "
Sodium silicate	2 "

By mixing these ingredients, a cement capable of resisting the strongest nitric acid will be obtained. If hot acids are dealt with, or the cement is to be used in places where it will be subjected to intense heat, the following will be found to possess still more resistant powers.

Sodium silicate	2 parts
Fine sand	1 "
Powdered asbestos	1 "

Both of these cements take a few hours to set. If a cement which will set immediately is wanted, use potassium silicate instead of sodium silicate. This mixture will set at once, and the resultant cement will have the same power of resistance as that made with the above formula.

SPARK COIL DATA

(1433) Edward Kujanik, 62 Bruce St., Galt, Ont., Canada, asks:

Q. 1. Can you give me data on the construction of a small spark coil capable of giving a spark about ⅛ of an inch long?

A. 1. The core of such a coil is composed of a bundle of iron wires three inches long, the diameter of the bundle to be ¼ inch. The primary consists of two layers of No. 23 D.C.C. wire, over which is placed an insulating tube, with walls 1/32 inch thick. Several layers of Empire cloth may be substituted for this tube if desired. The secondary consists of ¼ pound of No. 34 enameled wire. The condenser consists of 30 sheets of tin foil 2 inches by 1 inch, separated by sheets of paraffin paper. The primary voltage should be 2.

SOURCE OF HIGH AMPERAGE

(1434) John H. McMillen, Iowa Falls, Iowa, asks:

Q. 1. Would it be possible to re-wind a low voltage dynamo in order to use it for an electric arc welding machine with a maximum capacity of about 150 amperes

A. 1. You cannot re-wind a low voltage dynamo and use current from the same on an arc welder, with a maximum capacity of 150 amperes. There is no low voltage dynamo on the market which you can use for this purpose.

We would suggest that you equip your plant with the alternating current, and then step this down to the desired voltage and amperage.

Refrigeration in the Home

By L. K. WRIGHT

(*Continued from page* 1075)

The flywheel side of the shaft offers the hardest problem, for the old bearing must be removed and the opening drilled an inch larger to take the new bushing. This new bushing will be two inches longer and fitted with a cap to give pressure on the packing. The illustration, A, explains it. Because of the length of the new bearing the idler pulley will have to be removed and the driven pulley moved out to provide clearance. The projecting bit of shaft may be sawed off to give a finished appearance. It is a good plan to drill an oil shaft in the new bearing at an angle, as shown in sketch, to insure proper lubrication. It is best to pack the stuffing box with flax cord that has been soaked in graphite and glycerine. Another packing, though not so good, is butchers' white meat string soaked in a thick mixture of graphite and glycerine.

Next remove the oil filler from the crankcase and set an angle valve, No. 10, in its place. The lubricant used in the crankcase is glycerine, and is poured with a funnel through valve No. 10. Upon the opposite side a glass gauge should be fitted by drilling and tapping two holes in the crankcase, as shown in B.

Any other vents or openings in the crankcase must be plugged or covered by screwing pieces of sheet metal over them. Always gasket any opening so covered. Also be sure that there is a good gasket between the sections of the compressor.

A condenser is constructed by making a helical coil containing about seventy feet of quarter-inch copper tubing. One end of this coil is connected to a small receiver tank, C, made of a two-inch piece of extra heavy galvanized pipe, eight inches long and capped at both ends. These caps are drilled and tapped to take the tubing connectors by which the tubing is secured to the tank. As shown in the sketch the receiver is lying down, but it may be placed in an upright position in the center of the coil if care is taken to see that the outlet line supplying the expansion valve is at the bottom. The coil and receiver are then set into a tank constructed of galvanized iron, which has an inlet and an outlet line for water. The inlet water line should be at or near the bottom and the outlet line near the top. A cover is provided through which the copper tubing projects. After carefully soldering the cover to the tank, and the openings about the copper tubes, test with water pressure and see that it is tight.

After ascertaining your electric circuit factors, purchase a suitable motor of one-half horsepower. Measure the size of the pulley on the compressor and note the speed of the motor to determine the size of the drive pulley. The compressor should run from 150 to 250 R. P. M. The motor, compressor and tank are preferably bolted to a common base constructed of one-inch pine, for if the parts are not rigidly fastened, there is a tendency to draw together. If the motor is equipped with a belt tightener it would be the better policy to use an endless belt, because it is the more silent.

A measurement is taken of the ice bunker and a galvanized tank of suitable size constructed. A coil of sixty or more feet of one-quarter inch copper tubing is fitted into the tank, which is then filled with brine. It is better to provide the tank with a loose-fitting cover as the sweat from the unsubmerged lines would, in time, cause it to overflow; it would also weaken the brine. Dissolve three to five pounds of calcium chloride, depending upon the purity in each gallon of water, until the hydrometer registers a density of 90°. The density of this solution is about 23° Baumé, its weight about 13.5 pounds per gallon, and the freezing point —9° Fahr. In order to keep the brine from congealing or weakening test periodically and keep to standard density. In placing the brine tank in the ice bunker set it up on pieces of wood (2" x 2"), spacing on all sides to allow for air circulation, for it is upon this that the efficiency of the plant depends.

All valves, nipple and fittings are ⅜-inch extra heavy galvanized iron or brass. Determine the suction side of the compressor and insert a short nipple. It may be necessary to bush down to receive the nipple, to which is coupled a cross fitting, No. 6, the upper opening of which supports a low pressure gauge (reading to 100 lbs.); the under opening has a 6-inch nipple with a pair of flanges at its lower end. The lower flange will have several uses and a plug and nipple should be kept ready. The other opening of the cross fitting is connected by nipple to a shut-off valve, No. 3. This valve is connected to the suction line of copper tubing by means of a reducing tubing connector, or a bushing and a connector, No. 8. Be sure that this suction line is the one that leads to the top of the coil in the brine tank. The discharge side is coupled to the compressor by means of a short nipple, to which the cross fitting, No. 5, is fitted, the top opening supporting a high pressure gauge (H.P. to 100 lb.) the bottom opening being fitted with a nipple, six inches long, capped at the bottom; or a coupling may be used in its place, being fitted with a purge cock. This acts as an oil interceptor and removes all lubricant (glycerine) which escapes past the piston rings and prevents it from entering the system. Oil in the lines is detrimental to refrigeration. This purge should be drained occasionally. The other trap, on fitting No. 6, is for the purpose of trapping any scale and preventing it from getting into the compressor, where it might do damage to the piston and compressor walls. After one or two cleanings all the scale will be removed from the system. Valves, numbers 1 and 2, are stop valves. Number 4 is a check valve that prevents the high pressure side backing through the compressor to the low or expansion side. The needle valve, No. 7, is spaced from the stop valve with a short nipple. In connecting tubing to the valves use tubing connectors, as at Nos. 8, 9, etc. If it is desired a pair of flanges may be placed between the stop valve (No. 2) and the expansion (needle) valve and a disc of fine screening inserted in the flanges to intercept any dirt which would interfere with the proper action of the needle valve. If the expansion valve is suspected of being clogged, mark the position of the wheel with a piece of chalk and open fully, counting the number of turns, then return to exact position for the particles of dirt will have been forced through and away from the needle. Figure D shows how flange may be installed. In fitting all joints use a paste made of glycerine and litharge. Use but little glycerine and mix with the finger tips to insure a smooth, syrupy mass without lumps. Mix but what is needed for immediate use, as it will harden and be useless in a few minutes. Do not get any of this sealing compound inside the fittings, apply to the threads of the nipples only and never in valves or fittings.

Before attempting to charge the machine a high pressure test should be made. This

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is accomplished by closing valve No. 3 tightly, all other valves being open; be sure that the expansion valve is fully opened. See that the motor cups are filled with oil or grease, the crankcase showing at least a half gauge of glycerine, the belt tight, and that water is flowing through the condenser and that same does not leak. Remove the flange from scale trap (No. 6) and start machine, running high pressure gauge up to 100 pounds. Then stop machine and replace the flange half, meanwhile fitted with a plug. This plug is but temporary, but nevertheless, should be tight. Be sure and use gasket between the flange halves and when thought tight, open up valve No. 3. This will give an air pressure on the whole system. The pressure will fall to about 80 pounds or less and then should remain at a constant. Look over all joints for leaks; bad ones can be immediately detected by the hissing sound; if in doubt, test with soap and water and watch for bubbles.

When satisfied that the system is tight, open the purge cock on the cross fitting No. 5, and allow the air to escape. Then with valve No. 1 tightly closed, start machine, exhausting the air from the system through the purge. A good test to ascertain whether the system is tight or not is to fasten a rubber hose to the purge cock and submerge in a pail of water. This also shows when all the air is exhausted. When so exhausted, close valve No. 3 while the machine is running. Then stop machine and unbolt the lower flange, take out the plug and insert a nipple to which a charging hose has been clamped. A charging hose is made from a length of pressure or rubber tubing, such as is used by confectioners on their carbonic lines. A nipple is fitted into the tubing and secured by three or four hose clamps. The other end of the hose is similarly equipped with nipple and clamps.

Most refrigerants are dangerous to use and require special precautions, but the refrigerant used in this plant is practically odorless, non-injurious, non-explosive, and non-poisonous, yet is efficient and best for household use. The refrigerant, ethyl chloride, is obtained in a steel drum, to which the other end of the charging hose is fitted by means of the nipple. When the drum is hooked up to the machine lay it on or suspend it from a scale so that the amount of refrigerant entering the system can be noted. With the drum in position and hose connected, start machine and exhaust the air from the hose and compressor. Close purge valve while machine is running, and then open valve No. 1; then slowly open valve on chemical drum. Watch high pressure gauge very closely and load machine with about two pounds of refrigerant, and then give it a trial run. The drum of ethyl chloride need not be disconnected for the trial run; all that is necessary is to make sure the valve on the drum is closed. In charging the machine should the high pressure gauge begin to "spin" (mount too rapidly) stop the machine immediately as there is too much refrigerant in the plant giving a hydraulic pressure which might strain the outfit.

To run the plant have all the valves open; see that water is passing through the condenser and then start machine. The needle valve works on a micrometer screw and is very sensitive, a mere touch being sufficient to make a difference of several pounds' pressure on the low side. This valve will have to be adjusted so that the low pressure gauge carries from five to ten pounds of gas pressure, while the high pressure gauge will read from thirty to eighty pounds. Pressures on the high (liquid) side will depend upon the temperature of the cooling water, and pressures on the low side will have to be adjusted, so that the return or suction line frosts up to, but not on the compressor.

If the trial run is satisfactory begin to remove charging hose as follows: Close valve No. 3 and run machine until low pressure gauge shows a vacuum, then close valve No. 1, and disconnect drum by removing lower flange. Insert a plug in flange and replace with leaden gasket or shellacked paper one. Then exhaust air and gas from the compressor through purge. When all exhausted close purge tightly, make sure flange is tight, then open valves No. 1 and No. 3, and plant is ready to run.

The best location for the plant is right next to the ice box, or it may be located directly under it in the basement and the lines carried through the ceiling. The return line can be insulated and prevented from dripping (caused by melting frost) by wrapping a layer of newspaper some two or three inches thick round the line; then sewing on a canvas covering which is finished and waterproofed with a heavy coat of asphaltum paint. Fasten both high and low pressure lines rigidly by means of hangers of strap iron, staples or wire.

The brine tank will take quite a while to cool down on the first run, but once cooled will retain its temperature for long periods and take but a short time to further cool. In mixing brine it is advisable to do so a few days in advance in order to allow it to lose the heat generated in mixing.

If the builder places his plant in an exposed place it will be necessary to install a water drain at the lowest point to drain the water and prevent freezing. The bearing on the compressor may heat up slightly on the first run; the cap should be adjusted to give sufficient pressure to prevent escape of gas and yet not so tight as to heat the bearing. If desired a safety pop-valve may be installed by using a tee as per sketch E to unload at 125 pounds into a five-gallon can of water. But because of the small amount of refrigerant and its harmless nature, this is not absolutely necessary.

How Enameled Iron Tubs Are Made

By H. WINFIELD SECOR

(*Continued from page* 1066)

he removes the tub from the oven. If it is hot enough, the second operator shakes the powder-like enameling mixture over the inside of the tub and the top of the rim, this mixture being a secret formula with each manufacturer; after this the door is quickly opened by applying compressed air to the control cylinder, as before described, and the tub is replaced in the oven for a few minutes. The intense heat causes the enamel mixture to melt and fuse together, and adhere to the clean iron surface over the inside of the tub and the rim. The tub is now removed, placed on an iron truck and wheeled off and allowed to cool.

Fig. 5 shows red hot tub removed from oven momentarily, while second operator shakes enamel powder over the tub, while Fig. 6 shows the tub being replaced in the oven, in order to fuse and bake the enamel.

After the tubs have been carefully inspected for flaws in the enamel, they receive a coat of red-lead paint over the outer surface to prevent rusting, and they are then placed in the storage rooms, ready for shipment to all parts of the world.

Rapid Scene Changes in "JohannesKreisler"

By JOSEPH H. KRAUS

(*Continued from page* 1051)

side wall. Consequently, the actor appearing on the upper deck of the structure will seem to describe an arc as he turns and walks away. The structure of the platforms is at no time seen by the audience, due to the fact that only the characters or the particular scenes which are to be shown, are illuminated. Meanwhile other black robed figures are pushing one or the other of the platforms into place or erecting other scenes so that the moment the lights go out on one of the stagelets, they may be turned on at another place, and the action continued there without a moment's intermission. Of course the full size of the stage is not used at all times. Sometimes one or two, or even three of the smaller scenes, are simultaneously illuminated. These are not all on a level with the stage floor, but arranged in tiers, as our illustration clearly shows. In addition to the platforms already mentioned, there are on either side of the stage two more small stages also on rollers. One of these contains the permanent setting of the interior of a room in which Kreisler is telling the story; the other is so arranged that the scenes thereon can be changed. When any of the stages are not being employed, they are covered by black curtains.

In the full stage utilizations, each of the six sub-stages may have various scenes mounted upon them, and then by placing them in the correct position, the entire stage setting is built up.

When Kreisler floats through the air he is standing in a box, (erected on the moving bridge platform), and seems to float idly through the air landing on the stage beside Donna Anna. As a matter of fact, Kreisler has stepped from the box to the top of a platform made of structural steel, resembling a pair of parallel rules. A cable and a winch hold it in place, an operator releasing the cable gradually, permits Kreisler to descend through the air to the stage. Kreisler may act at all times while on this platform, his position being perfectly secure. A spot-light illuminates his face only.

In another scene where Kreisler cuts the heads from his enemies with his baton, three dummies are employed, the heads of each of the enemies are held over the collar band of the dummy. The arms of an assistant enter the arms of the dummy, and the arms of a second assistant enter the legs. In this manner grotesque dances are produced by the two assistants operating the arms and legs. The head when cut off moves to a side, separating itself rom the body completely. A slit in the black cloth background hides the actor's body. Spot-lights follow up the movements of the heads.

An Unsuspected Function of Sugar

By C. L. MELLER

(*Continued from page* 1073)

enduring sub-zero temperatures. In contrast to this clear sap, that will boil down to practically nothing more than sugar, there is the sap of many another genus of trees which even to the touch shows a sticky viscosity and boiled down produces a more or less mucilaginous substance. Rubber is the best known product of such a tree sap. Freezing a sap of this latter type separates it into a number of constituent parts, which seem unable to recombine after thawing, primarily because they were not in solution but were held in suspension; low temperature brings about a form of coagulation in a sap of this kind analagous to that brought about by boiling.

Recovering Sunken Treasures

(*Continued from page* 1056)

keel, which is often not the case. In some of these methods, holes are to be drilled into the sides of the vessel, and expansion bolts to which the cables are attached, are inserted into the holes. Even in wooden vessels such procedure presents many grave difficulties, and the sides of sail vessels under the stress developed by the lifting pontoons or jacks, would tear out these steel plates as though they were shells of pecan nuts. In the present installation a different method of raising a ship is employed. Here a framework built of structural steel, to meet the lifting stresses placed upon it when the sunken vessel is to be raised, is lowered over the vessel as she lies on the bottom of the sea. A globular diving bell housing an operator, who can communicate with the surface pontoon, directing in this manner by means of telephone or control switches the descent and positioning of the cradle lifting devices, assists in the proper locationing of these cradles. The upper part of the cradles are made buoyant, when filled with air, so that they may be floated around, or the air may be withdrawn, to permit of a gradual descent. At the base of the cradle two steel projecting lugs are to be found. These are perforated, so as to allow air or water at a high pressure to be driven through these openings. The jet of air or water thus formed, clears away the sand at the base of the cradle and under the vessel. Hydraulic pistons drive the lugs beneath the vessel.

In order to be assured of the fact that the cradle will not jam into the ribs of the vessel, cutting tools, found at the base of the cradle, and driven by compressed air or water power motors, clear away the silt at the base, plowing a furrow as they move downward. If a greater downward pressure is desired, some of the air in the top tank of the cradle is replaced by water, decreasing its buoyancy in this manner, and consequently, increasing its pressure. It will thus be seen that the revolving cutting wheels at the base will clear away any extra hard obstruction, while the water or air under pressure takes care of the sand; thus by its own weight the cradle will slip down around the vessel until deep enough, when the hydraulically operated projections closing the base of the cradle come into play. All of the cradles having been put into place and connected with the surface pontoon, which must be considerably larger than the vessel to be raised, the observer below the surface passes the signal up for operation of the jacks.

The pontoon device having been securely anchored at four or more points, is now made as buoyant as possible. All the water from the pontoons which heretofore tended to submerge it is pumped out, but due to the anchors, the pontoon raft is not permitted to rise to the surface of the water. Its buoyancy, being considerably greater than the counter effect produced by the vessel at the bottom, will cause the raft to maintain its predetermined position with relation to the surface of the water, even when the jacks are operated.

Compressed air is now forced into the projecting lugs around the vessel, and air permitted to pass into the cradles, making them likewise more buoyant and taking up some of the stress, which would otherwise fall upon the lifting cables. The air forcing itself around the base of the vessel to be raised, loosens the sand and agitates it. In this manner the suction effect met with in attempting to raise a vessel, is materially decreased. The lifting jacks are now operated, by opening the valves, permitting water under great pressure to thus enter the cylinders, slowly at first. The result is that a uniform lifting effort is developed, which increases and finally the weight of the ship is over-balanced and it rises until the pistons reach their extreme position. The jacks being automatic in their locking effect, hold the vessel in the position to which it has been brought, and the action of the pistons is reversed, the water under pressure being permitted to escape. This operation is repeated until eventually the vessel has reached its position within the cradle, formed by the partially submerged pontoon or raft structure.

When in this position, locks and chains are swung around it and the anchors are released by either cutting the cables or raising them by means of winches, which necessitates further submergence of the pontoon structure, so that one of the anchors may be lifted at a time. The cradle containing the raised vessel is then permitted to come to the surface and either towed or under its own steam, reaches port and a drydock.

The devices used for raising the vessel must of course be large enough to completely engirdle the ship at the bottom of the sea, regardless of whether it is lying on its side or in an erect position. If necessary, the smoke stacks and masts may be blown off by dynamite, so as to make room for the massive automatic tongs. The inventor proposes also to control the lifting jacks singly, so that the strain will not be upon all of them at one time, and one at a time can be released while the others are being operated.

The cost of salvaging operations with such a device, would, however, be extremely great, but the sea contains enough treasure to permit the salvaging of ships which would more than pay for the apparatus, even if but two or three vessels were raised.

The Submarine of Tomorrow

By GRASER SCHORNSTHEIMER

(*Continued from page* 1053)

reported that they will practically have double hulls and will be minutely sub-divided. Again, it has been rumored that these boats will have light deck and conning tower armor to protect them against depth charges and light shells. The new large Japanese submarines are also credited with this feature.

Another feature is really comfortable quarters for the officers and men. This feature takes large proportions when it is realized that it was necessary to give the German submarine crews two weeks ashore to every three days afloat, due to the hardships of this service.

The gun battery will consist of one 5 inch, 51 caliber gun mounted just forward of the conning tower and a single 3 inch, 23 caliber anti-aircraft gun mounted on the after part of the conning tower, on the base. The prime armament of the ships will be torpedoes. It is understood that there will be six 21 inch tubes carried in submerged positions, four in the bow and two in the stern. Ten extra torpedoes will be carried making a total of sixteen.

