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20 RADIO ARTICLES FOR THE BEGINNER

ELECTRIC WELDING UNDER WATER

See Page 15

HOWARD BROWN

FREE—$45.00 Radio Course Given Away—FREE

Get Ready For a Big Pay Job

Be an Electrical Expert

Earn $75 to $200 a Week

Men like you are needed right now to fill big-paying jobs in the electrical field. There never was a time when opportunities for money making were as good as they are now. Good jobs are open everywhere to men who know "what's what." Electrical Experts earn from $12 to $30 a day. Even the ordinary electricians get top-notch pay. Why don't you get in on this and get a real man's size job now? With my simplified Electrical Course I can quickly fit you to hold one. Read W. E. Pence's letter below. This is only one of thousands of such letters I have received.

You Can Be a Big Money Maker

I have trained over 20,000 men in electricity—thousands of successful men all over the world attribute their success to my training. I can make you successful, too. In fact I will guarantee your success. If you will follow my home study course you can become an expert, drawing a fat salary, in the same time it takes you to get a little raise in the work you are doing now.

Age or Lack of Education No Handicap

No matter how old or how young you are, or what education you have, there is a real future for you in electricity. If you can read and write I can put you on the road to success. I can help you to a position that will make people admire you and look up to you.

Cash In on Your Spare Time

Use your spare time to get a better job. Most of us have enough spare time every day to sell a little at about $10.00 an hour. Sell some to yourself at this price. Watch how quick you will earn the money back if you put the time into study.

Electrical Working Outfit Free

Every man who enrolls for my electrical course gets a big outfit of tools, material and instruments free. This includes an electric motor and other things not usually found in a beginner's outfit. These are the same tools and the same material you will use later in your work. Everything practical and good right from the start.

I Guarantee Your Complete Satisfaction

I am so sure I can make a big pay electrical expert out of you that I guarantee your success. I agree under bond to return every cent you pay me for tuition when you have finished the course, if you are not satisfied that it is the best investment you have ever made. If you don't make good, this million dollar institution will.

Act Right Now

Let me send you my big free book giving details of the opportunities electricity offers you and a sample lesson also free. Mail the coupon and get this at once. Learn how other men "got themselves ready to hold good paying jobs" and how I can help you do the same. This is your big chance—take it.

L. L. COOKE
Chief Engineer
Chicago Engineering Works
Dept. 25, 2144 Lawrence Ave.
Chicago, Ill.

Dear Sir: Send at once Sample Lessons, your Big Book, and full particulars of your Free Outfit and Home Study Course—all fully prepaid without obligation on my part.

Name.....

Address.....

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Jumps From $125 A Month to $750 and Over

READ the Story of W. E. Pence

W. E. Pence
in his working togs

Chehalis, Wash., Oct. 9, 1921

Mr Cooke:—

When I enrolled with you less than a year ago I was a common mechanic earning $25 to $30 a week. Today I am an "Electrical Expert" with a business of my own that gives me a clear profit of over $750 a month.

I have more work than I can do. The people around Chehalis come to me to fix their starters, generators and ignition troubles because they know that I know how to do it right.

My success, I owe to you, Mr. Cooke. The thorough practical training which you gave me through your Easily-learned Home Study Course in Electricity has made me an independent, highly respected business man in this community. *Sincerely yours, W. E. Pence.*

FREE TRIAL EASY TERMS

New! Not Rebuilt

Save Half
On This New Standard Typewriter

Send No Money!

We Ship You This Wonderful New Oliver Nine on Free Trial!

HERE IS OUR OFFER: The most startling offer ever made by any typewriter manufacturer. SEND NO MONEY — not a single penny down. Just mail us the coupon.

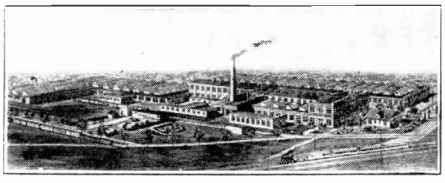
We will ship you absolutely FREE, on 5-DAY TRIAL, a brand new OLIVER NINE typewriter, direct from the factory to your home or office.

SAVE HALF OR MORE

You TRY IT! If you are thoroughly convinced that it is the best typewriter *at any price* that you ever tried, you then pay us a small amount a month—only a few cents a day—and this wonderful typewriter is yours at about half the cost of any other standard typewriter.

The OLIVER NINE is offered to you *today* at an amazingly low price. A few years ago the Oliver sold for $100, or more, like any other standard machine. We had the same cumbersome, expensive methods of selling through branch offices, agents, salesmen. Then we learned this new day way of selling direct by mail.

Today you get an *improved* OLIVER NINE, with many 1922 refinements and improvements—a finer typewriter than we formerly sold for $100—and you get it at this astonishing new low price—lower than the price of a rebuilt typewriter.



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950,000 SOLD

Don't make any mistake. This is *not* a rebuilt or second-hand typewriter, but a spick-and-span new OLIVER NINE, 1922 model, shipped to you direct from the factory.

This is the identical OLIVER used by foremost business concerns like the N. Y. Central Lines, the U. S. Steel Corp., New York Edison Co., Hart Schaffner & Marx, Morris & Co., and others of like character. It is the *finest typewriter* made *at any price*.

You are to be the sole judge of its merits. We will send it to you on FREE 5-DAY TRIAL without your sending us a cent. Then—when you have convinced yourself of its merits, its superiority—you pay a little each month at the present low price.

We might tell you volumes about the merits of the OLIVER NINE, its ease of operation, how durable it is, how economical, how noiseless. But we prefer that you learn these facts for yourself by actual test.

OVER A YEAR TO PAY

All we ask you to do is to fill out and mail the COUPON. We will then send you our complete FREE TRIAL OFFER, a beautifully illustrated catalog and a startling revelation entitled "The High Cost of Typewriters—The Reason and the Remedy."

MAIL THE COUPON

You can't afford to overlook this opportunity. A typewriter is today a *necessity*. An economy, as well as a convenience, to everyone. Mail the COUPON NOW, before you forget it. Learn how you can *save half* on a standard OLIVER typewriter — new from the factory.

FREE TRIAL OFFER

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

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675 Oliver Typewriter Bldg., Chicago, Ill.

Please send me without the slightest obligation on my part your special free trial offer, illustrated art catalog and the booklet "The High Cost of Typewriters—The Reason and the Remedy."

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Vol. X
Whole No. 109

Science and Invention

FORMERLY

ELECTRICAL EXPERIMENTER

233 FULTON STREET-NEW YORK

May, 1922
No. 1

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 and 236 Fulton Street, New York
Publishers of SCIENCE AND INVENTION, RADIO NEWS, and PRACTICAL ELECTRICS

Table of Contents for May

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

All communications and contributions to this journal should be addrest to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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ELECTRICAL EXPERIMENTERS!!

SKINDERVIKEN TRANSMITTER BUTTON

MOST SENSITIVE MICROPHONE

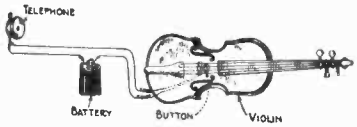
AS A PREMIUM

YOU can easily make a highly sensitive detectophone by using a Skinderviken Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. *This outfit was used by secret service operatives during the War. It is being used on the stage.*

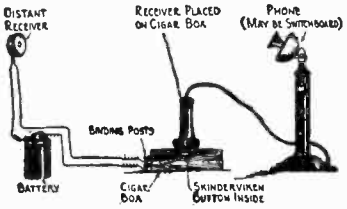
So much for its commercial adaptations! *You* can procure apparatus of the same type.


Actual size



One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position you like. It is the greatest invention in micro-phones and has won recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons cannot be seen by any one in the room as they are so small and light. Only a small brass nut is exposed to the view.

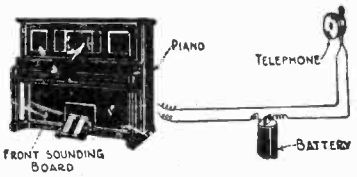
The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.



MR. H. Gernsback, editor of this magazine, who is the dean of electrical experimenters, said: "In the writer's opinion, obtained by actual elaborate tests, the Skinderviken Transmitter Button is probably the most efficient device of its kind on market today, due to its simplicity and other outstanding features. Should have a great future."

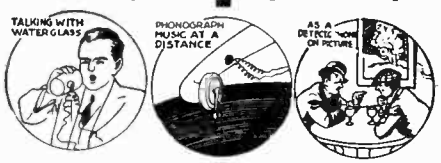
The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.



We have acquired a limited amount of these Transmitter Buttons and offer same free to our subscribers as a Premium, with a one year subscription to SCIENCE AND INVENTION. These Buttons sell everywhere for $1.00 and are worth it. We send you one prepaid upon receipt of the coupon below and the subscription price of our magazine. Do it today.

—o—



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Good Chemists Command High Salaries

DR. T. O'CONOR SLOANE, A.B., A.M., LL.D., Ph.D.
Noted Instructor, Lecturer and Author. Formerly Treasurer American Chemical Society and a practical chemist with many well known achievements to his credit. Not only has Dr. Sloane taught chemistry in the class-room but he was for many years engaged in commercial chemistry work.

Industrial firms of all kinds pay tempting salaries to get the right men. Salaries of $10,000 to $12,000 a year are not unusual for chemists of exceptional abilities. Chemistry offers those who are ambitious and willing to apply themselves conscientiously the greatest opportunities of any vocation. Why be satisfied with small pay and hard, thankless work—learn the profession of Chemistry and your salary will depend only upon your own efforts and your own abilities.

The work of the chemist is extremely interesting. If you are fond of experimenting, if you like exciting and intensely interesting work, take up Chemistry. To the man who is dissatisfied with his present job, to the young man just deciding on his life work, Chemistry holds alluring charms, and countless opportunities. If you want to earn more money, the way is open through our course in Chemistry.

Now Is The Time To Study Chemistry

Never before has the world seen such splendid opportunities for chemists as exist today. The war has awakened the United States to the need of trained chemists and chemical engineers. Everywhere the demand has sprung up. In factories, mills, laboratories, electrical shops, industrial plants of all kinds, chemistry plays a vital part in the continuation and expansion of the business. In every branch of human endeavor the need for chemists has arisen. No profession offers such alluring opportunities and the next ten years are going to show the greatest development in this science that this country has ever seen. Those who have the foresight and ambition to learn chemistry now will have the added advantages and greater opportunities afforded while the chemical field is growing and expanding.

What Well-Known Authorities Say About Our Course

From Hudson Maxim,

"Dr. Sloane has done a much-needed work in a much better way than anything of the kind has, heretofore, been done.

"Dr. Sloane has a remarkable faculty of presenting Science for self-instruction of the student in such a clear and understandable way as to be most readily grasped and assimilated.

"I, therefore, unreservedly recommend and place my highest indorsement on his work."

From Dr. W. W. de Kerlor,

"I can not recommend your course too highly and I congratulate both you and Dr. Sloane on same."

From John A. Tennant,

"This is something which has long been needed. Your long experience in the teaching of chemistry . . . assurance that the course will be practical as well as plain to the untrained students."

What the Students Say:

"Your course has been worth $50,000 to my concern."

"This is just like reading some fascinating fiction story."

"I have just been made Assistant Chemist of my concern."

"Your course is just what a person wants to start in the wonderful science of Chemistry."

"I find that your course is very interesting. I wait patiently for the next lesson."

"I find the study of chemistry more and more interesting at every lesson and you may be sure that I am getting into studying habit even more than I ever did even in my school days."

"I am well pleased with your course and I think, from the way it starts out, I have found a good teacher and school."

"Your course is sure wonderful, easy to understand, and so well laid out. I like it immensely."

"The lessons are fine and I like them."

"I have written to different people about your course and they speak very highly of same."

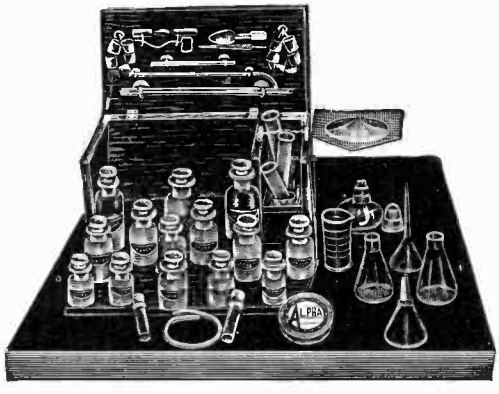
"If I don't learn it isn't your fault for I find that your lessons contain a whole lot."

(Names and addresses on request)

You Can Learn At Home

Dr. Sloane will teach you Chemistry in a practical and intensely interesting way. Our home study course written by Dr. Sloane himself is practical, logical and remarkably simple. It is illustrated by so many experiments that are performed right from the start that anyone, no matter how little education he may have, can thoroughly understand every lesson. Dr. Sloane teaches you in your own home with the same individual and painstaking care with which he has already taught thousands in the class room. And, Dr. Sloane personally examines and corrects all examination papers, pointing out your mistakes and correcting them for you. He will, in addition, give you any individual help you might need in your studies. This personal training will be of inestimable value to you in your future career.

Experimental Equipment Furnished to Every Student



We give to every student without additional charge, this chemical equipment including forty-two pieces of laboratory apparatus and supplies and eighteen different chemicals and reagents. The fitted heavy wooden box serves not only as a case for the outfit but also as a laboratory accessory for performing countless experiments. Full particulars about this special feature of our course are contained in our free book "Opportunities for Chemists."

Easy Monthly Payments

You don't have to have even the small price of the course to start. You can pay for it in small monthly amounts—so small that you won't feel them. The cost of our course is very low, and includes everything, even the chemistry outfit—there are no extras to buy with our course. Our plan of monthly payments places a chemical education within the reach of everyone. Write us and let us explain our plan in full—give us the opportunity of showing you how you can qualify for a highly trained technical position without even giving up your present employment.

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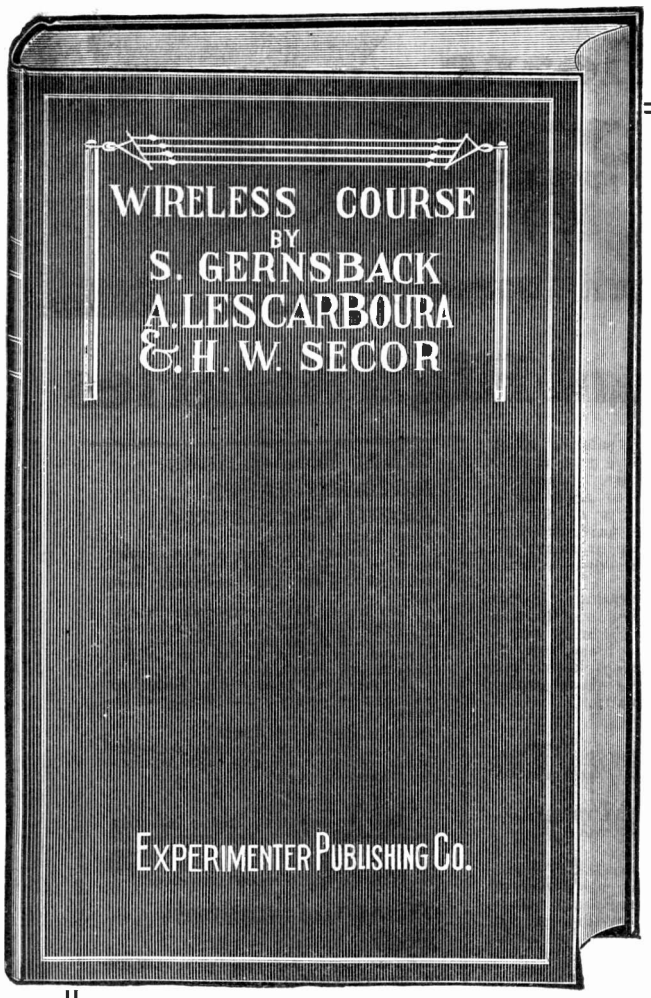

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in 20 Lessons

By

S. GERNSBACK, H. W. SECOR, A. LESCARBOURA

THIS Course has been considerably revised in order that it meet some of the many important changes which have occurred in Radio Telegraphy and Telephony within recent years. Much valuable data and illustrations concerning the Vacuum Tube has been added. This comprises the theory of the Tube as a detector and as an amplifier, and in addition has been included modern amplification circuits of practical worth. Incidentally, space has also been devoted to the development of the Radio Compass as operated and controlled by the United States Navy with its consequent great aid to present-day navigation.

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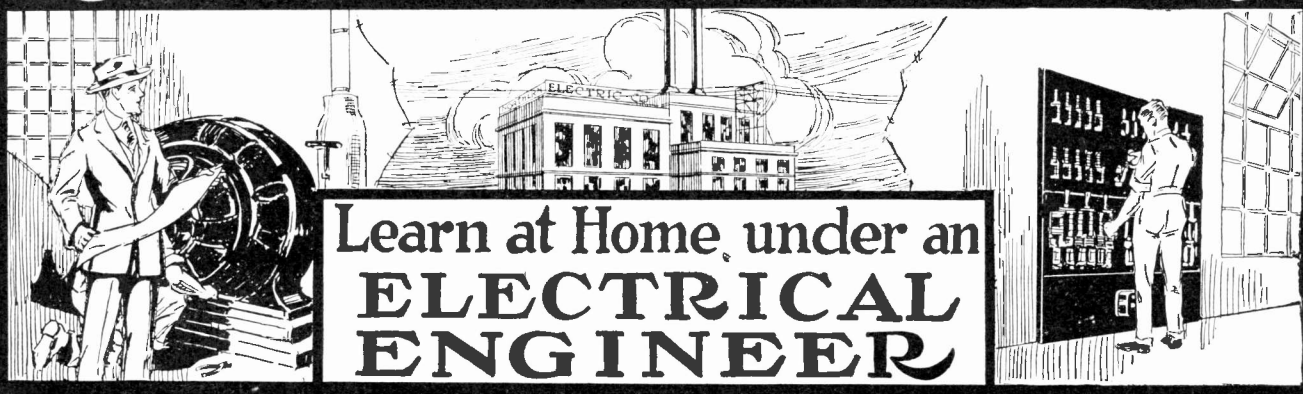

Learn at Home under an ELECTRICAL ENGINEER

Wicks Trained Men Make Big Money

A. W. WICKS
Elec. Engineer
Formerly with the General Electric Co. Former General Manager of company manufacturing Jenney Electric Motors, also formerly with Fairbanks, Morse & Co. Now Consulting Engineer, also Director, of the Wicks Electrical Institute.

Electricity, the greatest force in the world—offers you "Big Money" and "Quick Money" if you have the ambition to go and get it. Let me train you in electricity—at home—in your spare time—no matter where you live. I can quickly fit you to qualify as an expert electrician earning $2000.00 to $4000.00 a year. You don't have to go to school. You don't have to serve time as an apprentice. You start drawing the big pay as soon as you are qualified.

I am an authorized Electrical Engineer. So far as I know I am the only man with the degree Electrical Engineer to offer a Home Study Course in Electricity. My Electrical Engineering experience has covered a period of twenty-five years with some of the leading engineering and industrial corporations in this country. This wide and varied experience is the secret back of the success of my students.

Qualify to Fill One of These Big Paying Positions

Chief Electrician
$300 per month and up
Sub-Station Operator
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Electrical Contractor
Unlimited
Maintenance Electrician
$250 per month and up
Power Plant Supt.
$200 to $1000 per month
Electrical Wireman
$150 to $200 per month
Meter Tester
$150 to $200 per month
Electrical Sales Engineer
Unlimited
Supt. Elec. Installation
$250 to $500 per month
Traveling Elec. Inspector
$200 per month and up

New Easy Method

My new easy method knocks out all the unnecessary frills and gives you **real, practical electricity** — the money-making facts that you can cash in on. I teach **both why and how** through practical problems—the kind of problems you will meet later in your everyday work.

Why Wicks Trained Men Are Successful

Wicks trained men succeed where other men fail because they are trained thoroughly from the ground up. They have been trained under an Electrical Engineer. They have the knowledge gained of 25 years of experience behind them. Wicks trained men can't go wrong—they know only one way to do things—the right way.

FREE Electrical Outfit and Tools

Big outfit containing material, apparatus and tools FREE. I know the value of the right kind of tools, so I want my students to start out with the very tools they will need on the job. This outfit contains everything—there are no extras for you to buy.