The wireless equipment will be of a most advanced type. It will include both surface and submerged sending and receiving outfits. Submerged, the boats will be able to receive almost as well as though they were on the surface, but their sending power will be limited to about 100 miles, it is said.

As the Naval Treaty, formulated at the Washington Arms Conference, forbids us to build battle cruisers for a period of ten

years, it is important that these boats be successful, as the only two agencies for turning an enemy's line in action, are the battle cruiser and the submarine. Not being permitted to have the ideal type, we must turn to these submarines.

With these boats as a basis, as a last word in modern submarine design, let us consider the next step. A submarine is wanted which will be able to go to sea to raid commerce. This vessel will have to stay at sea for long periods.

First, such a vessel must have great size in order to carry the necessary engine power for high enough speed to pursue and capture a normal merchant vessel. Then, it must have fuel enough to be independent of shore bases for a long period. It must have accommodations comfortable enough to relieve the strain of a nerve-racking cruise on its crew. Lastly, it must mount guns heavy enough to engage and defeat a destroyer and to properly engage a cruiser.

This means a displacement of about 6,000 tons. It means great Diesel engines capable of developing around 18,000 horsepower to get a proper speed. It means the installation of the great electric drive to translate this power into speed and to charge the great storage batteries for submerged maneuvering. It means spacious quarters for officers and men, huge tanks for fuel oil and finally a large and well placed battery.

Speed in submerging and coming to the surface is of prime importance as it measures the time in which the vessel can get into action. Therefore, let us say that the boat's main battery comprises four 6 inch guns which are enclosed in two watertight turrets, into which the men can go while the submarine is coming to the surface. Modern destroyers have batteries seldom exceeding 4.7 inches and, therefore the 6 inch gun should be capable of answering them, as it is of approximately the size carried by the cruiser of today.

By way of spotting the hits of these guns and scouting for the submarine while it is resting on the surface, a small plane is entirely requisite. A catapult might be mounted on the fore turret to launch it. The plane could be of a very small knock-down type, using little space aboard a crowded vessel.

As wireless progresses it might be possible to install the Telephot aboard the airplane. In this way the submarine commander would at all times have a picture of the sea far beyond the vision of his observation instruments.

This idea as to the submarine of the future may seem to be far in advance of possibility. But even now, it has been reported that the Japanese are building a test vessel closely approximating the one outlined herein. In this story we have attempted to confine ourselves strictly to lines capable of the development of which we speak.

Novelties at New York Auto Show

(*Continued from page* 1064)

only the vaporized gas gets into the cylinders, and the liquid fuel is held in the basin marked 1, until the engine develops sufficient heat to vaporize it. A whirling motion is imparted to the gas being taken into the cylinders by the fan-shaped stationary deflector marked 2. This also aids in keeping the liquid fuel in the basin 1. The bowl is heated by the exhaust and when the liquid fuel is vaporized it passes on into the cylinders and is consumed.

Two windshield wipers are shown in Fig. 5 and 7. The former is actuated by an electric motor, which through a reversing gear and chain drive, pushes the cleaner back and forth across the entire upper section

of the windshield. The automatic reversing gear is located in the box just to the left of the motor. In the latter, Fig. 7, the wiper is actuated by the suction of the motor. The two cups are connected to the intake or vacuum tank, whereupon their rubber ends are alternately drawn in and released, thereby imparting, through a rack gear, an oscillating movement to the wiper. The cleaner or wiper can be locked from the inside of the car so that it will not swing when not wanted.

A novel air-cooled motor is shown in Fig. 6, which makes use of the heat-radiating qualities of copper. In the insert in Fig. 6 it will be seen that the copper is electrically welded to the iron. The copper fins are made of a continuous strip of thin sheet copper so bent that when wrapped around the cylinder walls, the bases of the crimps are in contact with one another, thus completely surrounding the iron cylinder walls with copper. Space is of course left for the push rods, and for close coupling of the cylinders. A powerful air turbine creates a constant draught of air around the motor, as indicated by the arrows in the diagram.

In Fig. 8 is shown a device whereby the water from the radiator to the motor may be stopped until the motor *warms up*. It is inserted in the water pipe between the motor and radiator and after the water in the hose from the motor to the thermostat reaches a temperature of 178°F, the thermostat automatically opens the valve and allows the water to circulate around the motor. If, for any reason, the thermostat diaphragm should become punctured, a way is provided for automatic expansion of the thermostat, thereby opening the valve.

A novel spark plug is shown in Fig. 9, which keeps its points clean by means of a draught of air drawn through the plug, the action depending upon the suction of the motor. This draught not only keeps the points clean, but at the same time drives away the burnt gases from the points, thereby rendering them ready to fire the next charge.

Fig. 10 shows a little electrical heating device installed in the intake pipe, which vaporizes the fuel instantaneously, thereby providing easy starting of the motor even in the coldest weather. This device generates a heat of only 500 F. thereby insuring against premature explosion, as gasoline and air mixture do not explode until heated to at least 700°F.

An automatic gasoline signal which depends upon an air-tight gasoline tank is shown in Fig. 11. This is a whistle located upon the cap of the gasoline tank, which when the gasoline reaches a level of about ½ gallon, sounds a warning by means of the partial vacuum created within the tank. Obviously, it is necessary that the tank be air-tight for the operation of this device

The *super-wheel*, so styled by its inventor, is illustrated in Fig. 12. The spokes of this wheel are composed of heavy spiral springs, thereby taking up a great amount of the road shock. Inside of the shoe is a soft rubber insert with a vulcanized exterior as shown, under which lies an ordinary tube. When these inserts are used, the tube is inflated to the usual pressure, but is protected from punctures and blow-outs by the soft rubber insert.

(*Editor's note*: *The names and addresses of the companies supplying the above described accessories, will be furnished upon receipt of a stamped, self-addressed envelope.*)

Electrostatic A.C. to D.C. Converters

By CLYDE J. FITCH

(*Continued from page* 1077)

due to the resistance of the electrolyte in the rectifiers, and to the current leakage through the rectifiers, as the oxide film is not a perfect insulator.

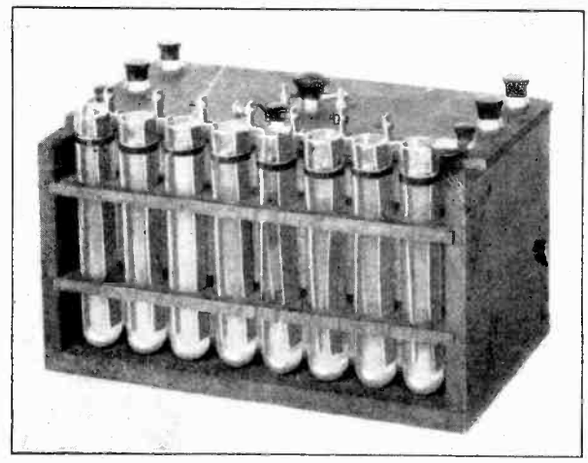
The aluminum and iron strips of the rectifier are each ¼" by 6" long. The solution is made by dissolving sodium phosphate in hot water, after which the solution is allowed to cool before using. The sodium phosphate may be obtained from any drug store. The rectifier will stand from 150 to 175 volts without breaking down, and as the voltage across terminals A and B is 310, it will be necessary to use two rectifiers in series. The rectifiers may be made up similar to the rectifiers shown in the photograph.

The condenser should have a capacity of several microfarads. Four, two microfarad paper telephone condensers connected in parallel will be sufficient when the current withdrawn is small.

The converter is to be connected to the alternating current line in series with a 110 volt lamp. At first the lamp will light up brightly, and as the rectifying film forms on the aluminum electrodes the lamp will gradually go out.

The converter shown in figure 2 will give the very same D.C. voltage as that of figure 1, and the action is identical. The only difference is that instead of using paper condensers advantage is taken of the electrostatic capacity of the rectifier itself for storing up the charge. This type of converter is very cheaply constructed. The small rectifier is made similar to the rectifiers in figure 1. The other rectifier and electrolytic condenser are combined in one unit and made as shown in figure 6. They consist of a strip of iron and a strip of aluminum, each ¼" by 6" long, which form the rectifier, and an aluminum plate which forms one side of the condenser of which the solution is the other side—the oxide film acting as the dielectric. An aluminum plate 6" by 24" will give a capacity of about 26 microfarads. This plate may be wound in a spiral as show in figure 6.

The converter shown in figure 3 will give a D.C. voltage equal to three times the maximum value of the A.C. voltage, neglecting losses. This converter is very simple. When connected to a 110 volt A.C. circuit only three small electrolytic rectifiers and two sets of paper telephone condensers will be required. The D.C. voltage will be 3×155 or 465, and will be slightly pulsating, but may be smoothed out or filtered by means of a condenser and a shoke coil as shown in figure 4.



Group of eight rectifier cells and transformer cabinet.

A glance at the diagram will show that one-half cycle of the alternating current wave will charge both sets of condensers in parallel, to the maximum value of the A.C. voltage. The two sets of condensers then discharge through the external circuit, in series with each other and in series with the next half cycle of the alternating current wave, so that the voltage at the D.C. terminals will be three times the maximum value of the A.C. voltage.

Figure 4 is substantially the same as figure 3 except that electrolytic condensers are used in place of paper condensers. This converter requires one rectifier and condenser made up according to figure 6, one condenser made up like figure 6 but without the aluminum strip, and two small rectifiers The choke coil and paper condenser smooth out the resulting pulsations, thus making the D.C. voltage constant for use on power amplifiers or radio telephone transmitting sets. The design of the choke coil will be taken up later.

The circuit in figure 5 will give a D.C. voltage of twice the maximum value of the A.C. voltage. For use on a 110 volt line this converter will require four electrolytic rectifiers and two sets of paper condensers Electrolytic condensers cannot be conveniently used on this circuit. One-half cycle of the A.C. wave charges the other set of condensers. The two sets of condensers discharge in series through the external circuit, thus doubling the voltage.

Figure 7 is a complete wiring diagram of the converter shown in the photograph. This converter was constructed by the writer and used for amplifying radio broadcast programs. The rectifier is made up of aluminum and block tin strips in a solution of sodium phosphate, contained in a 1" by 6" test tube. Eight of these rectifiers are used. A layer of oil on the surface of the electrolyte prevents it from evaporating

The 110 volt line is connected to the primary of a 110-220 volt transformer. The secondary of this transformer has four taps giving voltage variations ranging from 110 to 220 volts. The secondary is connected to the rectifiers and paper condensers so as to double the voltage by using the same circuit as figure 5. It is then connected through a choke coil to the D.C. terminals. Across the D.C. terminals are connected two sets of paper condensers for filtering purposes. These condensers are connected in series so as to reduce the voltage across each condenser and thus prevent the condensers from being punctured The D.C. voltage is adjustable from 300 to 600 volts, by means of the taps on the transformer. The potential is so constant that it is impossible to hear any A.C. hum in the loud talker when used for amplifying purposes.

The core of the transformer is made up of laminated transformer iron and has a cross-sectional area of 1¼" by 1¼", or 1.56 square inches. The outside dimensions of the finished core are 5" by 4½". The primary winding comprises 450 turns of No. 24 B. & S. enameled magnet wire wound on one leg of the core. The secondary winding comprises 900 turns of No. 26 enameled magnet wire wound on the other leg of the core. Taps are brough out of this winding at 450 turns, 600 turns, 750 turns, and the end tap at 900 turns. These taps connect to the tap switch as shown; the dead contact points are placed between each live contact point, so that the switch lever will not short-circuit a portion of the secondary winding when moving from one contact point to the other.

The design of the choke coil is very simple. It consists of a coil of wire wound on an iron core as shown at figure 8. The core is made up of laminated transformer iron, and has an air gap in the magnetic circuit. The function of the air gap is to increase the reluctance of the magnetic cir-

cuit. The function of the air gap is to increase the reluctance of the magnetic circuit so that the iron will not become saturated, thus destroying its magnetic quality. The inductance of the choke coil should be at least 1½ henries. The choke coil is designed according to the following formula, which is close enough for all practical purposes:

$$L=\frac{3.19n^2}{10^8R}$$

L=inductance in Henries
n=number of turns in the coil
$R=\frac{l}{a}$, where l=length of air gap in inches, and a=area of air gap in square inches.

R is the reluctance of the air gap. The reluctance of the iron is so small as compared with that of the air gap that it will be omitted here. If we use a core having a cross-sectional area of ½" x ½", or 0.25 square inches, and a 1/16" air gap, 1/16 ÷ 0.25 = 0.25. Substituting 0.25 for R, and 1½ for L, in our formula, we have:

$$1\tfrac{1}{2}=\frac{3.19n^2}{10^8\times 0.25}$$

Solving we get 3322 turns as the value of n, which is the number of turns required in the coil to give an inductance of 1½ henries. No. 36 B. & S. copper wire will do for this coil.

An electrostatic converter employing a step-up transformer and magnetic rectifier is shown in figure 9. This type of converter will deliver a higher amperage than the converters described above, and occupies less space. It has the disadvantage that the magnetic rectifier is not quiet in operation and requires more attention than the electrolytic rectifiers.

The connections are the same as those of figure 7, the potential at the transformer secondary being doubled by means of the rectifier and condensers. A tuned iron vibrator carrying silver contacts is magnetically connected to the transformer core as shown. This vibrates in front of a permanent magnet and makes contact with two adjusting screws. The vibrator is slotted so that its vibrating length can be adjusted in order to accurately tune it to the frequency of the alternating current.

This converter was successfully used by the writer for operating a 10 watt radio telephone transmitter. The hum was practically eliminated by means of the choke coil and condensers.

It should be remembered that one side of the alternating current line is grounded, and if any of the above circuits which do not employ a step-up transformer are used for radio or other purposes, which have a ground connection of their own, a short circuit is apt to result. This difficulty may be overcome in radio sets by connecting a small fixed mica condenser in series with the radio ground lead.

ALCOHOL AS MOTOR FUEL

Under the decision, announced by Commissioner Blair of the Internal Revenue Bureau, the sale of alcohol "for use in the manufacture of motor fuels" will be permitted when "to every 100 gallons of ethyl alcohol there is added one gallon of gasoline of that quality specified."

Further than to say that the formula had been approved on the application of persons interested in the motor fuel industry, Treasury officials declared they had no information as to the intent and scope of the use of which the formula was to be put.

The formal announcement by the Treasury set forth the following specifications as those which would be required for the gasoline content of the new fuel:

"Volatility—When 5 per cent. of the sample has been recovered the thermometer shall not read more than 65 degrees centigrade nor less than 50 degrees; when 50 per cent. has been recovered the thermometer shall not read more than 95 degrees."

New Process Colors Black and White Movie Films

By LEWIS YEAGER

(*Continued from page* 1054)

the emulsion on the film, so when each of the colors go back through the lense, it has a distinctive effect on the film. Blue has a different effect from red, etc. A simple example is cited.

Suppose we have a stairway before us, the first step red, the next yellow, the next green, the next blue, the next violet. Mr. Taylor takes a photo of the stairway with the ordinary movie camera with standard negative film. He develops the negative and prints a positive from it. This he later bleaches by a special process, until the image appears to have disappeared, so that it resembles a piece of film from which the emulsion has been removed. The various colors due to the wave length of light have each left a different trace, and the red will select red dye, while rejecting the other colors; the blue will also select its respective dye.

Mr. Taylor says the *duplicate positives* are printed from a black and white negative. The positives are treated with mordant and select dyes of certain chemical groups. In the laboratory we find an operator in charge of each coloring machine. The color wheel which applies the respective dyes is watched carefully by an operator.

Mr. Taylor gives the following explanation: Bleaching leaves the film selective to dyes of a certain chemical group, only for absorption in certain portions of the image, while another part of the image is selective to dyes of a different chemical group.

The film after being given the required coloring baths, is dried and a colored vase the size of a pea on the film will display all the original colors of a great piece of Sevres or of Cloisomé.

There are 16 individual squares of motion picture film to the foot; each square is a small *still* picture in itself representing its own bit of action and having its own importance and relation to the entire scene.

Sixteen separate pictures to one foot, 160 separate pictures to ten feet, 1600 pictures to 100 feet and 16,000 pictures to 1,000 feet. Each picture must be an exact duplicate of every other picture in the entire length of film so far as density and color are concerned; otherwise, the continuity of the film's luminosity would be interfered with to the extent that the screen would appear to be a series of flickers and the picture not fit to exhibit. This has been a very serious stumbling block to experimenters who have attempted to apply color to the cinema film. It seemed that they could not duplicate and for this one reason alone, if they were fortunate enough not to have other difficulties, their processes were rendered useless.

Taylor's process duplicates by a very ingenious device and I saw, on my visit to the Lasky Studio, 200,000 feet of film, all of even luminosity from one end to the other, ready to be assembled into a big super picture and shipped to the different cities of the world for exhibition.

I was permitted to see sections of the new release and can say there was absolutely no fringing such as is often seen on colored motion pictures. Any depth of color required may be given. It is not necessary to resort to gaudy scenes on the water edge with the new process. Even night scenes give the same color effects as scenes taken in dazzling sunlight. In the new release, a procession is shown where various colors of lanterns are used and these hues are faithfully duplicated on the screen.

How to Use Your Camera

By DR. ERNEST BADE

(*Continued from page* 1076)

The time required in setting up such an apparatus for taking a portrait will materially increase the value of the finished picture, since the subject will have sufficient time to compose himself so that the features will become more natural.

Another chapter is the taking of pictures of children, pictures showing the lively, carefree folk in the happy abandon of their play. Such pictures are difficult to take and can seldom be posed satisfactorily. The children must be observed either individually or in groups, and when exceptionally effective poses are noticed, they must be remembered. Then a suitable situation must be selected having the requisite lighting effects and the children are to be posed in this new surrounding. But if one can take snap-shots of the children unseen and unnoticed by them, then these are to be preferred to the former as they will be far more natural and spontaneous. For this purpose no other camera is so well adapted as the graphlex, but even it has its bad points as it seldom satisfies the high expectations demanded. Two things must be noticed: first the focus or sharpness of the picture must be correctly provided for, and secondly, the correct and most effective pose must be obtained. At this point it must be said that no camera is so well adapted for general portraiture as the long bellows camera,—for this purpose it is still the ideal instrument.

Silhouetted photographs give some very pretty results. Here the subject contrasts strongly, standing out against the background, although all of the superfluous details of the profile need not be suppressed or eliminated. The background consists of a large sheet of white paper fastened to the window frame. It must be entirely smooth and free from folds and wrinkles. The subject is placed before the paper and the picture is taken from the room directly into the light after all other windows have been darkened. The length of the exposure depends upon the light transmitted by the paper. When the diaphragm is almost closed, a second or so will be sufficient provided the background is comparatively bright. If the negative should show too much detail, it can be partially removed by simply over exposing the positive made from it.

Another method of arriving at the same result is to place the subject before a white background and, with diaphragm closed, make a rapid time exposure.

When printing silhouettes, frames, which are either round or oval in shape, are used, they should never be angular.

Peculiar as the silhouette photos may be, those which show the details of the expression as well as the silhouette are far more unique and interesting. They are modern in all that this word implies. Such pictures can be taken both in artificial and natural light, but care must be taken that the shadow is not distorted. Artificial illumination is best accomplished at an angle so that the silhouette lies in front of the profile. The subject is placed before, and quite close to, a white background.

SPOT FOUND ON SUN

A spot on the sun was discovered recently by Henry Pennywitt, official forecaster of the United States Weather Bureau.

"We have not fully measured the spot," said Dr. Burns of the Allegheny Observatory, "but we suspect it is one of those spots which periodically make their appearance. This one is to the side of the sun. Were it more to the centre we might have some serious weather disturbances."

Waterproofing and Mothproofing by Electricity

By ISMAR GINSBERG, B. Sc., Chem. Eng.

(*Continued from page* 1063)

all be treated in the same machine, or rather in either of two machines, depending on whether the cloth is silk or wool, or cotton or linen. The waterproofing effect that is attained in the fabrics is remarkable. A common muslin, treated by the Tate process, will be able to resist as much as 16 inches of water pressure without allowing a single drop of water to penetrate the fabric. The waterproofing is resistant to washing, although in time its original intensity will be lost. A coat or a suit of clothes, made of Tate waterproof woolens, can be dry cleaned and still retain its waterproofing. There is no other known process of waterproofing which can withstand dry cleaning.