Great Opportunities In the Electrical Industry

Just stop and think what electricity means to us in our everyday life and you will realize why there is such a big demand for electrically trained men. The whole world depends on the electrician. Electric Light Companies, Municipalities, Manufacturers and Contractors are paying bigger wages than ever and still need more men to fill big jobs.

A. W. Wicks, E. E., Pres., WICKS ELECTRICAL INSTITUTE
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Without any obligation send me

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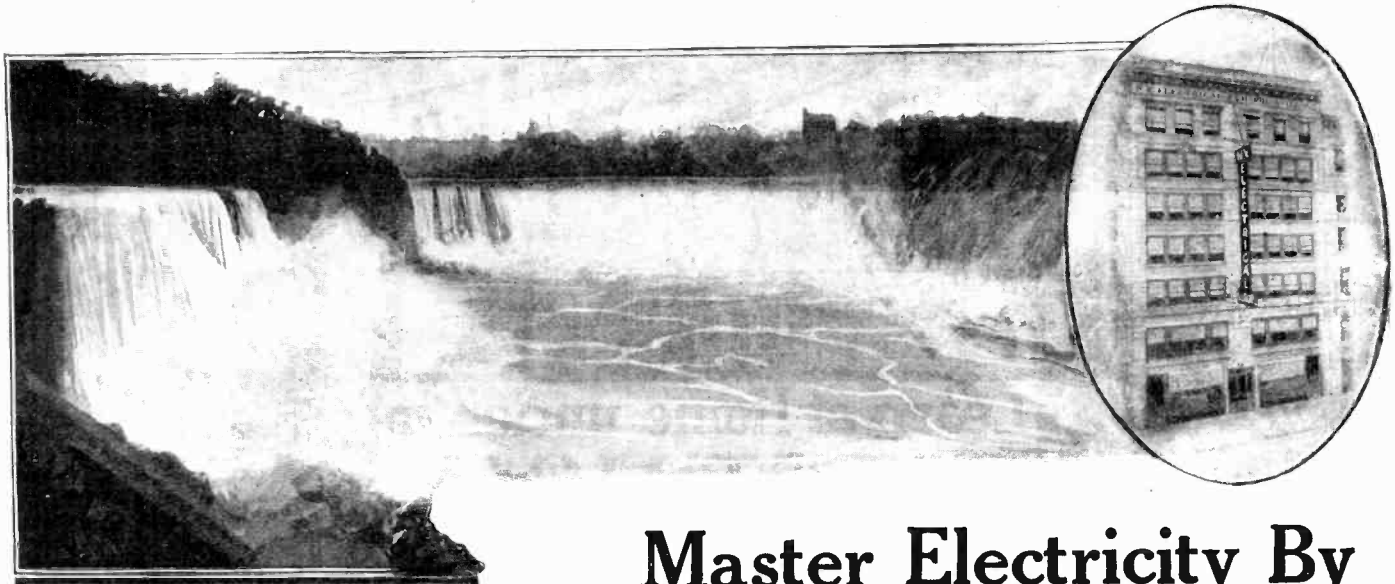

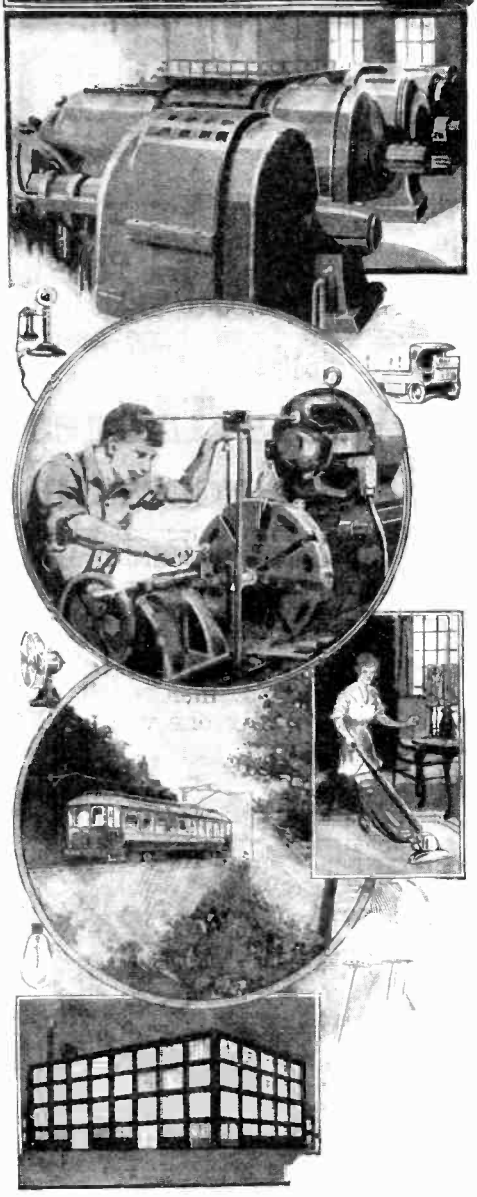

Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing.* That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

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At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business methods and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

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No previous knowledge of electricity, mechanics or mathematics is necessary to take this electrical course. You can begin the course now and by steady application prepare yourself in a short time. You will be taught by practical electrical experts with actual apparatus, under actual conditions.

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Volume X
Whole No. 109

Science and Invention

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

MAY
1922
No. 1

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

Worlds Within Worlds

EVERY once in a while, we get a communication similar to the following one from our readers. Since there seems to be so much interest in that subject, we have selected one of them which is typical. The writer in this case is Mr. Stanley Covington of Lynchburg, Va. He says:

"Some twelve years ago when I was studying chemistry and physics in High School I was taught that the atom was the ultimate particle and that a molecule of matter was composed of a number of positively and negatively charged atoms held together by electrostatic attraction in some form of symmetrical arrangement and that the number and arrangement of these atoms determined the nature of the molecule and the arrangement of these molecules determined the nature of the substance, each kind of matter having a special arrangement peculiar to itself. If I am not mistaken the atoms are said to move in regular orbits just as do the heavenly bodies. Now let us stop looking thru the large end of the telescope making things small, and, reversing it, look thru the other way. The atoms move in orbits and follow a symmetrical arrangement just as do the Earth, Moon, Mars and other planets. *Then why may not the planets and stars of our whole universe be atoms in a molecule of matter in another gigantic universe?* If this theory were proven true of what value would it be to science? Could we assume that the lesser atoms were sometimes inhabited by living beings and that the molecules on these atoms consisted of other universes and so on *ad infinitum?* If our earth were an atom in a piece of iron in the greater universe and were put into a gigantic furnace and melted, would the heat be sufficient to affect the temperature of the earth? Can any scientist today state definitely whether the relative distance between atoms, as we know them, in a molecule, is as great according to their size, as distances between the planets? If my theory be true would our knowledge of astronomy give us an insight into molecular structure and action, or are their laws totally different? Would the arc of Einstein's curved ray of light produced to form a circle have any relation to the size of the great molecule formed of our universe or would the center of molecular attraction tend to bend the light rays?

"But—say! Throw me a life preserver! I'm way beyond my depth. Thank you! And now that I am out of danger, I would like to hear a real scientist's views on this subject.

"What a great universe is ours! And God permits us to play with it."

This theory is as old as the atomic theory itself. It is a theory that has cropped up frequently during the last hundred years. Like many theories, no one has as yet been able to prove or disprove it.

It is quite natural to assume that our universe is but another atomic structure, exactly as are those atomic structures which are revealed to us by the microscope and other means known to the physicist.

Many scientists hold the view of Mr. Covington and so far there is nothing to disprove the theory. If our whole universe is only an atom with its molecules, and its electrons, there certainly is no good reason to doubt that there may not be still other larger structures.

In other words, we do not know, and probably will never know where the infinitely small commences, and the infinitely large stops. Our sun may be nothing but an atom in our planetary system, while the planets themselves may be nothing but charged electrons whirling around the larger atom. This is, of course, only figuratively speaking, but the theory certainly looks plausible when we stop to figure that the cases are both very analogous.

Now let us assume for a moment that, as our correspondent puts it, our earth is an atom in a piece of iron in a super-atomic universe. If this iron were put into some gigantic furnace and then melted, would the heat be sufficient to affect the temperature of the earth? According to all physical laws, it would. We know, for instance, that if we heat a piece of iron, it heats uniformly all the way thru, and there is no reason to doubt that if our earth were in such a position, the heat would not penetrate to it quickly. The heat would, as a matter of fact, come to us at the rate of 186,000 miles per second, but here again we are confronted with the time element.

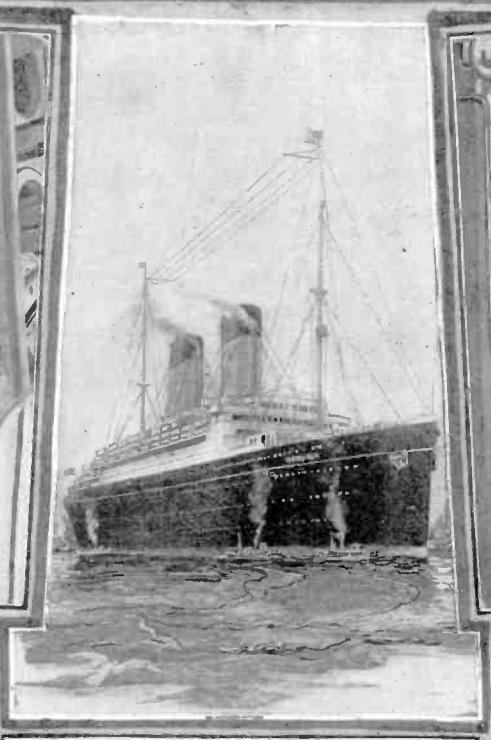
We can readily imagine a piece of iron as big as the earth. We know that it would take a considerable amount of heat and time to heat even such a small body as the earth to the melting point. We have no reason for not supposing that the imaginary piece of iron in which we are located is so tremendously large that using our time unit, it might take billions of years before the heat would reach us, simply because the imaginary piece of iron would, to our conception, be so infinitely great that it would measure millions or billions of light years across. The physical laws, however, would remain the same so that in due time the heat would reach us.