The Tate process has been used with great success in waterproofing tent cloth. Circus tents have been made from this cloth and have stood up under the severest weather conditions for extended periods of time. Similar good results have been obtained from Tate treated sailcloth, awning cloth, woolens used in making overcoats, hunting suits and out-door clothing. The rain cannot penetrate a Tate treated raincoat, and moreover the raincoat can be worn in entire comfort, for the Tate process does not destroy the ventilation. The uses to which this process of waterproofing can be put are too numerous to be mentioned here. In fact, wherever the garment or the particular product that is made from textile materials has to withstand the passage of moisture, in other words wherever it has to possess waterproof properties in order to render proper service, there will be found a use for the Tate process.

One of the most interesting tests that has been made up to the present time to determine the efficacy of the Tate process was on the motor boat, *Specjacks*, which recently completed an eighteen month trip around the World. The awnings and spray cloths on the boat were all made from Tate treated cloth. The awnings were never taken down, not even in hurricane weather, and not a single drop of water came through the canvas. The results were really remarkable for the *Specjacks* encountered the severest kind of weather in its record-breaking trip. Furthermore, today, after so much service, the canvas is completely waterproof as it was on the day it was first installed. In the words of the owner, Mr. A. Y. Gowan, the success of the trip was due to the perfect construction of the boat and of the engines, and to the waterproofing secured through the Tate treatment.

There is one other important characteristic of the Tate process. Woolens, that are waterproofed in this way, have been found to be mothproof or moth-repellent as well The significance of this fact is self-evident.

The fact that Tate treated woolens are really moth-repellent has been proven by scientific experimentation, extending for a period of over one and one-half years. These tests were carried out in the Massachusetts Institute of Technology. Colonies of moth larvae were bred on garments, which had been made from Tate treated cloth and which had been worn for over a year before the test was made. It was found that the larvae could not subsist on the Tate treated fiber. It was not that the chemicals poisoned the larvae, for the chemicals are absolutely non-poisonous, but simply that the animal could not eat the woolen fibers, treated in this manner. The Tate treatment mothproofs the fabric, conferring upon it moth-repellent properties of indefinite duration.

Answers to Puzzles

(*See page* 1071)

HARD-BOILED OR SOFT?

There are several tests for a hard-boiled egg. First, it will spin readily on the table. Second, if it has been recently removed from the water any drops that cling to the shell very quickly evaporate. And third, as the waiter said, the contents of the egg are rigid.

BOILING WATER WITHOUT INCREASE OF HEAT

This very interesting experiment, which was probably performed for the first time by Benjamin Franklin, may be carried out in the following manner: Fill a flask half full of water: boil for a minute on the stove; remove the flask and stopper it very tightly with a rubber stopper. On inverting the flask under a stream of *cold* water, the water in the flask will be seen to boil vigorously for some little time before it ceases altogether.

This experiment is frequently used to illustrate the effect of pressure on the boiling point of liquids. Thus water normally boils at 212 degrees F., but if the atmospheric pressure is low, as it is on high mountains, the liquid will boil at a much lower temperature. The effect of pouring cold water on the flask is to condense some of the water vapor above the hot water inside and thereby materially reduce the pressure there. The water then boils, but at a much lower temperature than it would if put in an open dish.

HERO'S FOUNTAIN

As soon as water is poured into the basin (A) some of it at once passes down tube (B) to reservoir (C) thereby increasing the pressure of the air in this chamber. This pressure is then transmitted through (D) to chamber (E) from which it forces water up through (F) to the fountain. As the water falls back into basin (A) the action is repeated, not indefinitely, alas, but until the reservoir (E) is empty.

PROOF OF THE EARTH'S ROTATION

Objects dropped down deep shafts have been observed to fall toward the eastern wall indicating that the surface of the earth is rotating faster than the bottom of the shaft.

But perhaps the most interesting demonstration of the earth's rotation is exhibited by a Foucault pendulum which consists of a heavy bob on the end of a long flexible wire and supported at the top. If started vibrating in one plane, say the north and south, it will gradualy shift the direction of its motion until it has made a complete circuit in a time which would be twenty-four hours if the experiment were conducted at the pole and less than a full circle at any lower latitude. At the equator the direction of its motion would not shift at all. This experiment thus shows visibly the turning of the earth beneath the pendulum.

PRACTICAL LEVITATION

To begin with let us suppose the balloon and load to be just heavy enough to make it sink in air. Then if some compressed air is admitted to the cylinder, the density of the air will be increased so that the balloon, will now displace a greater weight of air than it did formerly. Now as the buoyant force on a balloon is equal to the weight of the air which it displaces, it is evident that the buoyant force should now be sufficient to cause the balloon to rise. On reaching the top it strikes the upper lever, thereby opening valve V, releasing the excess air and reducing the pressure of the cylinder to normal. The balloon then sinks of its own weight only to strike the lower lever, readmit some air and thus start the cycle all over again.

THE HYDROSTATIC PUZZLE

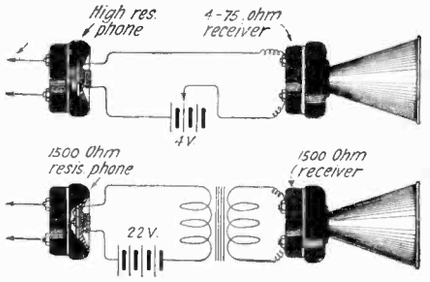
The pressure produced by the weight of the man and piston must equal the pressure of the water of height (H) above the level of the piston. Then 200 / 2=62.4 H (62.4 being the weight in pounds of a cubic foot of water). Or H=1.6 ft.

How to Hook-Up A Transmitter Button to Make an Efficient Loud Talker

A Transmitter button with a few dry cells and a telephone receiver will make a remarkably simple and efficient loud talker. A Microphonic amplifier of this type is just the thing for use with a radio set. The weak music and signals may be amplified many times their original value. It is possible to entertain a large audience with a simple radio equipment if a transmitter button is used in the circuit as explained in diagram A.

The cost is extremely low and the results are comparable with those produced by highest grade of expensive loud talkers.

As may be seen in the diagram, two dry cells or a small storage battery are connected in series with the transmitter button and a 4 to 75 ohm telephone receiver. The transmitter button is secured to the diaphragm of the telephone in the radio receiving set. To accomplish this properly, scrape off the enamel (if diaphragm is enameled) on the face of the diaphragm and solder the small hexagon nut supplied with the button to the exact center. Care should be taken that the thin diaphragm is not bent or otherwise



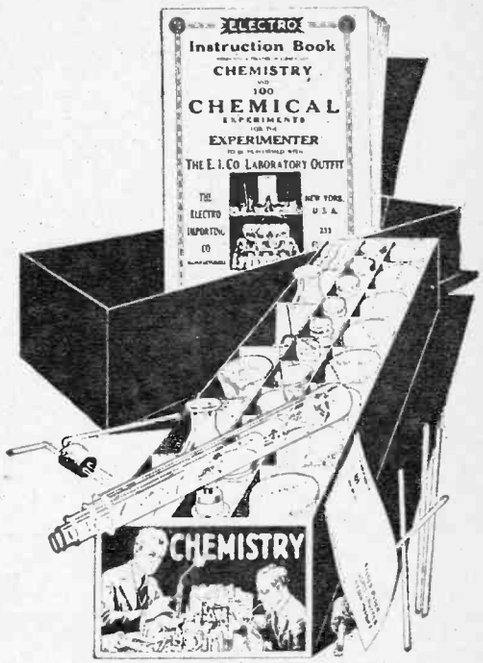
harmed. The transmitter button is then screwed into place. Connections, as shown in the diagram, are made with flexible wire. A horn may be placed over the low resistance receiver if desired. When the radio set is properly tuned and signals are being received, the transmitter button is operated by the vibration of the diaphragm of the receiver. As the receiver diaphragm vibrates, the mica diaphragm on the transmitter button also vibrates. The carbon grains are compressed at varying pressure; the current flowing through the local battery circuit is thus varied and results in an amplification of the sounds in the low resistance telephone loud-talker.

Diagram B, which includes a step-up transformer, is to be used with loud talking receivers of high resistance. The primary of the transformers should have a resistance of about 75 ohms. An ordinary telephone induction coil will serve as the transformer in this circuit.

A Chemistry Laboratory for $7.00

Think of it, fellows! Here is a real chemistry outfit with regular chemical apparatus that performs those fascinating, actual chemical experiments.

This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a Treatise in Elementary Chemistry, useful data and recipes and 100 instructive amusing experiments.



DESCRIPTION OF THE OUTFIT

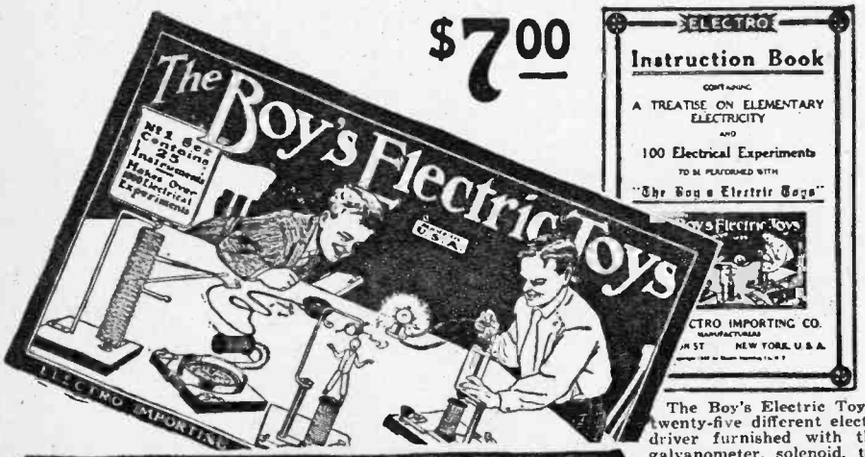
The outfit consists of forty-four (44) chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers, and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The instruction book is a real Chemistry Course for the Beginner. Some of the Contents are: Division of Matter: This is a Treatise on Elementary Chemistry, and deals with the theory of the Elements, Molecules and Atoms, etc.

100 EXPERIMENTS

How to make chemical tricks; how to make invisible and magic inks; how to test flour; how to test soil; how to make chlorine gas and smoke (German War Gas); how to bleach cloth and flowers; how to produce oxygen and hydrogen; how to make chemical colors; how to test acids and alkalies, and hundreds of interesting hints and formulas.



$7.00

Every Fellow Wants the BOY'S ELECTRIC TOYS

The Boy's Electric Toy contains: Enough material to make and complete over twenty-five different electrical apparatus without any other tools except a screwdriver furnished with the outfit. Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephones, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.,

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book we furnish one hundred experiments that can be made with this outfit, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by the means of this outfit, two hands and a screwdriver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

We guarantee satisfaction.

The size over all the outfit is 14 x 9 x 2¾. Shipping weight, 8 pounds. "The Boy's Electric Toys" outfit as described, $7.00. Immediate shipment.

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Please send me by express THE CHEMICAL LABORATORY. If I don't like it I need not accept it. If I want it I only pay $7.00 plus the few cents express charge.

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ELECTRO IMPORTING CO.,
233 Fulton St., New York.

Please send me by express THE BOY'S ELECTRIC TOYS. If I don't like it I need not accept it. If I want it I only pay $7.00 plus the few cents express charge.

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S.&I. 3-23

BUILD YOUR SET WITH BARAWIK STANDARD

PLATE CIRCUIT "B" BATTERIES

You can make real savings on these batteries. Don't pay more. We guarantee them to equal any on the market regardless of price. Absolutely uniform. Extra long life.

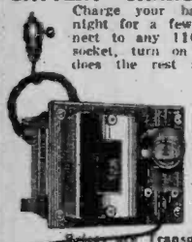
M180 Signal Corps type, small size, 15 cells, 22½ volts. Each.....95c
M184 Variable Large Navy size, 6½x4x3 inches 5 taps, giving range from 16½ to 22½ volts in 1½ volt steps. Each.....$1.80
M188 Combination Tapped 45 volts 30 cell, 13x4x3 battery. Tapped to give 45, 22½, 21, 19½, 18 and 16½ volts. Handles both detector and amplifier tubes. Each.....$3.55

WILLARD "B" STORAGE BATTERY

Better results. No battery noises. Cheaper in the long run. Easily recharged by our Battery Charging Rectifier. Leak proof glass jars. Will last for years.

M205 Price $9.00

HOMECHARGER BATTERY CHARGING RECTIFIER



Charge your battery at home over night for a few cents. Simply connect to any 110 volt 60 cycle light socket, turn on current and rectifier does the rest automatically. Will work for years without attention. Simple connections. Gives a tapering charge which batteries should have. You can make it pay a profit charging your friends' auto batteries. Long connecting cords with pair of battery clips.

Prices are Transportation Paid.

M201 For 6 volt battery.....$13.95
M203 For 12 volt battery.....13.95

STORAGE "A" BATTERY

A very high grade battery made especially for radio service. Guaranteed for three years. Properly cared for will give many more years of service for filament lighting. Made of best new materials. Full capacity. The best battery buy on the market. Try one of these batteries on your set for 10 days. If at the end of that time you are not fully satisfied with the battery return it and we will refund the purchase price.

M194 6 volt, 40 ampere size. Each....$10.00
M196 6 volt, 80 ampere size. Each.....12.50

BATTERY CLIPS

M198 Two for.....28c
Clip onto storage battery terminals, lead coated. Make positive non-corrosive contact at all times.

WIRE CONNECTING CLIPS

M199 Per dozen 30c
Small connecting clips for quickly fastening leads onto binding posts, etc. Handy and useful. Every radioist should have at least a dozen.

PORCELAIN BASE SWITCHES

Fine white porcelain bases. Copper contacts and blades. Can be used as antenna switches.

M385 Single Pole Single Throw. Each 20c
M387 Single Pole Double Throw. Each....32c
M384 Double Pole Double Throw. Each....50c

FILAMENT CONTROL RHEOSTATS

Crosley—Wound on vulcanized fiber. Adjustable to any panel. Complete with knob.

M130 Each.....45c

Best grade. High heat resisting base. Diam. 2¾ in., cap 1¼ amp. Resist. 6 ohms 1¼ in. knob with pointer, 75c value.

M132 Each.....45c

POTENTIOMETER

Same style as above rheostat. Gives fine "B" battery adjustment. Resistance 200 or 300 ohms

M133 Each.....98c

VERNIER RHEOSTAT

Gives exceedingly fine control of "A" battery current. A necessity for best receiving results.

M135 Each.....78c

QUICK ACTING VERNIER RHEOSTAT

Gives very fine control of current and can be switched on or off instantly at any desired point. M124 Each.....$1.19

Porcelain Base Rheostat for table mounting. Resist. 10 ohms.

M136 Each.....78c

KLOSNER VERNIER RHEOSTAT

M129 Each.....85c
Regular $1.50 value. Limited quantity at this price.

RADIO TUBES

Tubes for winding coils. Strong solid material, with smooth clean surface.

M950 Diameter 3 inches, per foot.....20c
M951 Diameter 3½ inches, per foot.....25c
M952 Diameter 4 inches, per foot.....30c

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THIS GUARANTEE PROTECTS YOU—Examine the goods we ship you. They must suit you in every respect. If you are not satisfied with your purchase return the goods at once and we will refund the price you paid.

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We want Agent-Dealers in every locality to handle our line of goods.

Our Proposition Means Money to You

Our prices save you money. The quality of our goods insures satisfied customers. Our service will help you do a large business on a small investment.

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We have selected a line of goods—both completed sets and parts to assemble sets—that will enable you to supply every demand and make money. You can make a good income on our proposition with a very small investment.

Our catalog shows the merchandise you should handle, gives much radio information and will help you establish a successful business. Enclose 10c for the catalog. Tell us what you can and want to do, and how much you can invest. We'll do the rest.

For the Person Who Makes His Own Set

Our catalog is interesting and valuable. Even if you are not interested in radio as a business you will find many interesting things in this catalog and you will save money buying your supplies from us.

VACUUM TUBES

Standard Brands—Cunningham Radiotron. Every one guaranteed new and perfect. We will ship brand in stock unless you specify otherwise.

M105 Detector, UV200 C300 Ea. $4.45
M110 Amplifier UV201 C301 Ea. 5.95
M118 3 Watt Transmitter..... 7.20
M107 WD11 1½ v. Fil. Each.....$5.85
M108 Wd11 Socket. Each.....49c
M109 WD11 Adapter. Each.....48c

MYERS TUBES

Can be used in Myers receptacle or in any standard socket with adapter listed.

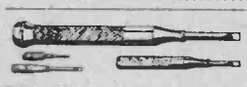
M113 High-Mu Audion. Has 5 times amplification of ordinary tubes. Oscillates anywhere from 2 to 300 volts on plate. We include our best grade rheostat with each tube. Each including rheostat $5.00
M116 Receptacle for above. Each.....1.00
M117 Adapter to adapt Myers tubes for use in any standard socket. Each.....$1.05

MYERS CHOKE COIL

Designed to work with Myers tubes. Brings in loudest signals. Flexible over a broad band of wave lengths. Free from amplifier noise and distortion. Mounts in Myers special receptacle.

M119 For Audio Frequency Amplification.....$3.50
M120 For Radio Frequency Amplification.....5.00

FOUR-IN-ONE SCREW-DRIVER



M974 Each 55c
Especially suitable for radio work. Will handle any size screw used. Smaller drivers nest inside larger one and are held in place with screw cap. Made of steel, nickel finished. Every radio builder can use several of these handy tools.

VACUUM TUBE SOCKETS

Our Special Socket. A wonderful value. Moulded entirely of brown bakelite. Four binding post connections. Right angled contact springs.

M140 Each.....39c

PORCELAIN BASE AND TUBE

M144 Crosley for either panel or table mounting 36c

High Grade combination type for panel or table mounting. Metal tube. High insulation base. One of the best sockets made.

M146 Each 45c

TWO AND THREE GANG SOCKETS

These sockets make it easy to build detector and amplifier units and make a neat, compact workmanlike job. Perfectly made of high grade materials. Quickly mounted on panel or base.

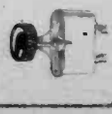
M147 Two-gang socket $1.05
M149 Three-gang socket 1.45

FIXED CONDENSERS

Moulded cases, nickeled binding posts.

M804 Each 48c

BRADLEYSTAT CARBON PRESSURE VERNIER RHEOSTAT

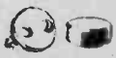


Current regulation is obtained by changing of pressure on carbon. This permits of infinitely fine variation of current. Very durable. Resistance 15 ohms. Capacity 2½ amperes.

M131 Each $1.65

VARIABLE GRID LEAK

Pencil mark type. Resistance may be varied exactly as needed. M160 Each.....19c



GRID CONDENSER

M162 Mounting holes spaced to fit lugs of above leak. Cap. .00025 MF. 14c
M163 Same as 162 but higher grade. Enclosed in metal case. 39c

PHONE AND GRID CONDENSERS

A compact style of condenser that is very satisfactory. Conducting sheets and dielectric are wound on fiber strip with eyelets for mounting and connections. Each 12c

M170 Phone Condenser .001 Mfd.
M172 Phone Bridging Condenser .0005 Mfd.
M174 Grid Condenser .00025 Mfd.
M176 Grid Condenser .00025 with pencil mark leak. Each.....24c

TUBULAR GRID LEAKS AND CONDENSERS—MOUNTED STYLE

Very convenient. Permits quick change of leaks or condensers of varying capacities.

Grid Leaks Each	Price		
	.....39c		
	Resistance		Resistance
M850	.5 Meg.	M855	.2. Meg.
M851	.1 Meg.	M857	.3. Meg.
M853	1.5 Meg.	M859	.5. Meg.

GRID AND PLATE CONDENSERS

Price, each 55c

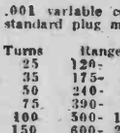
M830 .000025 Mfd. Corect for Myers Tubes.
M832 .0001 Mfd. For special circuits.
M834 .00025 Mfd. For U.V.201 and Cun. 301
M836 .0005 Mfd. For U.V.200 and Cun. 300

MOUNTINGS

Bakelite base. Spring clip contact.

M840 Single mounting. Each.....32c
M842 Double mounting. Each.....57c
M844 Triple mounting. Each.....75c

"HONEYCOMB" COILS



Carefully made—fine looking coils. Highest efficiency. Low distributed capacity effect, low resistance—high self inductance. Very firm enamel impregnation. Range given is in meters when varied with .001 variable condenser. Mounted coils have standard plug mountings.

Turns	Range	Art No.	Not Mntd.	Art No.	Price Mntd.
25	120- 250	M301	$0.39	M320	$0.89
35	175- 450	M302	.42	M322	.96
50	240- 720	M303	.49	M323	1.04
75	390- 910	M304	.54	M324	1.08
100	500- 1450	M305	.58	M325	1.13
150	600- 2000	M306	.63	M326	1.17
200	900- 2500	M307	.72	M327	1.26
250	1200- 3500	M308	.78	M328	1.35
300	1500- 4300	M309	.82	M329	1.36
400	2000- 5000	M310	.97	M330	1.57
500	2800- 6100	M311	1.12	M331	1.63
600	4000-10000	M312	1.27	M332	1.78
750	5000-12000	M313	1.43	M333	1.93
1000	7900-15000	M314	1.70	M334	2.28
1250	9750-19500	M315	1.92	M335	2.49
1500	14500-26500	M316	2.18	M336	2.65

COIL MOUNTINGS

M340 Three-coil mounting $3.59
M341 Two-coil mounting $2.69
High grade fine looking mountings. Polished black composition. Center receptacle stationary, two outer ones adjusted by knobs. Takes any standard mounted coil.

COIL PLUGS

Made of moulded bakelite. Fits any standard plug. Mounts any standard honeycomb coil.

M344 Each 50c

PANEL MOUNTING COIL PLUGS

Take any standard mounted coils. Made of moulded bakelite, mounted on brackets.

M345 Stationary. Each 89c
M346 Movable with anti-capacity handle. Each $1.10

RADIO FREQUENCY AMPLIFYING TRANSFORMER

M995 Very special $2.95
This transformer will get the long distance stations loud and clear. Permits of easy sharp tuning. Helps cut out static and interference. Makes your set sensitive enough to use a loop aerial. Enclosed in metal case affording perfect shielding. Suitable for panel or base mounting. Because of its special design can be mounted in any V. T. socket. Works with any style of tuner. Wave ranges 150 to 550 meters. Wiring diagrams included.

OUR SPECIAL AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

As high as three stages can be used without howling due to proper impedence ratio, minimum distributed capacity, low core losses and proper insulation. Mounted style has bakelite panel with binding post connections. Unmounted has core and coils assembled with two holes in core for fastening to apparatus.

M234 10 to 1 Mounted. Each.....$3.48
M235 10 to 1 Unmounted. Each..... 2.95
M236 3 to 1 Mounted. Each..... 3.40
M237 3 to 1 Unmounted. Each..... 2.85

THORDARSON AUDIO FREQUENCY AMPLIFYING TRANSFORMER

An especially high grade transformer with correct characteristics for Cunningham, Radiotron or A. P. Tubes. Wonderful results without distortion on one, two or three steps. Low distributed capacity. Fully mounted bakelite panel.

M232 3 to 1 Ratio. Ea. $3.69
M233 6 to 1 Ratio. Ea. 4.25

RADIO CORPORATION TRANSFORMERS

Audio Frequency Amplifying Transformer. Especially designed for Radiotron tubes. 9 to 1 winding ratio.

M712 Each $6.40

RADIO FREQUENCY AMPLIFYING TRANSFORMERS

Range 200 to 5000 meters. For long distance reception.

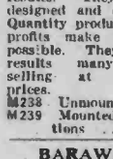
M714 Each $5.95

OUR COMPETITOR AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

While these are very low priced transformers, nevertheless they will give excellent results. They are carefully designed and carefully made. Quantity production and small profits make the low price possible. They will equal in results many transformers selling at much higher prices.

M238 Unmounted, with wire leads.....$2.00
M239 Mounted, with binding post connections $2.75

BARAWIK SPECIAL PANEL MOUNTING VARIABLE CONDENSERS



M812 43 plate .001 Mfd. $2.29
M813 21 plate .0005 Mfd. 1.80
M814 11 plate .00025 Mfd. 1.32
M815 3 plate Vernier ... 1.05
These are especially high grade condensers and we guarantee them to be mechanically and electrically perfect. Fine polished end plates of heavy bakelite. Shafts ¼ inch diameter. Sturdy, heavy aluminum alloy plates perfectly spaced to insure smooth, even reliable capacity. Our low prices save you money. These condensers are of the very best make and are not to be compared with many inferior cheap condensers offered. We guarantee them to please you or your money back.

COMBINATION VERNIER VARIABLE CONDENSERS

M824 23 plate .0005 Mfd. with dial and knobs. Price.....$3.25
M826 43 plate .001 Mfd. with dial and knobs. Price.....$3.95
The latest improvement in condensers consists of regular variable condenser controlled by large knob and dial mounted with a three plate vernier condenser, which is controlled by separate knob mounted above knob on dial. This arrangement permits of very fine tuning. Compact convenient mounting on panel. High grade design and construction. Finely finished.

ENCLOSED VARIABLE CONDENSERS

One of the best made condensers. Rigid, accurately spaced aluminum plates. Formica ends. Engraved scale. Knob and pointer. Clear transparent case.

M806 43 plate .001 Mfd. $3.95
M808 21 plate .0005 Mfd. $3.25

KNOCKED DOWN VARIABLE CONDENSERS

You can save money by assembling your own condensers. Formica top and base. Complete with all parts not assembled. Go together easily and perfectly. Panel moulding type.

M820 41 Plate .001 Mfd. $1.95
M821 21 Plate .0005 Mfd. 1.60

THE BARAWIK CO.

Chicago's Original Radio Supply House Beware of Imitators

102 South Canal Street

CHICAGO, ILL.

RADIO GOODS---DEPENDABLE QUALITY---LOWEST PRICES

PRESERVE THESE PAGES—ORDER FROM THEM AND SAVE MONEY
FAST SERVICE—TRY US AND BE CONVINCED

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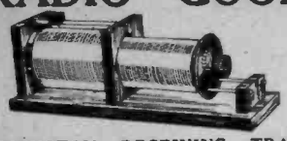
OUR GUARANTEE PROTECTS YOU—We handle only the best goods, carefully tested and checked by expert radio engineers. You are assured of getting guaranteed apparatus that will give superior results. And while our goods are best, our prices are lowest. Our goods equal or surpass the claims we make for them. We do not attempt to deceive or mislead. Our reputation for fair dealing is our most valued asset.

HOW TO ORDER—Write your Order plainly, state Article Number, Description and Price of items wanted. Send Postoffice or Express Money Order, Certified Check or Bank Draft for Total of Order. Prompt Shipment is assured when these directions are followed.



ARLINGTON RECEIVING TRANSFORMER

Will tune in all stations up to 3,500 meters. Very efficient on short waves and for radiophone reception. Used with our Detector Two Step Amplifier it produces very excellent results. Also does good work with crystal detector. Silk covered windings on formica tubes. Very fine mahogany finish wood work. Base size 6x18 inches. Slider controls primary, 12 point switch on secondary. Can be tuned very close. Brass metal parts nickel finish. A wonderful value at our price.

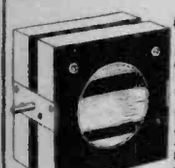
M720 Price $6.39

TUNING COIL

Range up to 950 meters. Wound with bare copper wire, machine spaced. Ends of mahogany finished hard wood. Two easy sliding contacts on polished brass rods, four binding posts. Substantial, efficient, attractive. Length, 8¾ in.

M722 Price $2.45

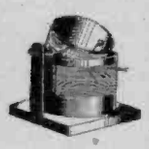
VARIOMETER



M410—Completely assembled, price $2.69. Perfect in design and construction. Accurate wood forms of genuine solid mahogany. Correct inductive ratios. Solid baked windings. Positive contacts. Highest efficiency. A real bargain.

M411—Not assembled nor wound but all parts complete except wire, including winding form, $1.48

VARIO-COUPLER



M415 Price, completely assembled ..... $2.45. With this loose coupler and two variometers, together with the necessary other parts, a highly efficient tuning set can be made. Easily mounted on panel. No base included. Primary winding on formica tube. Inductively coupled for 180 to 600 meters. Multiple taps permit fine tuning.

M416 Not assembled nor wound but all parts complete except wire. Price $1.18
M417 Rotor ball only. Each 29c
M408 Bakelite stator tube only. Each ... 35c

MOULDED VARIOMETER

Polished black moulded rotor and stator forms. Maximum inductance with greatest efficiency and minimum distributed capacity. A high grade durable instrument that will make up into a set you will be proud of and will get the best results. Wave length 180 to 600 meters, 4¼ in. square, 1⅞ in. thick.

M412 Price including mounting brackets $4.25

MOULDED VARIO-COUPLER

This coupler is designed to work with the above variometer. The stator and rotor forms are of polished black moulded composition. Primary has seven taps to enable finest tuning. Wave length range 180 to 650 meters. Fitted with panel mounting bracket.

M419 Price $3.95

180° VARIO-COUPLER

M418 Price ..... $2.89. Our price shows you a big saving. An instrument of highest quality. The most efficient type of coupler, insures sharper tuning and louder signals. Primary and secondary wound on genuine bakelite tubes. Secondary connections through soldered flexible cables eliminates contact noises. Primary has 7 taps. Can be panel or table mounted. Range 180 to 650 meters.

BRASS ROD

Supplied only in 12 inch lengths.

M961 Threaded 6-32, per 12 inch length.. 8c
M963 Threaded 8-32, per 12 inch length..10c
M965 Solid 3-16 inch, per 12 inch length..10c
M967 Solid ¼ inch, per 12 inch length....12c

TINNED COPPER WIRE

Size 14 tinned copper wire. For wiring sets. Best size for neat job and proper results.

M969 Ten feet for 12c

CHOKE COILS AND RESISTANCES

For Super Regenerative Circuit

M355 100 Millihenrie Iron core choke coil. Each $1.20
M354 10 Millihenrie Open core choke coil. Each 92c
M357 12,000 ohm Non-Inductive wire wound resistance. Each $1.58
M356 12,000 ohm Moulded resistance. Ea. 45c
M358 5 Millihenrie Open core choke coil. Each 92c
M389 1 Henrie Iron core, choke coil. Ea. $1.20

BARAWIK QUALITY HEADSETS

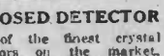
These headsets have proven on rigid tests to be one of the very best on the market. The tone quality is excellent with an unusual volume. Skilled workmen make them from only the best selected materials. The receiver cases are fine polished finish with polished black ear pieces. Fabric covered head band comfortably and quickly fitted to the head. Supplied with 5-foot cord. These sets were designed to sell for much higher prices than we ask, and at our price are a wonderful bargain. We guarantee that you will be pleased with them and agree that they are the best value by far yet offered. If they don't suit you we will cheerfully return your money.

M778—2000 ohm $3.75

OTHER STANDARD BRAND HEADSETS

M751 Murdock 56, 2000 ohm $4.20
M752 Murdock 56, 3000 ohm 4.95
M764 Frost, 2000 ohm 4.20
M766 Frost, 3000 ohm 4.95
M758 Western Electric, 2200 ohm 9.50
M754 Baldwin Type C with universal jack plug $12.00
M755 Baldwin Type C unit 5.50
cord $5.75
M756 Red-Head, 3000 ohm 5.78
M768 Brandes, 2000 ohm 7.15

TWO-WAY ROUND PLUG



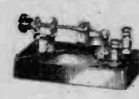
M397 Each ..... $.98. Takes two pairs of head set terminals. Quick easy connections. Polished round barrel. Fits any standard jack.

ENCLOSED DETECTOR

One of the finest crystal detectors on the market. Supersensitive galena crystal enclosed in heavy glass shield. Quick, positive adjustment. Brass parts polished nickel finish.

M730 Each $1.18

GALENA DETECTOR



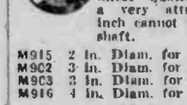
Easy fine adjustment. Crystal mounted in cup. Moulded base and knob. Brass parts polished nickel finish. An unequaled value.

M732 Each 59c

DETECTOR CRYSTALS CAREFULLY TESTED

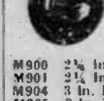
M736 Galena, Arlington tested, per piece. 19c
M738 Silicon, Arlington tested, per piece. 19c
M735 Buzzer tested, Galena, per piece.. 9c
M737 Buzzer tested, Silicon, per piece.. 9c

DETECTOR PARTS



M725 Price set. 32c. All metal parts for crystal detector. No base included. Easily assembled. Polished nickel finish.

BAKELITE DIAL AND KNOB



Moulded of genuine bakelite, polished black finish. Fluted knob. Fine engraved scale with sharp clear graduations and figures in contrasting white enamel. This is the finest quality dial and knob in a very attractive pattern. Two inch cannot be supplied for ¼ inch shaft.

M915 2 in. Diam. for 3-16 in. shaft. Ea. 40c
M902 3 in. Diam. for 3-16 in. shaft. Ea. 49c
M903 3 in. Diam. for ¼ in. shaft. Ea... 49c
M916 4 in. Diam. for ¼ in. shaft. Ea... 74c

ONE-PIECE DIAL AND KNOB

Moulded in one piece of polished black composition with clean plain engraved scale and numerals in contrasting white enamel. Ribbed knob to fit the hand. An attractive neat pattern.

M900 2½ in. Diam. for 3-16 in. shaft. Ea. 19c
M901 2½ in. Diam. for ¼ in. shaft. Ea.... 19c
M904 3 in. Diam. for 3-16 in. shaft. Ea... 25c
M905 3 in. Diam. for ¼ in. shaft. Ea..... 25c
M906 4 in. Diam. for 3-16 in. shaft. Ea... 42c
M907 4 in. Diam. for ¼ in. shaft. Ea..... 42c

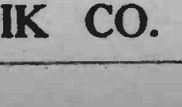
ROSIN CORE SOLDER

M958 Per Coil 22c
Self fluxing. Especially designed for soldering electrical connections. Fine for use with above electric iron. Coil will last a long time.

TINOL

M959 Per tube ..... 19c. With this preparation you can solder your connection with the heat of a match. Works fast. Makes a perfect electrical and mechanical joint. Self fluxing.

LONG NOSE PLIERS



M970 Price ..... 95c. The handiest pliers for radio work. Made of fine hardened steel. Length 5 inches.

DIAGONAL JAW NIPPERS

M972 Price ..... 92c. For fine electrical work. Made of hardened steel. Length 5 inches.

RADIO JACKS AND PLUGS

Finest grade jacks. Improved design. Best materials. Phosphor bronze springs. Silver contact points. Nickel finish. Mount on panels ⅛ to ⅜ in. thick.

Jacks Only:
M390 Open circuit. Each 43c
M391 Closed circuit. Each 49c
M392 Two circuit. Each 60c
M393 Single circuit filament cont. 69c
M394 Two circuit filament cont.. 85c

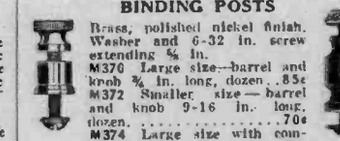
M395 Plug. Large space with set screws for attaching cord. Each 49c

COMPETITOR JACK AND PLUG

Well made, durable, smooth working. Interchangeable with any standard Jacks and Plugs Solder connections. Nickel finished metal parts.

M387 Open circuit jack. Each 27c
M388 Two circuit jack. Each 35c
M389 Standard plug. Each 35c

BINDING POSTS



Brass, polished nickel finish. Washer and 6-32 in. screw extending ⅝ in.

M370 Large size—barrel and knob ¾ in. long, dozen..85c
M372 Smaller size — barrel and knob 9-16 in. long, dozen 70c
M374 Large size with composition knob, dozen..... 50c
M376 Large size with hole for phone tip or wire, dozen 80c
M378 Small size with hole for phone tip or wire, dozen 35c

SWITCH CONTACT POINTS

Brass polished nickel finish. All have ⅝ in. long size 6-32 screws and two nuts.

Dozen 18c Hundred $1.05
Order by Article Number.

M360 Head, ¼ in.; Diam. ¼ in. High
M362 Head, 3-16 in.; Diam. ⅛ in. High
M363 Head, 3-16 in.; Diam. 1-16 in. High

Solder Lugs to Fit Contact Points

Also for connecting wires to binding posts etc.

M365 Dozen 12c — Hundred 60c

SWITCH LEVERS

Moulded composition knob. Exposed metal parts polished nickel finish. Fitted with panel bushing, spring and two set nuts. A high grade switch.

M382 1½ in. Radius
M381 1¼ in. Radius } 19c Each
M380 1 in. Radius

SWITCH LEVER STOP

Brass, polished nickel finish.

M386—Dozen 18c. Hundred $1.05

INDUCTANCE SWITCH WITH KNOB AND DIAL

Mounts switch point and contact lever behind panel. Enables you to build neat attractive set. Only one hole needed to mount on panel. 15 switch points, any number of which may be used. Dial indicates position of lever. Smooth wiping contacts. Attractive tapered knob.

M285 Price including knob and dial.... $1.80

OUTDOOR LIGHTNING ARRESTER

Including Knob and Dial

M980 Price ..... $1.68. Protect your instruments with this lightning arrester. You cannot afford not to. Weatherproof porcelain case. Air gap type. Permanent. Durable. The most practical quality arrester obtainable. Underwriters approved.

CABINETS

Fine looking cabinets solidly built. Made of genuine solid mahogany in elegant hand rubbed finish. You will be proud of your set mounted in one of these cabinets. Hinged tops. Front rabbeted to take panels. Panels not included. Prices are transportation paid.

Panel Size	Inside Dimensions High	Wide	Deep	Art. No.	Price Each
6x 7"	5 ½"	6 ½"	7"	M420	$2.48
6x10 ½"	5 ½"	10 "	7"	M422	2.75
6x14"	5 ½"	13 ½"	7"	M424	3.30
7x14"	6 ½"	13 ½"	7"	M423	3.60
7x18"	6 ½"	17 ½"	7"	M426	3.90
7x21"	6 ½"	20 ½"	7"	M425	4.20
9x14"	8 ½"	13 ½"	10"	M428	3.40
12x14"	11 ½"	13 ½"	10"	M430	4.40
12x21"	11 ½"	20 ½"	10"	M432	5.25

SOLID GENUINE CONDENSITE CELORON PANELS

Notice our very low prices on this fine quality grade 10 genuine solid sheet Condensite Celoron (a product with mechanical, chemical and electrical properties like formica and bakelite). Machines well without chipping. Won't warp. Waterproof. Highest mechanical and dielectric strength. Attractive natural polished black finish which can be sanded and oiled for extra fine work.

Panel Size Inches	⅛" thick Art No.	Price	3-16" thick Art No.	Price	¼" thick Art No.	Price
6x7	M450	$0.50	M460	$0.75	M470	$0.98
6x10 ½	M451	.75	M461	1.11	M470	1.47
6x14	M452	1.05	M462	1.55	M472	2.05
7x14	M458	1.20	M468	1.8	M478	2.40
7x18	M453	1.55	M463	2.3	M473	3.10
7x21	M457	1.78	M467	2.6	M477	3.60
9x14	M454	1.60	M464	2.3	M474	3.10
12x14	M455	2.10	M465	3.1	M475	4.15
12x21	M456	3.15	M466	4.6	M476	6.20

ETCHED METAL NAME PLATES

Made of brass. Silver plated characters and border on black background. All plates are 1 inch long and ⅜ inch wide, except "INCREASE CURRENT" which are quarter circle 1⅞ inch over all, and "ON" "OFF" which are ⅝ inch long. Attaching holes pierced.

M503 Per Dozen 35c

Not less than one dozen assorted sold. Specify marking wanted as follows:

Plate Variometer	Secondary	Aerial
Grid Variometer	Primary	Ground
Vacuum	Tickler	Phones
Primary Condenser	Loading Coil	Input
Secondary Condenser	Coupling	Output
Increase Current (to right)	Parallel	On
	Series	Off
Increase Current (to left)	Detector	1st Step
	A Battery	2nd Step
	B Battery	3rd Step

(Blank—takes pencil or pen marks.)

ELECTRIC SOLDERING IRON

M957 Price $5.75

Especially adapted to radio work. Will enable you to do neat clean work quickly. Simply attach to any light socket 110-120 volts. Complete with six foot cord and attaching plug. Renewable solder point. Will last a lifetime for ordinary home or light shop work. A wonderful value at the price.

MAGNET WIRE

Insulated copper wire. Best quality even drawn wire, one piece to a spool. Prices quoted are for 8 oz. spools.