Modern science knows of no reason why our universe should be built on a different plan than are atomic structures. For instance, it has already been proven that the distances electrons, atoms, and molecules are separated from each other are roughly on the same scale as our universe. The atom in relation to the molecule is separated just as far, for example, as the planets are from the sun.

For this reason the curvature of light rays due to Einstein would hold true just as well in an atomic world as in our universe.

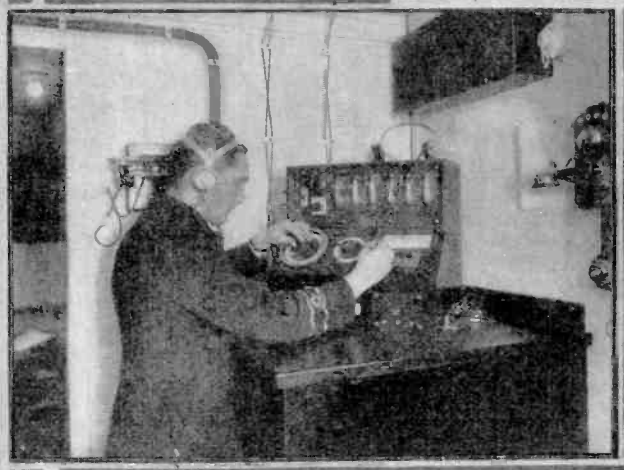
H. GERNSBACK.

A View of the Engine Room in the Palatial Ocean Liner "Homeric." Even Here the Machinery is Kept in Spic and Span Condition. One of the Mons er Piston Rods Is Here Shown, Compared to a Man.



The R. M. S. "Homeric" Turning Out to Sea. Note the Tugs Attending the Huge Vessel.

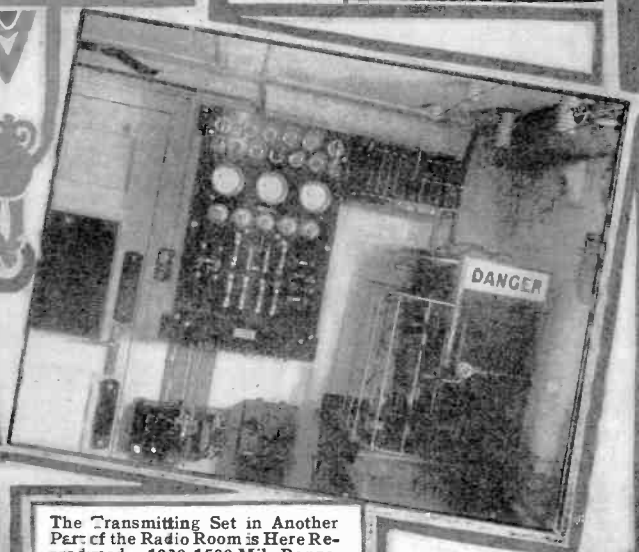
None of the Old Fashioned Methods of Cooking and Baking, With Perhaps the Exception of the Grill, are Found on the "Homeric." Here is the Baker Attending His Electric Oven.



The Radio Direction Finder Aboard This Vessel Can Locate the Transmitting Station Within One Half a Degree Accuracy.

The Receiving Set in Another Part of the Radio Room is Here Shown. The Apparatus in Back of the Operator is a Three Tube Transmitter.

A Section of the Ship's Bridge Showing the Dual Control System, Permitting the Pilot to Use Either of Two Wheels.



The Transmitting Set in Another Part of the Radio Room is Here Reproduced. 1000-1500 Mile Range.

Four Lower Photos by Staff Photographer.

Marvels of New Ocean Greyhound

ABOARD THE R. M. S. HOMERIC, MARCH 25, 1922, RADIO CABIN, OFFICERS' DECK

THIS is one of the finest vessels in the White Star Line trans-Atlantic service and incidentally the largest twin screw ocean liner afloat—her royal highness—the R. M. S. *Homeric*. This giantess of the seas measures 777 feet long, and has a displacement of 42,000 tons. The good ship *Homeric* is a veritable floating palace. Its breadth is 83 feet and the depth from bridge deck to keel 100 feet. Her engines are 28,000 horse power, giving a normal speed of 20 miles per hour. She carries 491 passengers in the first, 422 in the second and 1740 in the third class, and requires a crew of 750 men.

Let us take a rapid trip thru the vessel, and see the various points of interest. On the very top, we have what one might call a sun balcony. Here in the summer time passengers can sit and look at the broad expanse of ocean and the sky above. Perhaps a few gulls which accompany us on a trip across the ocean may be the principal points of interest for a few moments. Aside from that, there is "water, water everywhere." Nevertheless, there is not enough time to visit and accustom one's-self to a trip in the short five days' journey.

We glance around us first at the ponderous smoke stacks and ventilators; then as our gaze travels onward to the masts we see strung between the fore and aft masts one single wire divided by a large insulator at one end, and a duplicate at the other. Between the insulators is a stretch of wire three hundred and seventy-five feet long, while the distance between masts is almost six hundred feet. Near the front of the vessel, another peculiar arrangement where four wires, one running forward, the other sloping aft, and two directed to either side, claims our attention. These wires are the antennae for the ship's radio station. Here and there along the top deck are three-foot blowers which supply a forced draft for "in between" decks. A peculiar feature of these ventilators is that they are connected in such a manner as to create a draught or current of air thru specially constructed electrical ozone generators. It has been found that on rather glum days when the general spirit of the passengers is low, forcing ozone thruout the vessel not only buoys up their spirits, but has an effect similar to the passing of the three-mile limit upon the thirsty travelers.

From this deck we can pass directly into the radio room thru a narrow passageway. From this room, the ship communicates with the outside world. Here three officers are in constant attendance, listening for distress signals and transmitting messages which are telephoned in, directly from the first-class cabins, or from the room on the deck below, which is the General Radio Superintendent's room; the radio officers are kept extremely busy on their trips back and forth, they informed the writer, and never entertain any guests, nor are visitors permitted in this room unless by special privilege.

The photos of this radio room here shown were taken by the staff photographer for the exclusive use of SCIENCE AND INVENTION readers, who would like to know what the interior of this great leviathan's radio station looks like.

The transmitting set consists of a one and one-half K. W. transmitter, with which communication to land stations is possible during the entire voyage. A vacuum tube set is also in evidence which may be used if thought necessary or desirable.

For reception a long wave set is employed having only two vacuum tubes thereon. These tubes are of English construction and contain two grids, a filament and a plate. Referring again to the four aerials we find that they communicate with the direction finder located on the vessel. Here the vacuum tubes are not so sparingly employed as is evinced by the photo. From this room, we can pass to the gymnasium, but before doing so let us peep into the pilot's cabin.

Here three men are polishing up the brass which glistens as the waves cast the sun's reflection upon the brilliant metal. Two steering wheels, either of which may be used, if desired, are in evidence and signaling devices, two within the pilot's cabin itself, and eight on the officers' bridge, prevent possibility of a breakdown in the signaling systems. In this room meters and dials are found everywhere, all of which facilitate the easy and positive handling of this leviathan.

In "March-April" Practical Electrics

Telegraphic and Telephonic Transmission of Pictures. By Jacques Boyer, Paris Correspondent "Practical Electrics."

Antique Electric Motors. By T. O'Conor Sloane, Ph.D.

Electricity from Fruit and Vegetables. By H. Winfield Secor, Associate Member American Institute of Electrical Engineers.

Old and New Measurement of Light.

Induction Test for Locating Armature Troubles.

Artificial Lightning. Communicated by J. W. Hammond, General Electric Co.

Further communication to the engine room is established by speaking tubes and a dozen or more telephones of English type.

We next visit the gymnasium. This is more complete than many of the big shore gymnasiums. Here we find stationary bicycles upon which the youngsters can enjoy a friendly race. Each bicycle is fitted to a geared shaft which communicates with a pointer on a dial indicating the miles traveled. Special adjusting devices for increasing the friction upon a fly wheel, hence increasing the resistance upon the pedals, make the race equally beneficial for adult users. Electrical horses, massage machines, electric baths, violet ray treatment, and what not are found everywhere, besides the regulation heavy apparatus usually found in gymnasiums.

On the forward end of the deck under the navigating bridge is a drawing room. Next comes the reading and writing rooms, and then the lounge. Beyond this is a music room, and still further on, the smoking room. Finally the group is completed by the sun veranda. Looking down the sides of the rooms an unbroken vista of 340 feet is possible!