Double Cotton Covered		Enameled Insulation		Green Silk Covered	
Number	M990	Number	M992	Number	M991
Gauge	Price	Gauge	Price	Gauge	Price
18	50c	20	45c	20	$0.78
20	60c	22	55c	22	.90
22	75c	24	61c	24	1.05
24	85c	26	65c	26	1.18
26	95c	30	70c	30	1.70
28	$1.15	32	79c	32	2.05
30	1.65	36	98c	36	2.75

STRANDED ANTENNA WIRE

Cabled of fine copper strands. Very flexible. High tensile strength. Best for aerials.

M248—100 ft. coil 65c M249—500 ft. coil $2.95

SPAGHETTI

For covering connecting wires in sets. For size 12 and 14 wires.

M955 Finest quality braided and saturated with best baked lustrous transparent insulating varnish, 3 feet for 20c
M956 Best quality braid and covered with black insulating compound, 3 feet for 15c

ANTENNA INSULATORS

M260 Size 1x3¼. Two for 17c
M262 Size 2⅜x3½. Two for 58c
M264 Size 1½x4. Two for 80c
M266 Size 1½x10½. Two for $1.35

M260 M262 M264-6

SOLID BARE COPPER WIRE

Solid bare copper wire for aerials, leads or wiring instruments.

Solid Bare Copper Wire, size 14
M240—100 ft. coil 45c M242—500 ft. coil $2.15

Solid Bare Copper Wire, size 12
M244—100 ft. coil 65c M245—500 ft. coil $2.75

The Amateur Magician

By JOSEPH H. KRAUS

(*Continued from page* 1069)

Near the base of the candlestick-holder, a tin pill-box was located, the cover of which had been cut open leaving only the rim and the same was used to clamp a rubber diaphragm to the rest of the box. Another pipe leading from the bottom of this pill-box, led to a small funnel, having at its mouth a diameter of approximately 1½ inches. Close up against the base was a single stroke bell, the gong of which had been removed, and its hammer bent upwardly so that when the bell was operated the hammer would strike the rubber diaphragm. The circuit to the bell was completed by means of two wire brushes resembling pieces of wire hair brush. These were secured to a base of fibre, and the latter screwed to the candlestick base. The table-top itself did not disclose any openings, being covered with cloth, but Hargrave took particular care in placing his candlestock down upon the table. When he removed it again, he showed me that the table also contained two wire brushes, which projected upward, and when the candlestick was placed down upon the table, the brushes interlocked, making, as he said, a more perfect contact that the plate and point method he had heretofore used.

Near the center of the candlestick-holder, directly under the funnel end of the small copper tube, a hole was drilled through the table-top which admitted a ⅛ inch tube. This tube did not pass through the table-cloth or cover, consequently, the opening remained concealed. The tube was connected to the illuminating gas supply line, which furnished the gas for the light, seen emanating from the candles. The gas itself burned with a yellow flame much like that of a tallow candle.

"It is evident," Hargrave continued, "that whenever the single stroke bell is energized, it strikes the rubber tambour. This causes the gas contained within the metallic box, to be compressed, which, finding its path of least resistance is in an upwardly direction, causes the flame to rise considerably above normal. The flame then drops down, and at a word of command, it can be made to fall below normal.

"But why did I not smell any gas when you extinguished the light?" I interrogated.

"For the simple reason," was Hargrave's reply, "that I took the precaution to open one of the windows slightly. The amount of gas passing from one of the candlesticks is very small indeed, and it would take quite some time before the odor would have made you aware of the fact that the candles operated on illuminating gas. By insuring a proper circulation, you would probably never realize that fact. Naturally I get a sort of Bunsen burner effect, except that the air is not forced upward with the gas. The lack of air supply produces the yellow flame. When my assistant, who operates the keys controlling the relative lights, presses any of the switches, the hammer of the bell contained within the base, strikes the rubber diaphragm of the tambour. This causes the flame to lengthen. When the key is released, and the circuit opened, the hammer flies backward and the flame drops below the normal point."

"As to the rapid calculation of figures, that is very simply accomplished. My Japanese valet, who listens to your questions by means of a telephone receiver which connects to a microphone placed in his room, takes down the numbers on a comptometer. By the time you have figured up the result, he has already completed the operation, and the answer is being transmitted by means of the light flashes.

The Sleep Eliminator

By H. GERNSBACK

(*Continued from page* 1062)

and asked them if they would care to undergo an experiment to do away with sleep altogether, for a number of days. He found out that keeping awake for the first twenty-four hours was the hardest task, and the men under observation became very haggard and looked extremely fatigued. After the first sleepless night, the second and the third were not so arduous, and the work went on without so much personal discomfort. At the end of the experiment it was found that three or four entirely sleepless nights could be compensated for by eight or ten hours sleep, without the subject being any the worse for the experience.

When we reflect that if the life of the average human being is 50 to 60 years, one-half of this is actually wasted in sleep; then if we multiply this by the entire human race, we discover a waste that is appalling in its entirety. Suppose we could do away with sleep altogether! Suppose we could lead our regular lives without sleep at all! Would this not be a wonderful boon to the race? Would it not increase our activities and also increase our lives by just 100 per cent? It is a truly fascinating project, and is not half as improbable as it would seem at first.

There are, of course, many ways in which we can do away temporarily with sleep. Authors and writers as well as students, know well that when they become drowsy at about 11 or 12 o'clock at night, the most unfailing expedient to overcome sleepiness is to step to the open window and draw in fresh air. This is done almost unconsciously. It simply means that the body needed oxygen in order to supply the nerve centers with their needed regeneration.

Then, also, a good many night workers who must, perforce, stay awake, often take to harmless drugs, coffee being one of them. The caffeine seems to stimulate the nerve centers and other centers to again restore the balance and the work can go on again for a number of hours.

The idea which the writer advances in the following lines has to do with the artificial regeneration of the nerve centers, the blood vessels, and other centers that have become fatigued or worn out. The idea in its entirety is simple:

It shows us what will be done in the future. Our text illustration as well as that on our front cover, convey the idea, which is simple enough. No scientist will deny that the more we fight sleep the higher our blood pressure will go. Finally, during sleep, the blood pressure comes down. If, then, high blood pressure is one of the reasons why we feel the necessity of sleep, we have means to overcome this electrically, by means of D'Arsonval high frequency currents. These, as is well known, tend to drive down the blood pressure quickly, *and with lasting results.*

On our front cover we see the City Editor dictating his work at 3 o'clock in the morning. His body is surrounded by a D'Arsonval spiral, which keeps his blood pressure down as long as he works. We also see on the wall oxygen tanks which give the room atmosphere a higher oxygen value, which value, however, is not high enough to do any damage, just enough to stimulate the worker.

We also see that the chair is upheld by an insulated metallic sheet into which are fed other high frequency currents, which currents serve the purpose of stimulating the nerve cells. There are a number of such currents that can be used. It is the current that gives a sort of very slight twitching action to the nerve centers, the subject being hardly aware of the process. There are a number of machines at our disposal today that do these very things, as they are enumerated, and it is only a matter of experimenting to find out the right combination.

Under the influence of these two sets of currents, and the oxygenated air, it should be possible to eliminate sleep for any length of time without the subject feeling the worse for it, either during the treatment or afterwards.

As we mentioned before, sleep is not of a real necessity as long as we can do away with its causes in such a way that the subject under treatment experiences no ill effects.

In our text illustration we have shown a modern newspaper office, with a Sleep Eliminator. It is realized that in a newspaper office somebody must work during the night and sleep during the day. Such a thing, in a few hundred years from now, will probably be eliminated entirely by means similar to the one suggested.

In this newspaper office we have the D'Arsonval coil which is to reduce the blood pressure, mounted against the walls of the office, so that every worker gets the benefit. The wires are led along the walls, as clearly shown, and are energized by the machine shown at the left. The oxygen tanks are in evidence, as are the glass insulator platforms which insulate the workers from the floor, while the machine is in operation and while the subjects are being electrified.

If one desires to step off his chair, he

(*Continued on page* 1137)

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

AUTO TRANSMISSION LOCK

(692) F. C. Mason, Leicester, England, asks whether he should patent a lock for automobiles, engaging in the transmission. He sends in a very good drawing and description.

A. In the United States at the present time it is not desirable to employ a lock which will engage either the rear wheels or the gears of an automobile.

Such a lock increases the cost of insurance upon a car considerably, because of the fact that the car cannot be moved when once it is locked. Many insurance brokers here insist that a car be permitted to move for a distance of at least 200 feet. This is to enable firemen to remove cars from a burning garage, or to shift the cars should they be blocking a portion of the street to which fire apparatus must move in order to successfully battle with any flames occurring in that vicinity.

A car rigidly locked, as you describe, would have to be towed away, which towing would destroy the tires and perhaps even cripple the machine.

Locks of this nature would be very difficult to adjust to the standard cars, as changes in the transmission gear box would have to be effected, which changes are, of course, costly. Consequently, we are of the opinion that your device will not meet with very great favor, and therefore we advise against attempting to patent the same.

OUR COMMENT REQUESTED

(693) W. P. McCarty, Electra, Texas, asks us if we will comment on a perpetual motion machine.

A. Yes. We shall be glad indeed to comment upon your theory of a perpetual motion machine, and tell you why your device will not operate. No model is necessary but we would suggest that you make your description clear and your drawings to conform with the description.

CIGARETTE-MATCH COMBINATION

(694) Wallace More, Madalin, N. Y., asks whether he should work upon an idea for a combination match and cigarette.

A. Your idea of a combination match and cigarette is not new, and to be perfectly frank, worthless. To convince you of this fact, we would suggest that you cut off the end of a match, so that merely the tip protrudes. Push this tip into the cigarette, and strike this cigarette on a box. Nine chances out of ten, the cigarette will be broken. At the tenth attempt you may light the same, and then as you try to take one puff of smoke, find your mouth full of sulphur fumes.

We also believe that the idea is not patentable, having been fully covered some twenty years ago.

USE FOR CARBORUNDUM

(695) Kenneth Moehrl, Marshalltown, Iowa, desired to fit a peculiarly shaped carborundum stone into a handle to be used for a specified purpose. He asks whether he should patent the idea.

A. Carborundum "stones" of the type you described in your recent communication, are neither new, novel, or unusual. If you will write to any of the branches of the carborundum concern, you will find that stones of your size and thickness are obtainable.

Merely fitting a handle to them and specifying a use for the device, does not constitute a claim for a patent, and consequently, we would suggest no further action in the matter.

CREAM WHIPPER

(696) John Maxian, Bellaire, Ohio, submits a sketch for a cream whipper and requests our opinion.

A. We see nothing unusually novel in your "cream whipper." You have merely taken one of the old style whipping machines and fitted it with a gear and motor drive. This constitutes no claim for a patent whatever.

PHONOGRAPH RECORD

(697) L. W. Mulvey, Newburyport, Mass., claims to have originated a system of making a phonographic record play just twice as much music by inserting another groove between two adjacent grooves, in which groove the music is to be recorded. He inquires as to the patentability of the idea.

A. Although we do not doubt that you can secure a patent on a double-track phonograph record, we see absolutely no advantage in such a record. The music grooves in modern records are very close together. Any attempt to make them closer will break through the side walls. Consequently there is no room for an additional groove between those now found, and there is no way in which you could increase the amount of music by adding another groove, as at the same time you eliminate every other groove now found upon the record. By using a sapphire point instead of a steel needle the record grooves could be put closer together. This is one way of increasing the surface area of a record.

There is another method which we will not mention at the present time because the inventor is patenting the same and he has requested us to keep the idea secret.

CHECK PROTECTOR AND TYPEWRITER CLOCK

(698) F. C. McCleish, Memphis, Tenn., suggests that checks be made like money orders with stubs left on the end. His second idea is a lock for typewriters. He requests our opinion.

A. With reference to your check protector, we would advise that such a system could not possibly be patented, the idea itself being very old. Check protectors of this nature would not only be difficult to handle, but would necessitate an increased cost in printing and a mass of added paper. Imagine having a check made out for say $9,421.64. This would be obviously impossible with a check protector as described in your communication, unless it were made of such a large size as to take in all the figures.

The modern check protector prints the amount right on the check, and in fact perforates the check itself by such printing. It is practically non-raisable, speedy in operation, and inexpensive.

With regard to your second idea, we would like to ask you why anyone should care to lock a typewriter. Typewriters are not left open in offices where undesirable persons may wander.

They are generally locked with the desk itself. For transportation, a simple and far more effective system is employed. Two plates are screwed on the typewriter which hold the carriage rigidly in place, far more rigidly than any lock; and last but not least, unless the lock is very bulky and heavy, it is a very easy matter indeed to snip it free and sever its connections with the typewriter.

Changing Our Numerical System

(699) A. Aranza, Fairhope, Ala., writes:

There is a good and bad side to everything, and so it seems to be with our numerical system. This is founded on ten, and ten in my opinion is not the best and most economical number, nine is worse than ten, but eight is much better, and taken all together number sixteen is probably the best. So I have formed my numerals on the sixteen system, because sixteen has a large dimension and is easier to figure and divide. For example, take our dollar. This has a hundred cents; a half dollar fifty cents; a quarter, twenty-five cents; an eighth of a dollar, twelve and a half cents; and on further division we find that our money is in fractions. In my system, however, we can divide the dollar in half, quarter, eights, sixteenths, and even further, without coming to fractions. I have no doubt but that this system is superior to the modern system, and would like your advice regarding the same.

A. We do not think very much of your system of arranging numbers, so that they will be divisible by sixteenths. It is true that we have dollars, half dollars, quarters, but why should our system cut the dollar in half, and then cut the half dollar in half again: Today the decimal system is well established, and if the money and weights and measures systems would follow the decimal system, we would have something really worth while. In this system it is easy to multiply, subtract, divide, raise to any power, and extract any root. All we have to do is to add a few zeros or subtract them. The dollar now contains ten dimes, and each dime ten cents, each cent ten mills, the non-decimal divisions being the nickel, the quarter, and the half dollar. Inasmuch as the world is employing the weight and measures scale on a ten division plan, with the exception of the English speaking countries, who in scientific calculations also employ this system, we believe that there is very little hope for your suggestion. The centimeter, gram, second system is going to become the standard.

Experimental Electro-Chemistry

By RAYMOND B. WAILES

(*Continued from page* 1074)

acetate or sugar of lead. A copper plate, cut to any design such as a star, cross, etc., is placed above the iron plate and current passed, using copper as the cathode. The rings formed are very colorful.

Production of Light by Electrolysis

An electrolytic cell which produces cold light, i.e., light without heat, when a current is passed through it has recently been devised. The cell is shown in figure 4. It consists of a glass vessel containing two electrodes and an electrolyte. Electrode 1 can be either carbon or aluminum, while electrode 2, the anode, is made of an alloy of aluminum and manganese or aluminum, manganese and copper. The electrolyte consists of a solution of citric acid or a solution of ammonium citrate, borate or bitartrate.

When a direct current passes through the solution *via* the electrodes, a film of aluminum hydroxide is deposited on the positive electrode. This is because the hydroxyl radical OH, of water, is negatively charged and passes to the positive pole, is neutralized of its charge and combines with the aluminum metal to form aluminum hydroxide, $Al(OH)_3$. This film of hydroxide will then glow on continuous passage of the current, the whole constituting an electrolytic cell producing light radiations.

Alternating current can also be used with the cell, but electrodes of aluminum alloyed with copper and manganese have to be used, forming them first with a direct current so that the hydroxide film is deposited on both electrodes. Both electrodes when formed, will emit light when alternating current is applied to the electrodes.

The Star

By H. G. WELLS

(*Continued from page* 1059)

heavy, rushing without warning out of the black mystery of the sky into the radiance of the sun. By the second day it was clearly visible to any decent instrument, as a speck with a barely sensible diameter, in the constellation Leo near Regulus. In a little while an opera glass could attain it.

On the third day of the new year the newspaper readers of two hemispheres were made aware for the first time of the real importance of this unusual apparition in the heavens. "A Planetary Collision," one London paper headed the news, and proclaimed Duchine's opinion that this strange new planet would probably collide with Neptune. The leader writers enlarged upon the topic. So that in most of the capitals of the world, on Jan. 3, there was an expectation, however vague, of some imminent phenomenon in the sky; and as the night followed the sunset round the globe thousands of men turned their eyes skyward to see—the old familar stars just as they had always been.

Until it was dawn in London and Pollux setting, and the stars overhead grown pale. The winters dawn it was, a sickly filtering accumulation of daylight, and the light of gas and candles shone yellow in the windows to show where people were astir. But the yawning policeman saw the thing, the busy crowds in the market stopped agape, workmen going to their work betimes, milkmen, the drivers of news carts, dissipation going home jaded and pale, homeless wanderers, sentinels on their beats, and in the country, laborers trudging afield, poachers slinking home, all over the dusky quickening country it would be seen—and out at sea by seamen watching for the day—a great white star, come suddenly into the westward sky!

Brighter it was than any star in our skies; brighter than the evening star at its brightest. It still glowed out white and large, no mere twinkling spot of light but a small round clear shining disk, an hour after the day had come. And where science has not reached, men stared and feared, telling one another of the wars and pestilences that are foreshadowed by these fiery signs in the heavens. Sturdy Boers, dusky Hottentots, Gold Coast negroes, Frenchmen, Spaniards, Portuguese, stood in the glow of the sunrise watching the setting of this strange new star.

And in a hundred observatories there had been suppressed excitement, rising almost to shouting pitch, as the two remote bodies had rushed together, and a hurrying to and fro to gather photographic apparatus and spectroscope, and this appliance and that, to record this novel astonishing sight, the destruction of a world. For it was a world, a sister planet of our earth, far greater than our earth indeed, that had so suddenly flashed into flaming death. Neptune it was, which had been struck, fairly and squarely, by the planet from outer space and the heat of the concussion had incontinently turned two solid globes into one vast mass of incandescence. Round the world that day, two hours before the dawn, went the pallid great white star, fading only as it sank westward and the sun mounted above it. Everywhere man marveled at it, but of all those who saw it none could have marveled more than those sailors, habitual watchers of the stars, who far away at sea had heard nothing of its advent and saw it now rise like a pigmy moon and climb zenithward and hang overhead and sink westward with the passing of the night.

And when next it rose over Europe everywhere were crowds of watchers on hilly

slopes, on house roofs, in open spaces, staring eastward, waiting for the rising of the new star. It rose with a white glow in front, like the glare of a white fire, and those who had seen it come into existence the night before cried out at the sight of it. "It is larger," they cried. "It is brighter!" And, indeed, the moon a quarter full and sinking in the west was in its apparent size beyond comparison, but scarcely in all its breadth had it as much brightness now as the little circle of the strange new star.

"It is brighter!" cried the people clustering in the streets. But in the dim observatories the watchers held their breath and peered at one another. "It is nearer," they said. "Nearer!"

And voice after voice repeated. "It is nearer," and the clicking telegraph took that up, and it trembled along telephone wires, and in a thousand cities grimy compositors fingered the type. "It is nearer." Men writing in offices, struck with a strange realization, flung down their pens, men talking in a thousand places suddenly came upon a grotesque possibility in those words, "It is nearer." It hurried along awakening streets, it was shouted down the frost-stilled ways of quiet villages, men who had read these things, from the throbbing tape stood in yellow-lit doorways shouting the news to the passers-by. "It is nearer." Pretty women, flushed and glittering, heard the news told jestingly between the dances, and feigned an intelligent interest they did not feel. "Nearer! Indeed. How curious! How clever people must be to find out things like that!"

Lonely tramps faring through the wintry night murmured those words to comfort themselves—looking skyward. "It has need to be nearer, for the night's as cold as charity. Don't seem much warmth from it if it is nearer, all the same."

"What is a new star to me?" cried the weeping woman kneeling beside her dead.

The schoolboy, rising early for his examination work, puzzled it out for himself—with the great white star shining broad and bright through the frost-flowers of his window. "Centrifugal, centripetal," he said, with his chin on his fist. "Stop a planet in its flight, rob it of its centrifugal force, what then? Centripetal has it, and down it falls into the sun! And this—!"

"Do we come in the way? I wonder—"

The light of that day went the way of its brethren, and with the later watches of the frosty darkness rose the strange star again. And it was now so bright that the waxing moon seemed but a pale yellow ghost of itself, rising huge in the sunset hour. In a South African city a great man had married, and the streets were alight to welcome his return with his bride. "Even the skies have illuminated," said the flatterer. Under Capricorn, two negro lovers, daring the wild beasts and evil spirits, for love of one another, crouched together in a cane brake where the fireflies hovered. "That is our star," they whispered, and felt strangely comforted by the sweet brilliancy of its light.

The master mathematician sat in his private room and pushed the papers from him. His calculations were already finished. In a small white phial there still remained a little of the drug that had kept him awake and active for four long nights. Each day, serene, explicit, patient as ever, he had given his lecture to his students, and then had come back at once to this momentous calculation. His face was grave, a little drawn, and hectic from his drugged activity. For some time he seemed lost in thought. Then he went to the window, and the blind went up with a click. Half way up the sky, over the clustering roofs, chimneys, and steeples of the city, hung the star.

He looked at it as one might look into the eye of a brave enemy. "You may kill me," he said after a silence. "But I can hold

you—and all the universe for that matter—in the grip of this little brain. I would not change even now."

He looked at the little phial. "There will be no need of sleep again," he said. The next day at noon, punctual to the minute, he entered his lecture theater, put his hat on the end of the table as his habit was, and carefully selected a large piece of chalk. It was a joke among his students that he could not lecture without that piece of chalk to fumble in his fingers, and once he had been stricken to impotence by their hiding his supply. He came and looked under his gray eyebrows at the rising tiers of young fresh faces, and spoke with his accustomed studied commonness of phrasing. "Circumstances have arisen—circumstances beyond my control," he said and paused, "which will debar me from completing the course I had designed. It would seem, gentlemen, if I may put the thing clearly and briefly, that—man has lived in vain."

The students glanced at one another. Had they heard aright? Mad? Raised eyebrows and grinning lips there were, but one or two faces remained intent upon his calm gray-fringed face. "It will be interesting," he was saying, "to devote this morning to an exposition, so far as I can make it clear to you, of the calculations that have led me to this conclusion. Let us assume—"

He turned toward the blackboard, meditating a diagram in the way that was usual to him. "What was that about 'lived in vain'?" whispered one student to another. "Listen," said the other, nodding toward the lecturer.

And presently they began to understand.

That night the star rose later, for its proper eastward motion had carried it some way across Leo toward Virgo, and its brightness was so great that the sky became a luminous blue as it rose, and every star and planet was hidden, save only Jupiter near the zenith, Capalla, Aldeebaran, Sirius, and the pointers of the Bear. It was white and beautiful. In many parts of the world that night a pallid halo encircled it about. It was perceptibly larger; in the clear refractive sky of the tropics it seemed as if it were nearly a quarter of the size of the moon. The frost was still on the ground in England, but the world was as brightly lit as if it were midsummer moonlight. One could see to read quite ordinary print by that cold clear light, and in the cities the lamps burnt yellow and wan.

And everywhere the world was awake that night, and throughout Christendom a somber murmur hung in the keen air over the countryside like the buzzing of the bees in the heather, and this murmurous tumult grew to a clangor in the cities. It was the tolling of the bells in a million belfry towers and steeples, summoning the people to sleep no more, to sin no more, but to gather in their churches and pray. And overhead, growing larger and brighter, as the earth rolled on its way and the night passed, rose the dazzling star.

And the streets and houses were alight in all the cities, the shipyards glared, and whatever roads led to high country were lit and crowded all night long. And in all the seas about the civilized lands ships with throbbing engines, and ships with bellying sails, crowded with men and living creatures, were standing out to ocean and the north. For already the warning of the master mathematician had been telegraphed over the world, and translated into a hundred tongues The new planet and Neptune, locked in a fiery embrace, were whirling headlong, ever faster and faster, toward the sun Already every second this blazing mass flew a hundred miles, and every second its terrific velocity increased. As it flew its course, it must pass a hundred million of miles wide of the earth and scarcely affect it.

But near its destined path, as yet only

slightly perturbed, spun the mighty planet Jupiter and his moons sweeping splendid around the sun. Every moment now the attraction between the fiery star and the greatest of the planets grew stronger And the result of that attraction? Inevitably Jupiter, would be deflected from its orbit into an elliptical path, and the burning star, swung by his attraction wide of its sunward rush, would "describe a curved path" and perhaps collide with and certainly pass close to, our earth. "Earthquakes, volcanic outbreaks, cyclones, sea waves, floods, and a steady rise in temperature to I know not what limit"—so prophesied the master mathematician.

And overhead, to carry out his words, lonely and cold and livid, blazed the star of the coming doom.

To many who stared at it that night until their eyes ached, it seemed that it was visibly approaching. And that night, too, the weather changed, and the frost that had gripped all Central Europe and France and England softened towards a thaw.

But you must not imagine because I have spoken of people praying through the night and people going aboard ships and people fleeing towards mountainous country that the whole world was already in a terror because of the star. As a matter of fact, use and wont still ruled the world, and save for the talk of idle moments and the splendor of the night, nine human beings out of ten were still busy at their common ocupations. In all the cities the shops, save one here and there, opened and closed at their proper hours, the doctor and the undertaker plied their trades, and workers gathered in the factories, soldiers drilled, scholars studied, lovers sought one another, thieves lurked and fled, politicians planned their schemes The presses of the newspapers roared through the nights, and many a priest of this church and that would not open his holy building to further what he considered a foolish panic.

The newspapers insisted on the lesson of the year 1000—for then, too, people had anticipated the end. The star was no star—mere gas—a comet; and were it a star it could not possibly strike the earth. There was no precedent for such a thing. Common sense was sturdy everywhere, scornful, jesting, a little inclined to persecute the obdurate fearful. That night at 7:15 by Greenwich time the star would be at its nearest to Jupiter. Then the world would see the turn things would take. The master mathematician's grim warnings were treated by many as so much mere elaborate self-advertisement Common sense at last, a little heated by argument, signified its unalterable convictions by going to bed. So, too, barbarism and savagery, already tired of the novelty, went about their nightly business, and save for a howling dog here and there the beast-world left the star unheeded.

And yet, when at last the watchers in the European states saw the star rise, an hour later, it is true, but no larger than it had been the night before, there were still plenty awake to laugh at the master mathematician—to take the danger as if it had passed.

But hereafter the laughter ceased. The star grew—it grew with a terrible steadiness hour after hour, a little larger each hour, a little nearer the midnight zenith, and brighter and brighter, until it had turned night into day. Had it come straight to the earth instead of in a curved path, had it lost no velocity to Jupiter, it must have leapt the intervening gulf in a day; but as it was it took five days altogether to come by our planet. The next night it had become a third the size of the moon before it set to English eyes, and the thaw was assured.

It rose over America near the size of the moon, but blinding white to look at, and hot; and a breath of hot wind blew now with its rising and gathering strength, and

in Virginia and Brazil and down the St Lawrence valley it shone intermittently through a driving reek of thunder clouds, flickering violet lightning, and hail unprecedented. In Manitoba were a thaw and devastating floods. And upon all the mountains of the earth the snow and ice began to melt that night, and all the rivers coming out of high country flowed thick and turbid, and soon—in their upper reaches—with swirling trees and the bodies of beasts and men. They rose steadily, steadily in the ghostly brilliance, and came trickling over their banks at last, behind the flying population of their valleys.

And along the coast of Argentina and up the South Atlantic tides were higher than they had ever been in the memory of man, and the storms drove the waters in many cases scores of miles inland, drowning whole cities. And so great grew the heat during the night that the rising of the sun was like the coming of a shadow. The earthquakes began and grew until all down America from the Arctic Circle to Cape Horn hillsides were sliding, fissures were opening, and houses and walls crumbling to destruction.

China was lit glowing white, but over Japan and Java and all the islands of eastern Asia the great star was a ball of dull red fire because of the steam and smoke and ashes the volcanoes were spouting forth to salute its coming. Above were the lava, hot gases, and ash, and below the seething floods, and the whole earth swayed and rumbled with the earthquake shocks. Soon the immemorial snows of Tibet and the Himalayas were melting and pouring down by ten million deepening converging channels upon the plains of Burma and Hindustan. The tangled summits of the Indian jungles were aflame in a thousand places, and below the hurrying waters around the stems were dark objects that struggled feebly and reflected the blood red tongues of fire. And in a rudderless confusion a multitude of men and women fled down the broad riverways to that one last hope of men—the open sea.

Larger grew the star, and larger, hotter, and brighter with a terrible swiftness now. The tropical ocean had lost its phosphorescence, and the whirling steam rose in ghostly wreaths from the black waves that plunged incessantly, speckled with storm tossed ships.

And then came a wonder. It seemed to those who in Europe watched for the rising of the star that the world must have ceased its rotation. In a thousand open spaces of down and upland the people who had fled thither from the floods and the falling houses and sliding slopes of hill

watched for that rising in vain. Hour followed hour through a terrible suspense, and the star rose not. Once again men set their eyes upon the old constellations they had counted lost to them forever. In England it was hot and clear overhead, though the ground quivered perpetually; but in the tropics Sirius and Capella and Aldebaran showed through a veil of steam. And when at last the great star rose, near ten hours late, the sun rose close upon it, and in the center of its white heart was a disk of black.

When over Asia the star had begun to fall behind the movement of the sky, and then suddenly, as it hung over India, its light had been veiled. All the plain of India from the mouth of the Indus to the mouths of the Ganges was a shallow waste of shining water that night, out of which rose temples and palaces, mounds and hills, black with people. Every minaret was a clustering mass of people, who fell one by one into the turbid waters as heat and terror overcame them. The whole land seemed a-wailing, and suddenly there swept a shadow across that furnace of despair, and a breath of cold wind, and a gathering of clouds out of the cooling air. Men looking up, near blinded, at the star, saw that black disk was creeping across the light. It was the moon, coming between the star and the earth. And even as men cried to God at this respite, out of the east with a strange, inexplicable swiftness sprang the sun. And then star, sun, and moon rushed together across the heavens.

So it was that presently, to the European watchers, star and sun rose close upon each other, drove headlong for a space, and then slower, and at last came to rest, star and sun merged into one glare of flame at the zenith of the sky. The moon no longer eclipsed the star, but was lost to sight in the brilliance of the sky. And though those who were still alive regarded it for the most part with that dull stupidity that hunger, fatigue, heat, and despair engender, there were still men who could perceive the meaning of these signs. Star and earth had been at their nearest, had swung about one another, and the star had passed. Already it was receding, swifter and swifter, in the last stage of its headlong journey downward into the sun.

And then the clouds gathered, blotting out the vision of the sky; the thunder and lightning wove a garment around the world; all over the earth was such a downpour of rain as men had never seen before; and where the volcanoes flared red against the cloud canopy there descended torrents of mud. Everywhere the waters were pouring off the land, leaving mud stilted ruins, and the earth littered like a storm worn beach with all that had floated, and the dead bodies of the men and brutes, its children.

For days the water streamed off the land, sweeping away soil and trees and houses in the way and piling huge dikes and scooping out titanic gullies over the countryside. Those were the days of darkness that followed the star and the heat. All through them, and for many weeks and months, the earthquakes continued.

But the star had passed, and men, hunger-driven and gathering courage only slowly, might creep back to their ruined cities, buried granaries, and sodden fields. Such few ships as had escaped the storms of that time came stunned and shattered and sounding their way cautiously through the new marks and shoals of once familiar ports. And as the storms subsided men perceived that everywhere the days were hotter than of yore, and the sun larger, and the moon, shrunk to a third of its former size, took now fourscore days between its new and new.

But of the new brotherhood that grew presently among men, of the saving of laws and books and machines, of the strange

change that had come over Iceland and Greenland the shores of Baffin's Bay, so that the sailors coming there presently found them green and gracious, and could scarce believe their eyes, this story does not tell. Nor of the movement of mankind, now that the earth was hotter, northward and southward towards the poles of the earth. It concerns itself only with the coming and the passing of the star.

The Martian astronomers—for there are astronomers on Mars, although they are different beings from men—were naturally profoundly interested by these things. They saw them from their own standpoint, of course. "Considering the mass and temperature of the missile that was flung through our solar system into the sun," one wrote, "it is astonishing what little damage the earth, which it missed so narrowly, has sustained. All the familiar continental markings and the masses of the seas remain intact, and indeed the only difference seems to be a shrinkage of the white discoloration (supposed to be frozen water) round either pole." Which only shows how small the vastest of human catastrophies may seem at a distance of a few million miles.

How Old is the World

By HARRY VAN DEMARK

(*Continued from page* 1057)

meters high, or about 36 feet, as the river then only drained Lake Erie, for the three other lakes had their own separate outlets to the sea. The water falling over it was only about 15 per cent of what falls today. The channel cut was narrow, the wearing back of it followed very slowly, only about 12 centimeters or 5 inches, in a year.

After various geologic changes, all five lakes sent their water over Niagara, which today is divided into two falls, the smaller the American, and the Horseshoe Falls, falling from a height of about 50 meters (164 feet) into the cavity, giving an awe-inspiring display of the primitive powers of nature. In later times, a wearing away of the edge of the falls of a little over five feet, has been calculated. A number of geologists, Spencer, Taylor, and Gilbert, have on the basis of all the circumstances during the course of geologic epochs, tried to reckon the time which was required for Niagara to cut the entire channel or gorge. They reached figures varying between 20,000 and 40,000 years, giving a mean of 30,000 years (or at a rate of about one foot per year). At this rate Niagara Falls would reach Buffalo in about 90,000 years, but less water now passes over the falls, due to hydro-electric power developments, and also a harder rock has been reached by the falls, which wears away but slowly.

PHOTO-BY-WIRE FOR THREE FRENCH CITIES

Edouard Belin, inventor of the photo-telephonic process by which photographs are transmitted through the air and by wire, has gone to Lyons, where he will establish the first of three stations, under the contract with the French Government, which controls communications and which sees a future in M. Belin's new system. The New York *World* recently acquired from M. Belin the North American rights of the invention.

There will also be installations of the Belin equipment at Paris and Strassburg.

Renewed efforts to put the apparatus in action between Madrid and Paris were frustrated in the early tests by poor service. An hour was spent in efforts to talk over the line, but nothing more than dim "hellos" resulted, so it was decided that it would be useless to try to transmit photographs.

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

(*Continued from page* 1065)

"Well, yes, it is a glider, and yet in my opinion it is far superior to the ordinary glider. You have probably seen in the papers that both the French and the German governments are devoting considerable attention to the manufacture of airplanes without engines. The results have been most promising, some of the flights lasting *three hours and a quarter* without a motor of any kind. Shorter flights have also been made with a passenger on board as well as the pilot."

"But how can an airplane travel without a motor?"

"The wind raises it, the same wind which raises an ordinary kite. The difference is that the glider needs no string to hold it in the proper position against the wind. The pilot, on board the machine, by means of his steering apparatus, keeps the wings facing the wind, and so is able to rise to any desired height—that is, of course, so long as conditions remain favorable.

"The disadvantage of these gliders, as at present constructed, is that the equilibrium is not automatically regulated. It requires an expert pilot to run them, and the steering is very fatiguing. Then, too, the starting is difficult. It is not every hill that can serve as a starting-point, and the wind must be just right. To obviate this difficulty, the French are trying hard to devise a glider in which the pilot can assist himself by a kind of bicycle treadle which enables him to work a propeller. This would be of material assistance in starting."

"And *your* machine?"

"My machine is really a combination of an airplane and a balloon. But why waste time describing it. Come along with me and you can see it for yourself. The man from Missouri who wants to be 'shown', is the man who will learn."

A short ride in one of the doctor's automobiles brought the pair to the hangar where the motorless airplane was stored.

"You see, Silas," observed Doctor Hackensaw, "one great advantage of my machine is that I do not require a large space to start in, because I rise vertically instead of horizontally. Here is the machine—now tell me frankly what you think of it."

The reporter cast a disappointed look at the airplane. Save that it had no propeller and no motor, it was very much like any other flying machine except for the one fact that, instead of being a monoplane or a bi-plane, this machine had no less than *four* planes. This gave it a rather clumsy appearance.

"I see you don't like the looks of my 'quadriplane,'" remarked the doctor, noticing the reporter's air of disapproval. "Well, I don't blame you. I haven't sought beauty yet, I'm just seeking practical results."

"But this machine is only a glider!" cried Silas. "It has no motor, nothing to make it go!"

"It looks so, doesn't it?" chuckled the doctor. But she'll go all right!" Then turning to the man in charge, he added: "Run her out to the starting-place, James,—that is, if she's in good order."

"She do be that, sorr," returned the man. "She hasn't lost a foot of gas since last night."

"Gas?" exclaimed Silas Rocket, "where is there any gas?"

"Why, Silas; didn't I tell you that my machine was a combined glider and balloon,—and did you ever hear of a balloon without any gas?"

"But where in the world is the gas?"

"In the wings, my boy. You will notice that the wings of my machine are considerably larger and thicker than those of the ordinary airplane. The space between the upper and lower portion of each wing is filled with helium gas. In a word, each wing is a little balloon, and the combined balloons are sufficient to raise the machine into the air."

"I see."

"When I first set out to build this machine I looked at the problem in this way. If I could only find some simple means of raising a glider to a height, I could do away with a motor altogether, for I could volplane or dive down in any direction I pleased and at a high rate of speed. In fact, by utilizing the wind, I could do all that the glider does now, and far more, for my acquired velocity in descending would enable me to make better use of the wind power. I could tack, somewhat as a sailing vessel tacks, and so profit to the utmost by whatever breezes there happened to be. Hence I could travel a long distance before having to rise again."

Silas Rockett's face showed plainly his poor opinion of the machine. "It doesn't strike me as being practical," said he, at length. "Your invention is nothing but a balloon, with wings added for coasting down. But each time you go up, you have to fill it with fresh gas, and each time you come down you have to let the gas escape. The advantage over an ordinary balloon seems to me very slight."

"You're right, Silas," said Doctor Hackensaw approvingly, "or at least you would be right if I were foolish enough to waste my gas at each descent. But I do no such a thing."

"How do you manage, then?"

"In the first place I use helium gas, so as to avoid all danger of fire. Then, if you will notice, I have a specially constructed heating apparatus here. I use kerosene for fuel. When I heat the helium gas, it expands, and consequently the wings of my machine bulge out and occupy more space, the machine thus becoming lighter. Finally it becomes light enough to rise from the ground, and I can control its rate of ascent by means of the temperature."

"I see."

"When I have reached a sufficient height and wish to coast down, I turn off the heat. The cold air of the heights, acting on the enormous wing surface, cools the gas almost instantly, especially as the cooling is assisted by rotary fans, worked by the motion of the airplane, and which I can start or stop at will. The helium gas contracts, my machine becomes heavier than air, like an ordinary glider, and down I coast in any direction and at any speed I please, turning on the heat when I wish to rise again."

"You have an answer for everything, doctor," remarked Silas. "You must have given the subject a great deal of study."

"I should say so. I began my experiments forty years ago. I first experimented by fastening men to kites of various kinds and sending them up in the air. I tried the ordinary kite with a tail, the tailless kite, and the box-kite. But the weight of the kite-string that had to be lifted was the great drawback. I used for the purpose a very light yet strong clothesline, but my kites could not lift very much of it. Then, too, the wind would change and my kites with their human freight, would drop to the ground. My passengers were always provided with parachutes, but when one man broke a leg in falling, I gave up the attempt. Then the airplane was invented, and now the gliding-machines are doing such remarkable work that I decided to take up the subject again on these new lines. And here is the result. If you will take your place in the machine, I'll be the pilot, and we can take a trial spin."

"What!"

"Yes, I want you to come for a little ride with me around New York Harbor."

"But . . . . "

"Surely you're not afraid, Silas?"

"No," replied the reporter, dubiously, "but are you sure the machine's all right?"

"I'll answer for it, sorr," said the mechanic, reassuringly. "Me and Bill was out in it yesterday, and she worked like a charm!"

Too much preoccupied to notice the discrepancy in the pronouns, Silas took his seat, though not without some hesitation. He didn't much like the idea of being made the subject of an experiment.

"That's right, Silas," cried Doctor Hackensaw, encouragingly, "A brave man can only die once!"

But poor Silas did not feel disposed, at the moment, to die even once.

Doctor Hackensaw stepped into the pilot's seat and turned on the heat. Almost instantly the wings of the machine began to swell to several times their original size, and the machine slowly rose and began tugging at the ropes that held it down.

"Now Silas," cried the doctor, "before we start take a good look at your parachute. In case of any accident, grasp that, and it will break your fall. We're all ready, James, let her go!"

A moment later the released machine rose slowly from the ground. The wings themselves were so designed as to tilt upward, thus facilitating the rise, but the seats of the passengers always remained horizontal whatever the position of the car. A special telephone in the car enabled the two passengers to converse as easily as if in a quiet parlor.