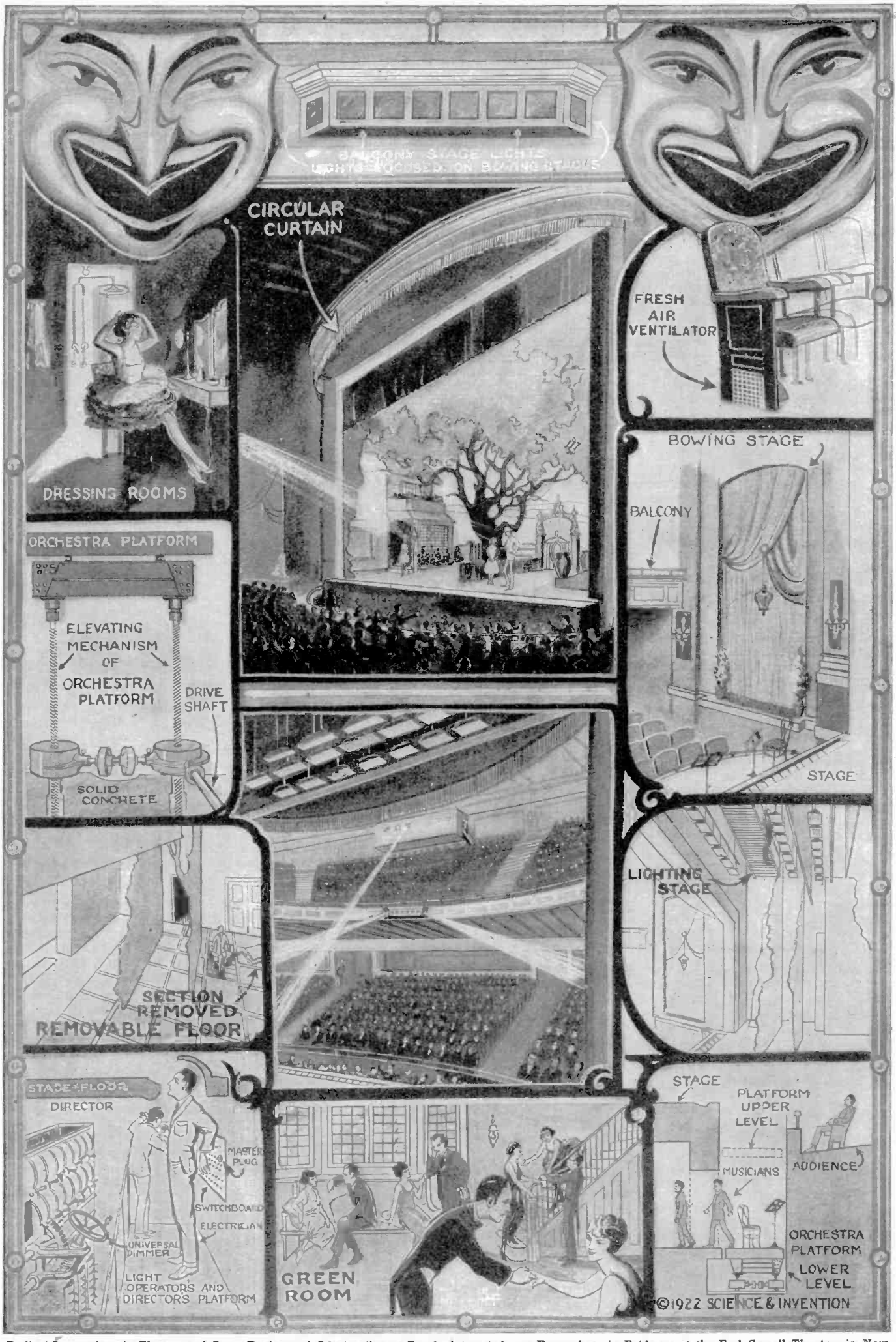
A word or two in reference to each of the public rooms before we proceed onward in our inspection of the *Homeric*, wonder of wonder ship building.

The lounge is forty-four feet long, and forty-seven feet wide, and its ceiling is twenty feet high. In the center is a great dome of amber glass, which floods the room with an indescribably soft, mellow light. On either side of the room, and extending along its entire length is a colonade of fluted pillars, with bases and capitals richly gilded. The windows in between are covered with harmoniously colored draperies. The carpet in the central part of the room is removable, uncovering a ball-room floor inlaid, in the design of stars in two kinds of walnut may be seen. Large canvases decorate the room, and palms as well as comfortable chairs and tables are occupied by the passengers. From this we can pass to the library, just forward of the lounge. Here cabinets along the forward wall are filled with books. At the sides in broad recesses, lighted by casement windows are double writing desks, of exceptionally generous proportions. An open fireplace is found at one end of the room. The color tone of the room is in ivory and olive green, with a touch of old rose in the carpet and hangings. Forward of the lounge lies the drawing room, where broad plate glass windows give a wide view ahead. The place is decorated to resemble a summer garden, and graceful chairs and settees in white enamel, surrounded by palms and ferns, give it a wondrous feeling of warmth and comfort. The smoking room has a ceiling carved out of wood with large wood carvings over the passageways. The room appears to be a club room, of the more exclusive style. Its marble fireplace, with open hearth, and exceptionally comfortable wing chairs, with tables for friendly games of cards, all make it a bachelors' attraction.

Beyond the smoking room is the glass-encased veranda, permitting a clear view astern. The music room is arranged in such a manner that one marvels at its luxurious appointments.

The next most commanding apartment on the *Homeric* is the dining saloon. This has a seating capacity of four hundred and sixty odd persons. In the center a great crystal dome hung from a ceiling of white and gold, reflects lights from hundreds of concealed bulbs. Three chefs carve the delicacies made by direction of the ship's steward, in full view of the passengers. Besides these various rooms, the ship has a dark room for the use of the amateur photographer, a typewriting room, a shop, a covered deck for sports, a playroom for children, steam and electric stoves, as well as open hearth fireplaces, and a daily newspaper, printed on board, which is served to everyone at the breakfast table in the morning. Concerts as well as impromptu programs are given; dancing, card games and other social affairs are indulged in and the five-day trip across the briny is all too short for any but the hardened traveler.

This mastodonic vessel, built by Germany, contains the ex-Kaiser's famous suite of rooms. Too bad that politics spoiled his chances of enjoying this richly furnished suite. The *Homeric* is characterized by its staterooms. In these, the old time berth has been completely done away with, and single or twin beds are found in both first and second class. Even in the third-class cabins where berths are still in evidence, the rooms house but two individuals, or a small family group. Most of the rooms are equipped with large tubs, hot and cold running water, and shower and sitz baths. Cupboards, writing tables and wardrobes are also found here, and lights over the individual beds add to the grace of the room, each of which is done in different colors.



Radical Innovations in Theatre and Stage Design and Construction so Rarely Attempted, are Everywhere in Evidence at the Earl Carroll Theatre, in New York City.

Wonders of Modern Theatres

By ERIC A. DIME

STAGE SCENERY OPERATED BY AUTOMATIC MACHINERY

AMONG the latest uses to which time, money and labor-saving machinery has been applied can be mentioned the theatre stage. The production and running of some shows cost a great deal, and naturally anything that will increase the net profits is welcome.

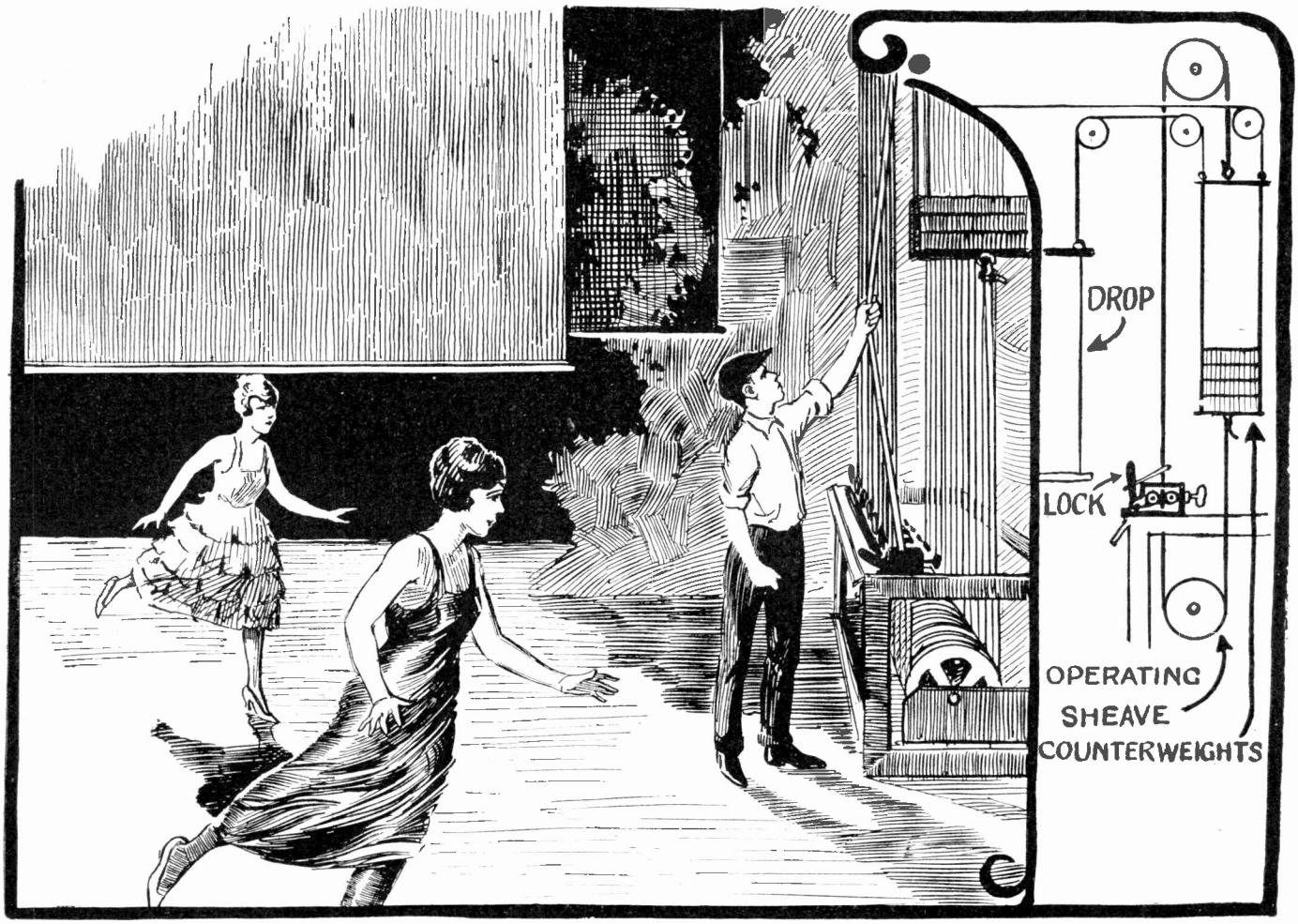
It is a well known fact that until recently the old methods of shifting scenery and raising and lowering curtains have been in use. Sometimes six or seven stage hands were necessary for the handling of these curtains and to lighten the load for the men, the curtains were counter-balanced by means of sand bags. These bags made the walls of the theatre back stage look like a balloon basket in flight or the window of a butcher shop cluttered up with a string of Virginia hams. The old methods also mean that all flat pieces must be carried forth and back on the stage and stacked against the walls when the scene is shifted. It has happened that on such occasions the stage hands collided with the players, and injury has been inflicted. The net result was a damage suit against the management of the show.

Now no more of these nuisances. Modern, economical as well as safe methods have supplanted the old system of handling scenery and drop curtains in theatres, and as an example reference can be made to the special mechanical apparatus installed in the new 49th Street Theatre, New York City. This theatre, which is the latest of six playhouses that are being erected by the Messrs. Shubert in Forty-eighth and Forty-ninth streets, is equipped with all the modern appliances which an up-to-date theatre should have.

The apparatus to which we have made reference makes it possible for one man to execute the lifting and lowering of the scenery. The machinery includes a series of counterweights; a wire cable runs from each weight straight up to a point near the ceiling, then over pulleys to points from which the scenery or curtains are suspended. The number of metal weights is regulated according to the weight of the curtains and scenes.

There is a set of lifts for each curtain, and in the 49th Street Theatre there are 25 sets all told. Placed along one side wall the sets occupy very little room and they are all operated by one man from the stage level. The apparatus is electrically operated. The man in charge simply presses a button and the scenery will either be lifted or lowered automatically as necessity dictates. In front of each set or near each button is a space for an index or guidance card which indicates to the operator the order and time for the lifting and lowering of the scenery.

While the presence of a few stage hands will be necessary in the "flies" to straighten out fouled "drops," the overhead employees will obviously be limited. Instead, they will be used on the stage level to assist in carrying properties on and off for the various scenes. In this way considerable time will be saved in running a performance, and the less time that is used the less the expense entailed. With the use of this new system one man can change the scenery for an act in two minutes, and the counterweight system is so well balanced that a curtain which may weigh several hundred pounds can be raised and lowered as if it were light as a feather. Under the old system such a curtain would be operated by means of pulleys, ropes and brute strength, and the work would require the services of three or four stage hands tugging at the ropes.

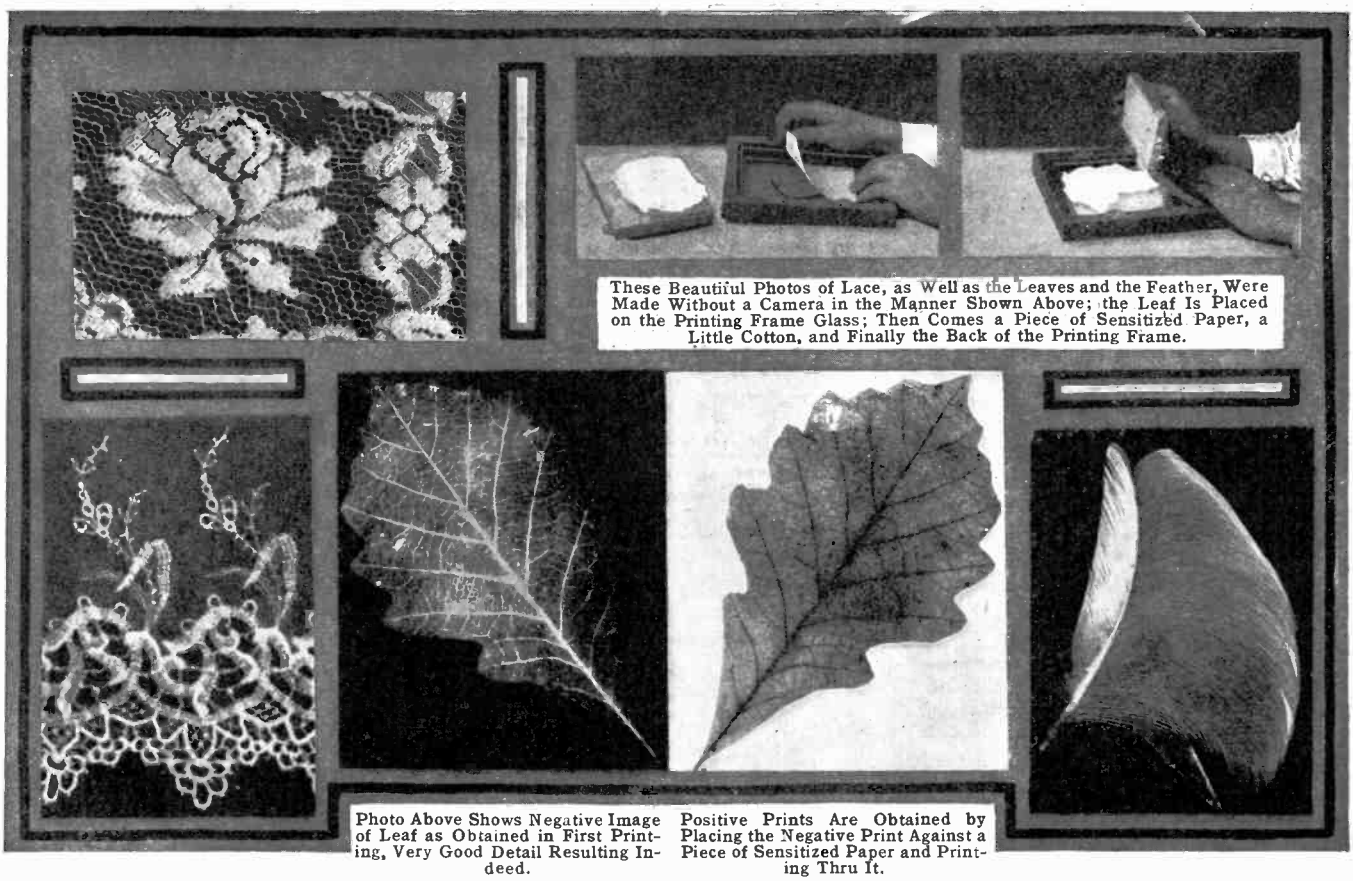


The New Counterweight System at the 49th Street Theatre, New York City, Permits of Rapidly Changing the Scenes, Which in Most Plays are Nearly all "Drops," by One Attendant, Who Exerts Practically no Effort in Raising or Lowering the Scenes. In this Manner the System Formerly Employed on Building Elevators Only Has Been Adapted to Stage Scene-Shifting Requirements.

NEW THEATRE A SCIENTIFIC MARVEL

Impressive theatres, as well as some marvelous structures appealing to the eye, have been built, but few have departed from the original design of theatre buildings. A theatre which challenges the above state-

(*Continued on page 73*)



These Beautiful Photos of Lace, as Well as the Leaves and the Feather, Were Made Without a Camera in the Manner Shown Above; the Leaf Is Placed on the Printing Frame Glass; Then Comes a Piece of Sensitized Paper, a Little Cotton, and Finally the Back of the Printing Frame.

Photo Above Shows Negative Image of Leaf as Obtained in First Printing, Very Good Detail Resulting Indeed.

Positive Prints Are Obtained by Placing the Negative Print Against a Piece of Sensitized Paper and Printing Thru It.

Photography Without a Camera

By DR. ERNEST BADE

THE common objects which interest us most are characterized by color. They hold our unconscious attention, while the beauty of form seems to be of secondary importance. Thus it is that the wonderful appearance of many objects of our daily association are never really consciously observed. Who has ever taken the trouble to examine the delicate fluff of a feather. Its structure is just as marvelous as its gorgeous color effect.

Here it is the color that catches the eye just as it is in the case of the leaf. It is the foliage of the common street trees which takes our eye, while the shape of the leaf is never seen. No painter or artist has ever brought out the beautiful form of the leaf as well as the arc-light does at night. From a considerable height is the light thrown downward thru the foliage of the street trees upon the sidewalk below, casting, in wonderful detail, their outline in shadow, and this is made possible by the small luminous focus of this light.

It is a very simple matter indeed to study the outline or "shadow picture" as it may be called, of familiar objects by a photographic method where special manipulations are not a necessity. All that is required is a piece of sensitized paper and a printing frame. The process is exactly similar to the method of printing a positive from a negative film. The objects suitable for such reproduction are leaves, wings from insects, textiles, laces, needlework, and in fact, anything which is at all transparent or translucent.

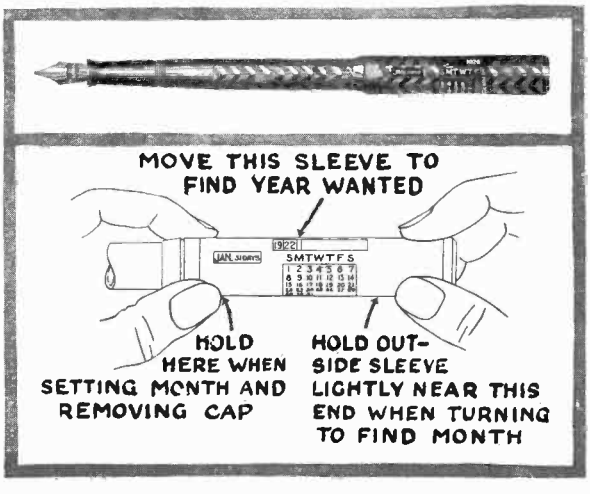
The most wonderful designs can thus be secured from the most insignificant source. Place the object to be printed upon the glass of the printing frame. Cover it with a piece of sensitized printing paper so that the shining side faces the object. Place a layer of cotton upon the paper which will press it firmly against the object. Then print, either in direct sunlight for about two minutes, according to the paper; or better still, in artificial light which takes a little longer, and develop as usual.

It is a comparatively simple matter to make positives from these prints. All that is necessary is to place the paper negative upon glass in a printing frame and cover with another piece of sensitized paper and expose as usual. This will take a little longer than with the original print, but no difficulty will be encountered in printing thru the paper.

Perpetual Calendar on Fountain Pen

DID you ever sit down to write a letter in a hotel room, a railway coach, or any other place, only to learn that you did not know the date of the month, and that there was no calendar near at hand?

But no more of such annoyances after this. A clever inventor has perfected a fountain pen, the cap of which contains a perpetual calendar, and with one of these pens in your pocket you need never worry over what date it is. Paul S. Hauton, of New York, is the man who invented this new perpetual pen calendar. The mechanism is both unique and simple. The outside sleeve of the fountain pen cap contains openings for the year, the names of the month and the dates of the month.



The right month is obtained by turning this sleeve until the name of the month shows in the slot. The right year is brought into position by moving an inside sleeve to the right or to the left, and this movement brings automatically all the dates of the month into their right position.

The pen shown in the accompanying diagram gives the years from 1918 to 1925, and with one of these pens handy a person can easily find out on what day in the week a certain date falls during the year. By a slight mathematical calculation it is also possible to find any dates in any year further back or ahead of the years printed on the calendar.—*Eric A. Dime.*

Electric Welding Under Water

By ROBERT G. SKERRETT

WHILE a match won't burn under water, nevertheless a diver can cut submerged metals with a fusing flame. Herein lies one more example of the seemingly impossible achieved by the inventive mind of the man of science. This accomplishment is not a mere laboratory spectacle but a thoroughly practical application of engineering cunning.