Doctor Hackensaw was jubilant. "You see, Silas," he observed, "We have none of the noise and fuss here of an ordinary airplane. We are rising quietly and steadily. That's one great advantage over the flying-machine, the ease of starting. We do not require a special aviation field, I can rise or land most anywhere, because my ascent is practically vertical. Then, too, the start and the landing are effected as slowly as I wish, thus eliminating two of the greatest dangers of the airplane, which must start or land at a high rate of speed. For war-purposes, too, this faculty of hovering is very useful. For example, we are now directly above the Woolworth building. See how easy it would be to drop a bomb on it from here—much easier than from a balloon, for a balloon is at the mercy of the wind, while I can remain in the same relative position by descending in a spiral toward the building."

Silas looked down and was forced to admit the truth of his companion's remarks.

"Don't you see," cried the doctor, exultingly, "that my machine combines the advantages both of the balloon and of the airplane. I can travel in any direction I please, like an airplane, and yet haven't the

heavy and finicky motor to bother with—nor the expense of the gasoline. Traveling is cheap for me. What does it matter if I do not travel quite so fast. I can attain any speed I please in my descent. Neither do I waste my helium gas, as the ordinary balloon does, because I do not allow the gas to escape."

The machine was now well up in the air, and the doctor decided to make his first downward dive. He accordingly turned off the heat, the rotary fans began to revolve—the wings collapsed to a fraction of their former thickness and the car began to glide downward through the air at a rapidly increasing speed. When the motion became too swift, Doctor Hackensaw with a dexterous swerve of the tail would start the machine rising again.

"Look Silas," cried the doctor, gleefully, "Here we are over Coney Isalnd! If you look sharp, you will see, some distance beyond the bathing place, a basket floating out in the ocean. We'll suppose that's a sperm-whale, and I'll show you how easy it would be to harpoon it, with a buoy attached to the harpoon, and then follow the buoy in our machine without any of the dangers we should run in a whale-boat."

"Why, doctor, I didn't know you were such an expert!" exclaimed Silas admiringly, as he saw the ease with which his companion handled the machine.

Scarcely were the words out of his mouth, however, when he was startled by a crackling sound—the steering wheel broke, and the machine, no longer under control, began a series of headlong dives.

"Quick, Silas!" cried the doctor, "Take to your parachute, man! Quick, I tell you, or you'll be in the ocean!"

Suiting the action to the word, Doctor Hackensaw chose an opportune moment and jumped clear of the falling machine. His parachute opened beautifully and down he came lightly among the gaping crowd of bathers on the Coney Island beach.

Poor Silas, however, was not so fortunate. It took him some time to understand how matters stood, and then his parachute stuck and refused to come free from the falling airplane. When he did finally succeed in making his leap, he was some distance out over the water, and down he went deep into the briny waves. He emerged, gasping and sputtering and was quickly rescued by one of the boats. As he reached the shore, dripping wet and in a pitiable condition, it did not add to his peace of mind to see the doctor genially shaking hands with the pretty girl-bathers who had surrounded him.

"Well, Silas," exclaimed the doctor, gaily, "how goes it?"

Silas gazed ruefully at his newly bought suit of clothing, now reduced to tatters by the jagged framework of the machine, but he said nothing.

"Never mind, Silas," cried the doctor, cheerily, "Christmas is coming soon, and I prophesy that Santa Claus will bring you a complete wardrobe of clothing, far superior to any you have ever had. Now mark my words because I pride myself that I am something of a prophet. Now smile and look pleasant because there are some moviemen here and they want to get a *close-up* of you. You will go down to posterity as a pioneer of the motorless airplane, for although this first experiment has failed I feel confident that my machine will eventually open up a new era in the history of flying."

THE ULTIMATE COLD

The absolute zero, the lowest degree of cold that can ever be attained, has been approached within less than one degree.

This important announcement was made recently at a meeting of the Faraday Society at the Institution of Electrical Engineering in London by Prof. Onnes, of Leyden, Holland, who in 1908 liquefied the gas helium at a temperature only 4.3 degrees above absolute zero.

Measuring One Millionth of an Inch

(*Continued from page* 1067)

to locate our measurement within one tenth of a half wave length of light, or one tenth of a hundred thousandth of an inch, in other words, one millionth of an inch. This location, although approximate, may be made more accurate by varying the thickness of the wedge of air by pressure upon the optical flat, so that the distance between two adjacent bands is greater.

In making a test to determine the variation between an unknown gauge, and a standard gauge, both gauges are placed upon an optical flat and wrung or twisted on its surface, so as to make sure of contact. Another optical flat is now placed upon them. Consider in Fig. 7 that the unknown block at the left in our illustration, is being compared with the block of known thickness, at the right. It will be seen that the interference bands occur, one-half a band lower on the wedge of the left hand gauge, than do those on the standard. It is quite evident that if both gauges were of the same size, then any bands which occur on one gauge would occur in exactly the same position on the other, and therefore, the bands would appear to be practically continuous, but in view of the fact that the gauges are of different sizes in this illustration, then the one at the left is five millionths of an inch shorter than the one at the right, its interference band occurring lower than the one at the right by the distance of a half-half wave length.

For the purpose of measuring a ¼ inch plug that is not tapering, the gauge block is placed upon the lower flat, and the upper flat placed upon both this and the plug itself, as indicated in Fig. 10. This plug is usually placed a distance away from the gauge equal to the width or the diameter of the gauge, so that the number of bands may be counted, and if the plug is larger, they may be multiplied by two. The wedge of air increasing in thickness from the point of contact of the upper flat to the end of the gauge, by ten millionths of an inch for every dark band, we can readily count six bands on this illustration. Multiplying this figure by two, we find that the plug is twelve millionths of an inch oversize, or larger than our ¼ inch plug standard gauge. If the plug is undersize, then the bands will directly indicate how much that plug is under size; we do not have to double the figure.

In measuring a steel ball, Fig. 8 the same procedure is followed, the number of dark bands are counted, and the diameter of the ball readily determined. Of course a standard gauge must always be employed in such measurements.

In order to select balls of uniform size, Fig. 9, a slightly different procedure is followed, both balls being arranged on a cardboard templet a fixed distance away from the stangard gauge, and if the lines are parallel to a line joining the center of the two balls, which line is likewise at right angles to a line joining the center of the steel balls and terminates midway between them, we know that our balls are of uniform size. If the bands are angularly disposed, then we can determine, by projecting lines, as illustrated in Fig. 9, just how much these steel balls vary with respect to our gauge.

In Fig. 7 the principles employed in determining these different measurements are illustrated. One can always be sure of his measurements to within an accuracy of a hundred thousandth of an inch. He can approximate his measurement to within a millionth of an inch with very little chance of varying another millionth.

—Photos Courtesy of H. L. Van Kuren.

An Amplifier for Your Present Tuner

By BERT T. BONAVENTURE

(*Continued from page* 1085)

two sockets. Using a hard tube as a detector, with higher plate potentials than 22½ volts, will give almost as good a sensitivity as a soft tube with considerably less tube noises.

The first point in the design is the calculation of the tuned impedance used in the plate circuit of the radio frequency amplifier tube. The three circuit tuner for which this amplifier was designed had a wavelength range of from 150 to 650 meters. It is obvious that the impedance should also be able to cover this range. First the approximate capacitance values of the condenser must be known. For a 23 plate condenser if the following values are used in the hypothesis, one will not be far off the averages values: maximum, .00045 mfd., minimum .000015 mfd. In the particular condenser used in this amplifier, the values were .0004275 mfd., and 13.5 micromicrofarads respectively as given by capacity bridge measurements. Care should be taken that the condenser selected should have low dielectric losses. Condensers with fibre end plates should be immediately rejected, as the losses therein are bound to be too high for use in radio frequency circuits. High losses mean broad tuning with resulting interference.

To calculate the inductance of the coil to be used in parallel with the condenser, the following formulæ are used:

(1) $LC = K$, with λ constant.

where L = inductance in centimeters,
C = capacitance in microfarads,
λ = wavelength in meters,

(2) $$L = \frac{4\pi^2 a^2 n^2}{b} K$$

where L = inductance in centimeters,
a = mean radius of the coil in cm.
b = length of coil in cm.
n = total number of turns in the coil.

K = factor varying as $\frac{2a}{b}$.

(2a) $$n^2 = \frac{Lb}{4\pi^2 a^2 K}$$ . . . transposing (2).

Formula (1) gives the oscillation constant squared of the circuit, when the wave length is known. Take 650 meters as the maximum wave length that is desired to be received. The LC value for this particular wave length is 119. (See *Lefax* sheets for a table of these LC values.) Knowing the maximum condenser value, .0004275 microfarads, we may now calculate the inductance required to tune to this wave length, making use of (1).

$LC = 119$ or $L \times 0.0004275 = 119$.

$L = 119/0.0004275 \times 10^5$ . . . when L is in microhenries.

Therefore,

$L = 278$ microhenries.

Now, let us see if this value of inductance is small enough to tune to the minimum wave length, assuming it to be 150 meters. LC for 150 meters is 6.35. Whence the minimum LC of our coil and condenser should be 6.35 or less in value, preferably less. Substituting the minimum condenser value in (1) solving we get

$LC = K$ or $278 \times 0.0000135 \times 10^3 = 3.75$

This figure corresponds to 115 meters, so that our coil is capable of covering from 115 to 650 meters. Actually these values will be

somewhat higher due to the capacity between elements of the tube also being across the coil. That is why the coil was designed to go as low as 115 meters, so as to allow for the plate to filament capacitance of the tube.

Let us now take up the actual winding of the coil, using formulæ (2) and (2a). Formula (2) is merely given as the starting point from which (2a) is obtained, the latter giving the number of turns of wire for a required inductance. The factor K may be obtained from Bucher's *Wireless Experimenter's Manual* or from *Bulletin 74* of the *Bureau of Standards*.

The particular coil used in this set had a diameter of 2⅝ inches and was 1½ inches long. It was decided to let the depth of the winding be ½ inch long, since litzendraht wire was used in winding and banked in two layers to save space, the rest of the coil being used for mounting purposes. Allowing for some distributed capacity of the coil, it was found that an inductance of 250 microhenries would be sufficient for our purpose.

Calculation of n.

$$(1) \ldots \pi^2 = \frac{Lb}{4\pi^2 a^2 K}$$

$L = 250$ microhenries.

$b = 2 \times \frac{1}{2} = 1'' = 2.54$ cm.

$a = 2.625/2 = 1.3125'' = 3.34$ cm.

$a^2 = 11.12$

$K = 0.46228$

$$n^2 = \frac{250 \times 10^3 \times 2.54}{4 \times 9.87 \times 11.12 \times 0.46228}$$

Whence $n^2 = 3128$ and $n = 56$ turns.

The coil was therefore wound with 56 turns of No. 38-10 strand litzendraht wire, giving an inductance by actual measurement, of 257.5 microhenries, a value which is sufficiently accurate for our purposes.

With this coil constructed, the rest of the assembly is purely a matter of a little manual labor. The frame on which the sockets, transformers, and binding posts are mounted is made of ⅜-inch angle brass, with the corners strengthened. In bending the brass at the corners, cut out a right angle triangle from the point where the bend is made. This prevents bulging of the stock when the bend is made by allowing the ends of the cut to come together. Strengthen this joint by soldering an oblong-shaped piece of brass on the inside of each corner, using care to make a neat job. The dimensions of the bends are given in Fig. 2. The dotted line shows where the strengthening pieces are to be soldered. All dimensions given are optional with the constructor, as he can follow his own personal taste.

Two of these brackets are made, exactly alike, and are held firmly to the panel by means of four No. 8/32 machine screws through each leg. The cross-pieces at the top and bottom are made of the same ⅜-inch angle brass and are fastened to the brackets by 6/32 machine screws. Care should be taken in drilling and tapping the holes for these screws, due allowance being made for the thickness of the brass stock when punching the centers prior to drilling.

This rigid frame-work supports the four sockets, the two transformers, the binding post strip and the plate impedance inductance coil. A single strip of ½ by 3/32-inch brass was cut long enough to accommodate the sockets when they are placed side by side. The sockets are mounted on this strip, which is then fastened to the frame with two 8/32-inch machine screws, one in each bracket, mounting the strip high enough to give sufficient clearance above the transformers. This is done to facilitate wiring to the transformers, and care should be taken not to place the sockets too high, otherwise the tips of the tubes, when placed in the sockets, will protrude from the top of the cabinet and pre-

vent the closing of the hinged cover. The two views of the rear of the amplifier show these points clearly. The transformers are mounted directly under the tubes into which they feed, with the secondary leads nearest the tube. In wiring the transformers, make sure that the outside lead of the secondary winding goes to the grid and that the outside of the primary winding goes to the plate of the preceding tube. These leads are the high potential side of their respective windings and have a lower capacity to ground than the inner leads. This capacity effect increases with the frequency, tending to distort high pitched notes, which deleterious effect is minimized by observing the above precaution.

Mount the transformers directly on the frame, at right angles to each other, using braces to give rigidity. This connects the cores to the frame work which will be later grounded to the negative side of the filament, which connection may be seen in the lower right-hand corner of the photograph of the general view of the rear of the amplifier. In mounting the condensers, no special means were taken, since they are so light that the bus bar wiring is sufficiently strong to support their weight. The disposal of these condensers may be seen from the photograph. The grid leak is mounted directly on the detector tube socket, using the spring clips taken from a standard grid leak mounting. As to the binding post strip, 1½ by 3/32-inch brass strip was bent into the shape seen and fastened with 8/32-inch machine screws to the bracket on each side. The rest of the apparatus layout followed the dimensions of the front of the $\frac{3}{16}$-inch panel, as given in Fig. 3.

It is advised that the outer ring of peep-holes be omitted. They were drilled in an endeavor to balance the panel by having the diameter of the net work equal to the diameter of the condenser dial, but it is believed that the panel will look better if the outside ring be left out. Drill the panel from the face side; to prevent chipping on that side, countersink the peep-holes slightly. All the brass parts of the amplifier were nickel-plated to produce a commercial appearance, but it is optional to go through this trouble, though it does give a business-like effect. It is advised that the connecting bars used to strap over to the tuner unit be nickel-plated, as it will considerably improve the general appearance of the set.

In operating the complete set, proceed to tune the receiver as usual, at the same time tuning the plate circuit of the radio frequency tube by means of the condenser. If oscillations commence, bring the potentiometer adjustment into play, which will throw the grid of the tube sufficiently positive to stop the oscillations. The dial of the condenser may be calibrated to read directly in wave lengths, or a chart made of the wave lengths corresponding to the different positions of the dial. When this is done the tuning is simplified considerably as the condenser is set for a particular wave and left there, the rest of the tuning operations being performed as though the radio frequency tube did not exist.

All the broadcasting stations in the vicinity of New York can be heard with sufficient volume on a loop, using the amplifier alone, and with a good outdoor aerial considerable long distance reception is possible, depending, of course, on the type of tuner used in conjunction with the amplifier.

A ONE-OUNCE TYPEWRITER

A typewriter weighing one ounce and fitting in a vest pocket has been built by Dr. H. E. Wetherell of Philadelphia. He devised it for his own use.

Held between the fingers and upon the paper, the machine writes by means of a wheel equipped with rubbing letters which special devices bring in contact with the paper.

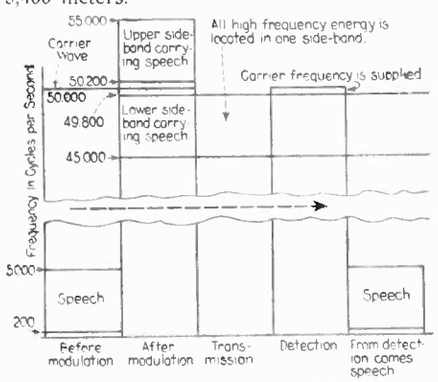
Talking Across the Atlantic

(*Continued from page* 1080)

The new system used in the trans-Atlantic tests is quite different. Since it is possible to build a receiving set such that it is unnecessary to transmit the carrier wave this can be entirely suppressed and is suppressed in the new system. The energy which would otherwise go to it is assigned to the side-bands thereby doubling their useful power.

This is not the only notable feature of the new circuit. When both side bands are transmitted our diagram shows that the ether is called upon to carry a band of frequencies 10,000 cycles wide, extending from 45,000 cycles to 55,000 cycles. Now the transmission of either side band alone is all that is necessary and as good results can be obtained by suppressing one side band and assigning its high frequency energy to the other. It is evident that by the suppression of one side band it becomes possible to transmit twice as many messages through the ether at one time as would otherwise be possible.

In the present tests this frequency is 55,500 and corresponds to a wave length of 5,400 meters.



Graphic chart showing how trans-Atlantic radiophone, transmitting wave energy, is confined to one side-band, as explained in the accompanying text.

The present system differs from the usual radio transmitting systems in another important respect. The usual type of transmitter sends out, in addition to the group of waves which does not comprise the message, two groups each of which does carry the message. In the new apparatus only one of these groups is radiated. This makes possible the sending of twice as many messages at the same time without interference. This feature is particularly important at long wave lengths where fewer messages can be carried simultaneously than at short wave lengths. The present system was perfected in connection with the so-called *carrier* telephone which is now in use in this country on certain long distance telephone lines.

Mr. Thayer and the others who spoke to England Sunday night used a telephone located in the offices of the American Telephone and Telegraph Company at 195 Broadway. This telephone instrument was connected to the radio equipment at Rocky Point by a telephone circuit about 70 miles long, half of it being underground cable and half open wire and connecting telephone repeaters and equalizers of a type similar to those used on long distance telephone lines. See picture diagram.

The distance from Rocky Point to New Southgate is about 3,400 miles. Prior to the tests of Sunday evening, other tests were made to measure the transparency of the atmosphere to radio messages over such great distances. Measurements were also made to determine the strength which the signals received in New Southgate must have in that station in order to be clearly heard above the noise of static and interference from other radio stations. For

the purpose of these tests large numbers of disconnected, single words were transmitted. The use of disconnected words constitutes an unusually severe trial of any telephone system. In ordinary conversation, the continuity supplied by the thought is a great aid to the understanding of each word. It is intended to continue these measurements over a sufficiently long period of time to supply the most reliable data.

The measurements thus far made serve to indicate that the transmission at night is better than during the day. The strength of signals received during the night may be hundreds and even thousands of times stronger than those received during the day. However, it has been found possible to transmit telephone messages satisfactorily during daylight, provided interference is not too great, and when sufficient power is employed.

Secrecy in Radio at Last

(*Continued from page* 1082)

an inch apart. Upon the periphery of each disc, are figures from 0 to 9, those on the extreme right hand disc signifying units, those next tens, next hundreds, and so on. The left hand disc corresponds to hundreds of thousands. The discs turn together upon their shaft, and their position in relation to each other may be changed at will. By means of a series of pawls, electrical circuits are closed, and the cylinder is controlled through a space of six seconds, whereupon the starting and stopping times of the cylinder are repeated.

The following explanation may seem rather complex, but upon careful study of the same, and referring to the accompanying photograph and diagrams, the reader will obtain a very good idea of how the apparatus works.

The unit of time is one second, and the unit through which the cylinder rotates, is 20/30, or 2/3 of a second. After the cylinder has revolved during its allotted space of time, 1/3 of a second is left to complete the unit of time. It is this lag that is made use of by the six revolving discs, which distribute this time throughout various parts of the six seconds which they control, thereby making the message undecipherable to anyone who has not a similar apparatus, and the key number.

For our illustration we will take the code or key number to be 687,943. This number is used in connection with the number 000000. The process gone through is now somewhat as follows. Subtracting 6 from 10 we have 4. Each second is divided into thirtieths, and from the above we have that the first *period of quiet* is 4/30 of a second long. This may be clearly seen from the diagram shown herewith, in which the heavy lines denote time of revolution. Now the cylinder revolves 20/30 of a second. Now we have 6/30 of a second left in the first second. This is again a *period of quiet.* In the next second the code number is 8, which subtracted from 10 leaves 2, or 2/30 of a second *quiet.* Again the cylinder rotates for 20/30 of a second, and the remaining part, or 8/30, is a *period of quiet.* So it goes for six seconds, the various time periods being distributed as shown in the diagram. At the end of six seconds, the process is repeated until the message is finished. Obviously, 999,999 combinations are possible.