We are fairly familiar with the oxy-acetylene torch and with the many uses to which it is put in the open air in cutting iron and steel. The heat generated by the combustion of the commingling gases is in the neighborhood of 3,500 degrees Fahrenheit, if not somewhat higher, and this is sufficient to melt iron oxide and even most metals when exposed to that incandescent tongue of flame.

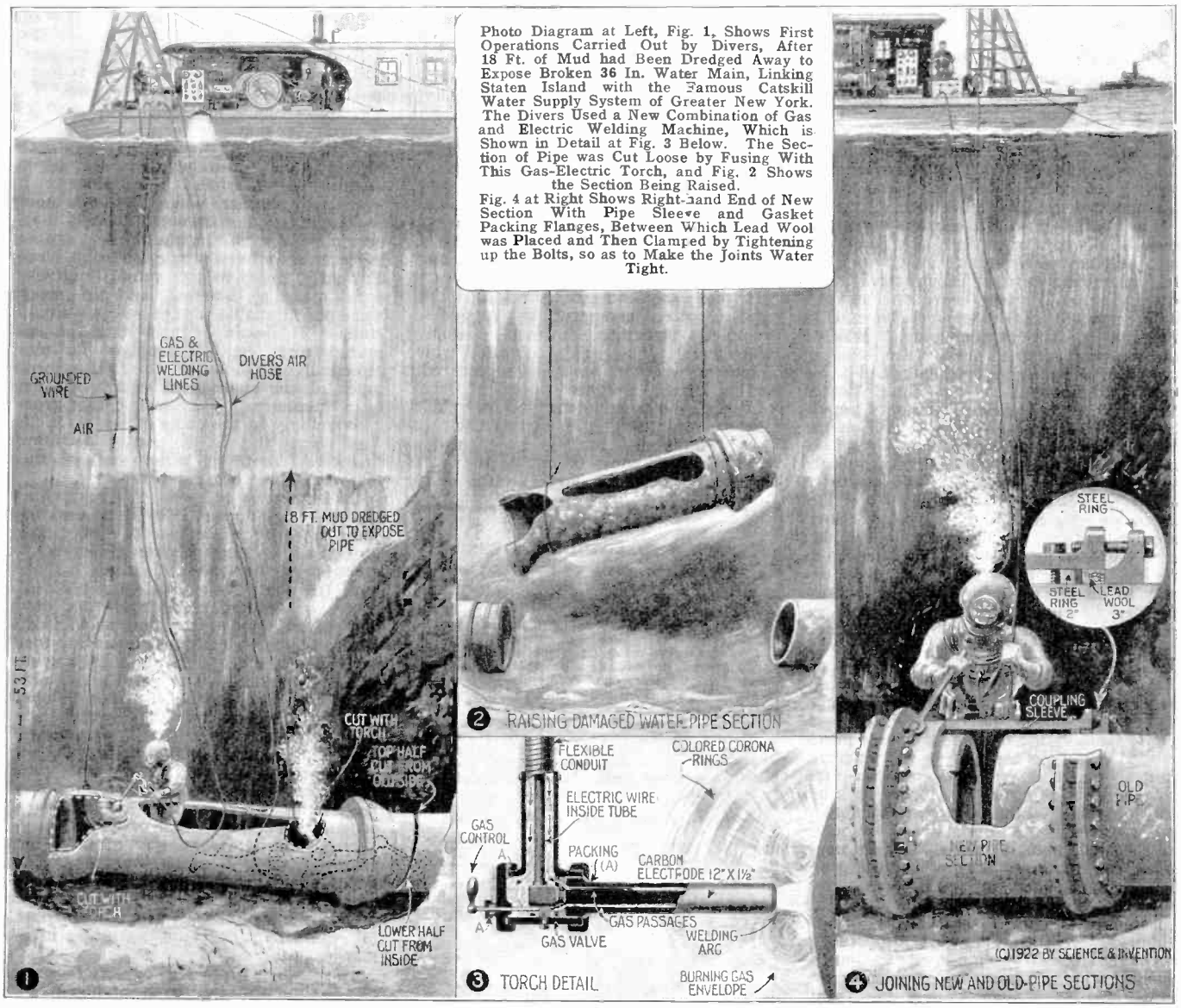
The oxy-acetylene torch has been instrumental often in saving time by speeding up repairs on ships, and the problems of the steel worker above water are frequently not unlike those of the diver occupied within or outside of a flooded or floating craft. Therefore, the latter operative would be much helped if he, too, could have at his command a kindred apparatus. This want ingenious Germans tried to meet about twelve years ago, and with a measure of success. Their torch burned fairly well under water at moderate depths of 15 or 20 feet; but at a greater submergence the oxy-acetylene gas became balky. The stuff back-fired—in short, exploded instead of burning as a flame. This is one of the peculiarities of acetylene when ignited at a pressure of 30 pounds or so.

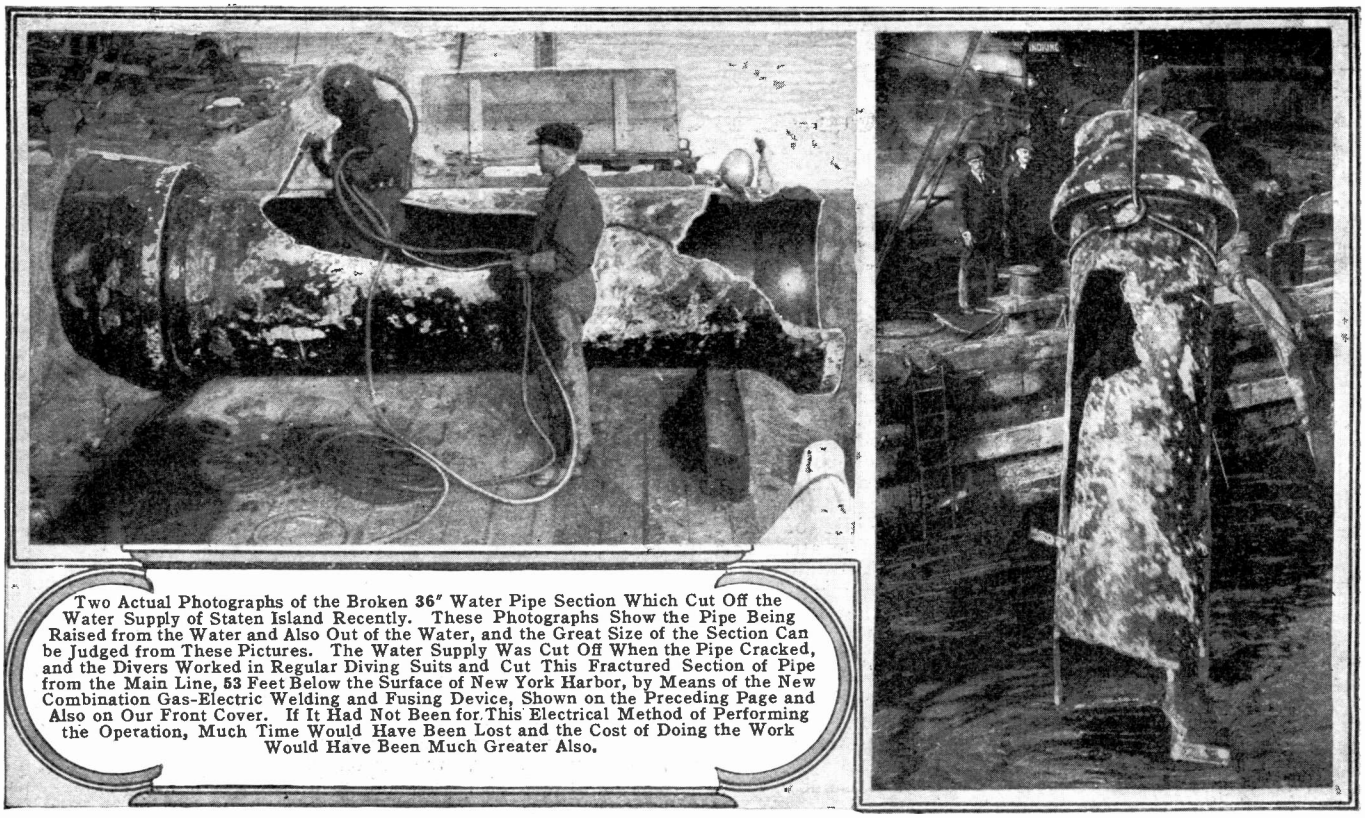
Four years back, two Americans tackled this subject from another angle, and Ralph E. Chapman and J. W. Kirk produced a subaqueous torch that combined the use of oxy-acetylene gas with the electric arc. This torch could be ignited under water. Herein lay a decided improvement, because the German torch had to be lighted in the open air before it was taken below the surface. If, by chance, the American torch was flooded and put out, unlike the Teuton apparatus, it could be relighted on the job by the diver. This first cutting tool was further improved and used effectively during the refloating of a big trans-Atlantic liner, then sunk in New York harbor; and with it holes were cut through a number of bulkheads, the deepest of these openings being about 50 feet down.

Within the last two years the torch has been still more modified and greatly bettered. The use of acetylene has been abandoned and the electric arc is now counted upon to do most of the cutting. A gas is still employed in combination with the electrode, but, strictly speaking, its main function is to blow the softened metal aside, altho it also helps in the actual cutting. In addition, the gas creates a vaporous atmosphere immediately about the arc, and pushes away the surrounding water so that the electrical flame can attack the metal.

Current at a low voltage (about 10 volts) is delivered to the electrode by a conductor carried inside of an armored hose, which also conveys the gas to the point of action. The torch, itself, is composed of a carbon electrode pierced transversely by a couple of little tubes which discharge the needful gas from the tip of the electrode. The instant the diver brings the carbon within a fraction of an inch of a metal surface an arc is induced, and this

Photo Diagram at Left, Fig. 1, Shows First Operations Carried Out by Divers, After 18 Ft. of Mud had Been Dredged Away to Expose Broken 36 In. Water Main, Linking Staten Island with the Famous Catskill Water Supply System of Greater New York. The Divers Used a New Combination of Gas and Electric Welding Machine, Which is Shown in Detail at Fig. 3 Below. The Section of Pipe was Cut Loose by Fusing With This Gas-Electric Torch, and Fig. 2 Shows the Section Being Raised.
Fig. 4 at Right Shows Right-hand End of New Section With Pipe Sleeve and Gasket Packing Flanges, Between Which Lead Wool was Placed and Then Clamped by Tightening up the Bolts, so as to Make the Joints Water Tight.