A message received by a regular Belin machine not equipped with the Crypto, if it is transmitted with the use of the *anti-capturer,* would result in a series of irregularly spaced dots, which would have absolutely no meaning. The space between the revolutions may be changed, so that it

would be practically impossible for any operator to guess the code number, and therefore the system is very nearly perfect. The inventor however, has provided for even such emergencies, and by means of a separate disc and contact causes signals to be sent out during the time that the cylinder is stopped. These signals are separate and distinct from the transmission of the message, but to a listener-in would seem to be part of it.

Of course, it is obvious that the actual use of the Crypto must be limited, but under certain conditions its use would be invaluable. In war times, messages could be sent from the commander of an army to his subordinates without the least possible chance of interference or detection. Communication between banks could be carried on regarding stock matters without divulging their secrets. It is reported that a certain European nation has placed its order for the apparatus to be installed in its State Department and its Embassy in an important foreign capital.

This apparatus, which is the latest of M. Belin's inventions, has been greeted with acclaim by European scientists, and will no doubt, be received with the same welcome in this country.

Radio for the Beginner

By ARMSTRONG PERRY

(*Continued from page* 1083)

run the chance of their ruining a highly sensitive one that cost a lot of money and that might be put out of commission in the first scrap for its possession. The phone with the mica diaphragm has an arm attached to the diaphragm that may be broken off if the phone is even dropped to the table. The point of attachment is so critical that it is said that only an expert should attempt to make repairs.

With a receiving set that has amplification enough to bring in everything the operator wants to hear in good volume, the ordinary types of phones give satisfactory results and they are strong enough to stand up under any reasonable demands. With such a receiving set I have found it necessary to detune slightly, or reduce the amplification, in order to get satisfactory results with highly sensitive phones. A very strong current vibrates the mica diaphragm too powerfully and the result is a harsh, rasping sound instead of clear speech or music. But if the incoming currents are apt to be weak, the most sensitive phone in my outfit is none too good.

The materials used in the ear-piece are worth considering. The cap is usually of hard rubber, or something that resembles it. The rest of the case may be either metal or rubber. Metal will stand more banging but it may rust. A metal head band may rust also, if it is not covered. A leather covered head band may outwear a cloth covered one or, if subjected to heat, it may dry out and crack. Phone cords may be well or poorly made. If the tips are soldered on, the solder may have burned the insulation so that it will come loose where it joins the tip and look messy.

Some receiving sets are provided with jacks for the phones. In this case the phone cords should end in a plug that will fit the hole where the jack is. Other sets have binding posts of a type adapted to hold a wire but not a phone tip. In this case a connector and wires are used. Connectors are sometimes sold as a part of the phone equipment and sometimes they must be ordered separately. If there are clips on the ends of the phone cords they may be able to get a hold on a binding post but cannot conveniently be applied to a jack.

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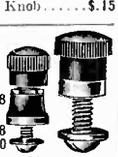

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3, 3/16"x3/16", 4-36 thread, doz... .35
4, ¾" dia., ⅛" thick; shank 6/32" doz. ..... .40
5, ¼" dia., 3/16" thick; shank 4-36, doz. .40
6, 3/16" dia., 3/16" thick; shank 4-36, doz. .40
7, 3/16" dia., ⅛" thick; shank 4-36, doz. .40
75, Switch Stop ⅞" long, 4-36 thread, complete with nut, each ..... .04
76, New style Switch Point, to be pressed into bakelite panels with forced fit. Wire is soldered to pin end. Head ¼" dia., 1/16" thick, doz. ..... .40
77, same as above, but head is ¾" dia. x 3/16" thick, doz. ..... .40

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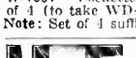
R-1551 Sockettes, nickeled, set of 4 (to take WD-11 Tube) ..... .25

Note: Set of 4 sufficient to hold 1 Tube.

VACUUM TUBE FUSES



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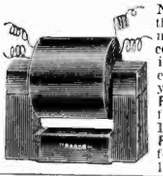
UNIVERSAL BEARING

THE bearing to hold variometer and variocoupler rotors. Total length of bearing 2¼". Outside shaft, 1¼". Length of thread 1". Length of threaded sleeve, ¾".

R-1375, Bearing .....$.25

AUDIO FREQUENCY TRANSFORMERS

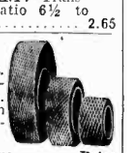


No better Transformer on the market. Highest class materials. Impregnated coils. Silicon steel stampings used. Save 50 per cent by assembling it yourself.

R-1100, A.F. Transformer, ratio 4¼ to 1 .....$2.65

R-1150, A.F. Transformer, ratio 6½ to 1 ..... 2.65

HONEYCOMB COILS



No better coils on the market. Too well known for lengthy description. Firm impregnation. Range given is in meters when varied with a .001 Variable Condenser:

No.	Turns	Range	Price
R-5000	25	120- 250	$ .40
R-5001	35	175- 450	.45
R-5002	50	240- 720	.50
R-5003	75	390- 910	.55
R-5004	100	500- 1450	.60
R-5005	150	600- 2000	.65
R-5006	200	900- 2500	.75
R-5007	250	1200- 3500	.80
R-5008	300	1500- 4500	.85
R-5009	400	2000- 5000	1.00
R-5010	500	2800- 6100	1.15
R-5011	600	4000-10000	1.30
R-5012	750	5000-12000	1.45
R-5013	1000	7900-15000	1.70
R-5014	1250	9750-19500	1.95
R-5015	1500	14500-26500	2.20

CORD TIP JACKS

Take the place of binding posts on instruments or panel. Cord tip firmly gripped by jack. Made of brass, highly nickel-plated and polished. Screw to attach lead wire. No soldering necessary.

R-1500, Cord Tip Jack, each.....$.15

CARDBOARD TUBING

Only seamless tubing made in United States. Perfectly seasoned. Heavy wall. (I.D.—Inside Diameter. O.D.—Outside Diameter. L.—Length).

R-6600, 3" I.D., 3¼" O.D. x 7" L. .....$.30
R-6601, 3½" I.D., 3¾" O.D. x 7" L..... .35
R-6602, 3¼" I.D., 3½" O.D. x 5" L..... .25
R-6603, 3¾" I.D., 4" O.D. x 5" L..... .27
R-6604, 4" I.D., 4¼" O.D. x 5" L..... .35
R-6605, 2¾" I.D. 3" O.D. x 2⅜" L..... .15

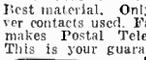
MICANITE TUBING

Especially suitable for CW work Nothing better made. Natural color.

R-250, Micanite Tubing, 4" dia., 6" long $1.20
R-251, Micanite Tubing, 6" dia., 6" long 1.60

JACKS AND PLUGS

Best material. Only pure silver contacts used. Factory that makes Postal Telegraph jacks makes these. This is your guarantee.



R-1000, Jack, 4-springs double circuit .....$ .75
R-1001, Jack, 3-springs .80
R-1002, Automatic 5-spring Jack..... 1.00
R-1003, Plug ..... .65

BUS BAR WIRE

This wire is square, measuring 1/16" by 1/16". Easy to solder as it is already tinned. Used on all up-to-date instruments. Sold in 2-foot lengths only.

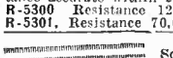
R-6400 Bus Bar Wire, per 2-foot length..$.05

NON-INDUCTIVE RESISTANCE

Made of special graphite copper-plated at the ends. Round rods 1¾" long, ¼" diameter. Resistance accurate within 20 per cent.

R-5300 Resistance 12,000 ohms.....$.65
R-5301, Resistance 70,000 ohms..... .65

BRASS RODS



Sold in 6" lengths only

R-8032, Brass Rod, 8/32" thread, per length .....$.08
R-6032, Brass Rod, 6/32" thread, per length ..... .06
R-1425, Brass Rod, plain ¼" round, per length ..... .10
R-3616 Brass Rod, plain 3/16" round, per length ..... .06

"RASCO" BABY DETECTOR

Base is solid black composition; mounted on same is nickel holder and binding post, which holds the fluted hard rubber knob with its sliding rod member. Patent nickel detector cup and binding post. Patent cup holds crystal.

R-1898, Baby Detector, with Galena .....$.50

"RASCO" LUBRICATED PANEL SWITCH

Our patent spring fork holds the switch handle always at a uniform tension. At the same time it insures best contact possible. New wiping contact covers every portion of the switch point. Double leaf blades used.

R-1921, "Rasco" Switch .....$.40

PANEL SWITCH LEVER

Impossible for this lever not to make positive contact. Leg radius 1¼". Nickel-plated and polished. Lock fork holds the screw (in which it rotates) securely. Loose contact impossible.

R-200, Switch Lever .....$.30

"RASCO" NAME PLATES

The circular plate is our new Binding Post Name Plate. Diameter, ¾". These denominations: PHONES, GROUND, —, OUTPUT, "A" BATTERY —, "B" BATTERY +, LOUD SPEAKER, GRID, LOAD, "C" BATTERY—AERIAL, +, INPUT, "A" BATTERY+ "B" BATTERY +, LOOP, TICKLER, PLATE, "C" BATTERY +, FILAMENT.

R-6000 to 6019, Binding Post Name Plates, each denomination .....$.03
Dozen ..... .30

Square Name Plates

Same denominations as above also these: SERIES 1st STEP, 2nd STEP, 3rd STEP, SECONDARY CONDENSER, TELEPHONE, SECONDARY, DETECTOR, TRANSMIT, GRID VARIOMETER, PARALLEL, COUPLING, PRIMARY, LOADING COIL, RECEIVE, ANTENNA, PLATE VARIOMTER, "BLANK", AUDION, ON, OFF.

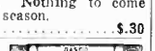
R-834 to 866, Square Name Plates, each..$.04
Dozen ..... .40
R-839 "INCREASE CURRENT" (Right)
R-840 "INCREASE CURRENT" (Left)
Each ..... .10

VERNIER

Cleverest vernier made. Can be used with any dial. Soft rubber ring engages dial. Does away with vernier condenser. We guarantee results. All metal parts moulded in best black composition. Nothing to come apart. Biggest hit of the season.

R-1450, Vernier .....$.30

"RASCO" CONDENSERS



R-5050, Phone Condensers, each.....$.20
R-5056, Grid Condensers, each..... .20
R-5059, Grid Leak Condensers, each ..... .30

COPPER FOIL

Thinnest copper foil made, .001" thick. Comes 4" wide.

R-5025, Coper Foil, per ft. $.10
10-ft. length ..... .80

RADIO CEMENT

Weather resisting. Used particularly for cementing covered wires. Coils covered with this cement require no form. Wires hold together solely with this cement.

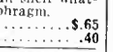
R-1750, Cement, 2-oz. bottle $.50

TELEPHONE SHELL AND CAP

For the experimenter we list this composition shell and cap. No holes in shell whatsoever. Takes standard 2⅛" diaphragm.

R-2700, Shell-and-Cap, complete .....$.65
R-2701, Shell only ..... .40

MICA DIAPHRAGMS



Made of special India mica in two sizes, 2⅛" diameter and 1-13/16" diameter. Excellent for experimentation in telephone work.

R-2550, Diaphragm, 2⅛" .....$.20
R-2551, Diaphragm, 1-13/16" ..... .15

RHEOSTAT WINDINGS

These windings, with the switch arm shown below, constitute a complete rheostat for the experimenter. Resistance wound on flexible black fibre. Carries 1½ amperes, resistance 6 ohms.

R-4300, Rheostat Resistance each .....$.20
R-4301, Potentiometer Resistance, each (200 ohms) .....$.35

BLADE WITH COLLAR

Fits above.

R-1675, each .....$.10

MAGNET WIRE

We list only best qualities. "DCC" means Double Cotton Covered. "GS" means Green Silk. "E" stands for Enameled. The following come on 8-ounce spools:

R-2500, DCC No. 18.....$ .50
R-2501, DCC No. 20..... .60
R-2502, DCC No. 22..... .75
R-2503, DCC No. 24..... .85
R-2504, DCC No. 26..... .95
R-2505, DCC No. 28..... 1.15
R-2506, DCC No. 30..... 1.65

The following come on 4-ounce spools:

R-2507, GS No. 20.....$ .50
R-2508, GS No. 22..... .55
R-2509, GS No. 24..... .60
R-2510, GS No. 26..... .65
R-2511, GS No. 30..... 1.05
R-2512, GS No. 32..... 1.30
R-2513 GS No. 36..... 1.85

The following come on 8-ounce spools:

R-2514, E No. 20.....$ .45
R-2515, E No. 22..... .55
R-2516, E No. 24..... .60
R-2517, E No. 26..... .65
R-2518, E No. 30..... .70
R-2519, E No. 32..... .80
R-2520, E No. 36..... 1.00

LITZ WIRE

R-323, equals No. 25 B&S, per foot .....$.02
R-890, equals No. 28 B&S, per foot ..... .01
R-891, equals No. 21 B&S, per foot ..... .03
R-892, equals No. 20 B&S per foot ..... .04
R-893, equals No. 11 B&S, per foot ..... .12

Discounts of 10 per cent in 100-foot lots.

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CONTAINS 75 VACUUM TUBE HOOK-UPS, 300 ILLUSTRATIONS

500 ARTICLES, 68 PAGES

All Armstrong Circuits: These important circuits are explained clearly, all values having been given leaving out nothing that could puzzle you.

Just to name a few of the Vacuum Tube circuits: The V.T. as a detector and one-step amplifier; Armstrong circuits; one-step radio frequency amplifier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; 4-stage radio frequency amplifiers; radio and audio frequency amplifier; inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; combination V.T. detector one stage amplifier; two stage radio frequency amplifier and detector with feedback coupling (regenerative); regenerative receiver, using single spider web coil; Armstrong super-regenerative circuit; two stage radio frequency amplifier coupled to a two-circuit tuner, using two-slide tuner regenerative receiver; two stage audio-frequency amplifier, using crystal or V.T.; one stage radio frequency detector, two stages audio-frequency with feed-back coupling to first tube; power amplifier with loud speaker; regenerative receiver and one stage amplifier for DX work; one stage radio frequency detector with feed-back coupling; three stages radio frequency, two stages audio-frequency loop reception; crystal detector with rectification; one tube super-regenerative receiver; short wave regenerative receiver with two variocouplers, capacity-coupled tuner; trap circuit to eliminate interference; selective circuit to eliminate interference. The catalog contains 300 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of

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Radio Specialty Co.

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Oldest and Original Exclusive Radio Parts House in U. S.

Factories: Brooklyn, N. Y. — Elkridge, Md.

DEALERS

Get Our Special Proposition

Fish Hang Up Young to Ripen

By DR. ERNEST BADE

(*Continued from page* 1055)

placed in a ditch prepared for them. Here they remain for a few days and then they are hung upon a plant by means of a thread which consists of a viscid liquid. In this position they must remain for about five days. Then the parent picks them off, and, under their tutelage, they make their first attempts in swimming.

The reason for the suspension of the young fish which are not, as yet, able to swim, is found in the fact that the young will receive plenty of clean, oxygenated water near the surface, where they can absorb the contents of the food still remaining in the egg sack. Only after this has been devoured are they enabled to swim. Then, under the care of the parents, they hunt the tiny water infusorians, nature's baby-fish food. Without suspension, the young, delicate creatures would soon be buried deeply under the dust-like muck which rises in dense clouds at the least agitation. This would then fill the respiratory organs and the creatures would suffocate.

Young fish with well ossified skeletons, the bony fish (*Teleostei*), are often provided with an adhesive cement organ situated just above the mouth. With its aid, the young, just-hatched fish, attach themselves to the surface of the waterplants, etc., where they then remain until the egg sack has vanished. The larval stages of *Protopterus, Lepidosiren*, etc., belonging to the sub-class lung-fish (*Dipnoi*), still possess outer gills and these are all provided with such cement organs and in this respect they closely resemble the tadpoles. This, undoubtedly, refers to the relation existing to these two groups of animals.

Even the electric fish of the group *Mormyridae*, peculiar individuals inhabiting the fresh waters of Africa, are exceptionally characteristic of this region and are provided with adhesive organs in their early stages.

The Sleep Eliminator

(*Continued from page* 1114)

simply moves a switch at his right, which disconnects the electrifying current. It is the same when he wishes to use the telephone. If he did not turn off the switch he probably would get a somewhat severe shock. He can, however, work at his desk to his heart's content, because the desk itself is supported by glass insulators, so it makes no difference if the desk is metal or wood.

In this illustration we also see an addition in the form of ozone generators. This is another suggestion, because it has been found that ozone is one of the most stimulating and exhilarating agents known, and if used in the right proportions will also greatly help to keep the workers from even thinking about sleep.

With methods such as these, if translated into practice, there is no probability that the subjects will experience any ill effects, and will not be worse off for having worked a week, or even a month, day in and day out.

Of course, any time during the day clothes and linen can be changed, and a shower taken, to refresh the body, just the same as we take it now.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the May issue must reach us not later than March 15.

The Circulation of Science and Invention is over 160,000 and climbing every month

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Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Fords run 34 miles on gallon gasoline. Other cars show proportionate saving. Wonderful new carburetor. Starts easy in coldest weather. Fits any car. Attach yourself. Money back guarantee. Sent on 30 days' trial. Agents wanted. Air Friction Carburetor Co., Dept. 3226, Dayton, Ohio.

Use Insyde Tyres in your old casings and get from 3 to 5 thousand miles more service. Positively prevent punctures and blowouts. Used over and over again. Low priced. Big money saver. Agents wanted. Write for terms. American Accessories Co., B-784, Cincinnati, Ohio.

300 per cent. Profit: Selling Kleanrite Magic Clothes Washing Compound. Sells, 25c; Profit, 18c. Sample free. Bestever Products Co., 1941-W Irving Park, Chicago.

Make $25 to $50 week representing Clows' Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clows Company, Desk 27, Philadelphia, Pa.

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Big money made silvering mirrors, plating and refinishing metalware, autos, chandeliers, headlights. Outfits furnished. N. Decie Laboratories, 1133 Broadway, New York.

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Agents Wanted in Every City to sell standard Radio apparatus on a liberal commission basis. A few stocking agencies open to reliable parties. Delfelco, 12 Meeting St., Pawtucket, R. I.

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Housewives Buy Harper's Invention on sight. New business. No Competition. Ten-Use Set is combination of ten indispensable household necessities. $7.50 to $30.00 a day easily. Write for Free trial offer. Harper Brush Works, 112 A Street, Fairfield, Iowa.

Agents. Our soap and toilet article plan is a wonder; get our free sample case offer. Ho-Ro-Co., 138 Locust, St. Louis.

Write and learn how to start profitable business without capital or experience. Silvering mirrors, refinishing auto headlights, tableware, plating. Outfit furnished. International Laboratories, Dept. 25, 309 Fifth Ave., New York.

Sell Wall Emblems. Every Lodge Member wants one. Big money—all or spare time. Free sample and cash bonus plan. Kier Emblem Co., Dept. S.I.3, 538 So. Clark, Chicago.

Agents Wanted (Continued)

Earn big money fast applying gold initials to autos. Every owner buys—$1.35 profit on $1.50 sale—particulars and samples free. Write quick. Lithogram Co., Dept. 19, East Orange, N. J.

Only one sale a day means $200 per month! Five sales, $1,000 per month! Marvelous new adding machine. Retails $15. Work equals $350 machine. Adds, subtracts, multiplies, divides automatically. Speedy, accurate, durable, handsome. Five-year guarantee. Offices, stores, factories, garages, buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial offer. Lightning Calculator Co., Dept. W., Grand Rapids, Mich.

Free, Formula Catalog. Laboratories, Boylston Bldg., Chicago.

Large Shirt Manufacturer wants Agents to sell complete line of shirts direct to wearer. Exclusive patterns. Big values. Free samples. Madison Mills, 503 Broadway, New York.

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Manufacturers on large scale, also homeworkers, wanted to manufacture Metal Toys and Novelties. Millions needed of Barking Dogs, Wag-Tail Pups, Wild Animals, Automobiles, Indians, Cow-Boys, Baseball Players, Cannons, Toy Soldiers, Crowing Roosters, Statues of Liberty, Miniature castings of Capital, Bathing Girl Souvenirs and others. Unlimited possibilities. Guaranteed Casting forms furnished manufacturers at cost price from $5.00 up, with complete outfit. No experience or tools necessary. Thousands made complete per hour. We buy goods all year and pay high prices for finished goods. Cash on Delivery. Contract orders placed with manufacturers. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1696 Boston Rd., New York.

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