Two Actual Photographs of the Broken 36" Water Pipe Section Which Cut Off the Water Supply of Staten Island Recently. These Photographs Show the Pipe Being Raised from the Water and Also Out of the Water, and the Great Size of the Section Can be Judged from These Pictures. The Water Supply Was Cut Off When the Pipe Cracked, and the Divers Worked in Regular Diving Suits and Cut This Fractured Section of Pipe from the Main Line, 53 Feet Below the Surface of New York Harbor, by Means of the New Combination Gas-Electric Welding and Fusing Device, Shown on the Preceding Page and Also on Our Front Cover. If It Had Not Been for This Electrical Method of Performing the Operation, Much Time Would Have Been Lost and the Cost of Doing the Work Would Have Been Much Greater Also.

is maintained until the apparatus is withdrawn. The temperature of the arc is approximately 6,500 degrees Fahrenheit, and the operation of this fusing agent is in no wise influenced by the depth at which it is brought into play. Of course, the pressure of the gas is regulated to suit the depth of submergence so as to offset the hydrostatic pressure at the point of service. The gas employed burns freely and has no explosive tendency.

The under-water, gas-electric torch has proved its worth on several occasions during the past twelve months. It was helpful in cutting thru a heavy steel hatch cover, located 70 feet below the surface, in salvaging a sunken submarine; and in February of the present year it was of the greatest value in speeding up the removal of a damaged pipe length in a 36-inch subaqueous main that links Staten Island with the Catskill Water Supply System of Greater New York. Where the break occurred, the conduit lies 53 feet beneath the surface of the harbor and under a heavy blanket of mud. The desire of the engineers of the Municipal Water Department was to withdraw the fractured section, without displacing the adjoining pipe units, so as to insert a new length as rapidly as possible. There was only one way to do this; *i. e.*, by using submarine torches to release the injured pipe, together with a portion of an attached section.

The work involved an encircling cut having a linear length of about 11 feet, and required severing cast iron 1⅝ inches thick. The lower third of this cut was made from inside the pipe, and this necessitated enlarging the hole in the fractured unit so that a diver could enter the main to reach his objective. In order to break the joint at the other end of the length to be removed, the under-water workers were called upon to detach a large upper sector of the flared terminal at that point which overlapped the contiguous sound unit of the main. In doing this, the torches severed cast-iron walls 3½ inches thick as well as a reinforcing band of wrought iron 1½ inches thru and 4 inches wide. The task of cutting was completed in a span of ten days, while the water in the harbor was at its lowest winter temperature, and the torches performed without a hitch. Afterwards, no trouble was experienced in lifting out the detached pipe or in lowering a new section into position and securing it.

It is hard to say how much longer the repairs would have taken had a different course been pursued; but there is reason to believe that the torches saved weeks of time and enabled the thousands of dwellers on Staten Island to get their accustomed supply of water from the Catskill Mountains before the local reservoir was exhausted.

In these days of steel ships, their salvage is often hampered by ragged or crumpled structural material situated under water. This was a condition which vexed the wreckers who had to deal with the big British freighter "Lord Dufferin" in 1919. While at anchor in New York Harbor, the craft was rammed by the S. S. "Aquitania," and the liner substantially sliced off about 65 feet of the "Lord Dufferin's" stern. A large section of the freighter's plating was bent sharply and forced deep into the underlying mud; and the salvors had to cut this steel from the hull before the steamer could be refloated and towed to a dry-dock for repairs. The American submarine torch was used effectively on that job.

Again, in the refloating of steel craft, it is at times desirable to cause one inundated compartment to discharge its water into another, where a suction pump is located; in fact, several flooded chambers may be so interconnected and drained successively from a single accessible pump. Formerly, holes in intervening bulkheads were made by blasting, and the results were objectionable for the reasons already stated. It should be plain that the submarine torch can be employed far more effectually for jobs of this nature inasmuch as the consequent repairs are held to a minimum. This was demonstrated convincingly in the cases of the S. S. "St. Paul" and the U. S. Army Transport "America," both of which sank at their piers in New York Harbor.

On numerous occasions steel ships have had to be dry-docked in order to deal with some more or less moderate derangement or damage to their bottom structures or associate under-water features. Divers have frequently been frustrated by fouled cables or binding metal that they could not cut with the usual tools at their disposal; but now, that the submarine torch is available, much delay and dry-docking can be avoided. The torch has established its worth in this direction, particularly on one merchantman, by quickly cutting, here and there, thru a wire hawser that had become entangled between her propeller and the stern guard and which had balked the efforts of divers for days. By the aid of the torch, the steamer in question was able to sail on schedule.

In view of what has already been achieved, there is ample warrant for the belief that this gas-electric apparatus is going to be of great service to maritime wreckers and, likewise, prove of outstanding value to subaqueous engineers in numerous ways.

It is fully protected by letters patent and is thus protected from infringement.

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

No. 5 The Secret of Invisibility

(AUTHOR'S NOTE. The "invisible cloak" of the fairy tales is as old as the hills. Yet it is not impossible that science may some day find means of making men invisible. In fact, to a certain extent the thing has been done already. At Coney Island and in the circus side-shows there has been exhibited the "living head,"—a woman's head and bust being in plain sight, the rest of her body being invisible—concealed by mirrors. So perfect is the illusion that it takes a keen eye several minutes to detect the angle formed by the two mirrors used. It is but a step from this to a cloak of unbreakable glass mirrors, so constructed as to render the wearer invisible when viewed from any side, and yet allow him freedom to move from place to place. Of course *invisibility* must not be confused with *intangibility*.)

CONFOUND that flivver!" cried Silas Rockett. The reporter was off on his summer vacation, chugging along in an antiquated car, made somewhere around the year 1492, but so dilapidated that it was held together only by a few strings. One of these pieces of twine had just broken, bringing the car to a stop on the bank of a pretty little country lake.

Silas hunted around until he found an empty tin tomato can and some twine, and with the aid of these he soon managed to repair the damage to the car.

Scarcely had he completed the work when he was surprised to hear a loud splash in the middle of the lake, and looking intently in the direction of the sound, he was amazed to see emerge from the water an object that seemed for all the world like the bust of a young woman outlined with dripping spray. But, as he gazed, the form vanished, and naught was left but a moving furrow in the water, as if an invisible boat were passing through the liquid.

"That must be a tremendous fish, if fish it is!" exclaimed Silas, and he hastened toward the inlet of the lake, whither the monster seemed to be traveling. Hiding in the bushes there, he carefully watched the trail made by the animal in the water, but was astonished beyond measure to see that though the track was so plainly marked, the creature that made it was absolutely invisible.

The animal by this time had reached the shallow water of the inlet, and now arose out of the water, the spray dripping from the invisible body. And then, to add to the reporter's astonishment, a small footprint appeared in the mud, followed by another, and then Silas heard a light silvery laugh.

Now, the reporter was a brave man, and not prone to believe in the supernatural. He resolved therefore to solve this mystery at once, and accordingly sprang from his concealment and threw his arms courageously around the invisible body. A cry escaped from the creature and Silas felt himself struck and kicked, but he held on with grim determination and his hands meeting with a fold of some sort in the outer protecting armor of the animal, he wrenched hard at it with his hands and succeeded in pulling it apart. Instantly he heard a feminine shriek, and before his eyes appeared a wonderful vision of a beautiful young girl speeding away in confusion to the shelter of the woods, while the reporter found he held in his hands a most peculiar rubber cloak, covered on the outside with a number of small mirrors so cunningly arranged that the wearer of the cloak was completely invisible.

Now Silas Rockett was a modest man, and he began to regret the curiosity which had led to the confusion of the young mermaid.

"Come back, young lady, and get your cloak!" he cried. "I'll leave the coat here, and when you hear me chug away in my auto, you will know the coast is clear."

So saying, the discreet man started for the spot where his machine was waiting for him, but he had not gone half the distance when he heard shrieks of distress followed by a woman's cry for help.

With a bound he turned around and rushed into the woods just in time to see a stout young fellow chasing the girl. Silas's arrival was most opportune, for the villain had just succeeded in clutching the girl by the arm.

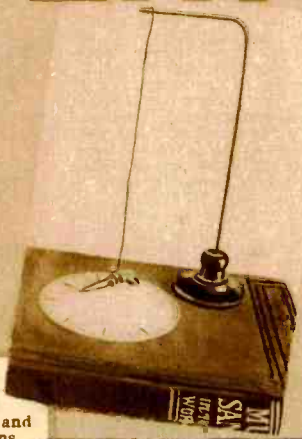
Silas was a muscular man, and with a blow of his fist he sent the fellow sprawling, then taking off his own chauffeur's duster, he threw it around the trembling girl.

(*Continued on page* 94)

"He Threw His Arms Courageously Around the Invisible Body. A Cry Escaped from the Creature and Silas Felt Himself Struck and Kicked.....Suddenly He Heard a Feminine Shriek, and Before His Eyes Appeared a Wonderful Vision of a Beautiful Young Girl....."

PARLOR SORCERY

Vinegar Bottle "Acrobat"—Stand Bottle on Head in Center of Handkerchief; Pull Quickly: Bottle Remains Standing.

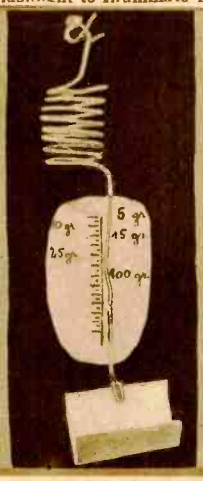


A Balance Act on the End of a Knife, With a Cup and a Fork Piercing a Piece of Cork in Handle.

Hygrometer Made from a Catgut Violin String and Piece of Iron. Wet and Dry Air Conditions Are Marked on the Scale.

The "Speaking Head"—Person Sits on Knees Behind a Chair Covered With Dark Cloth. Use Flashlight to Illuminate Face.

The Siren—Each Speed Gives a Different Note, Reinforced by Air Thru a Paper Horn.

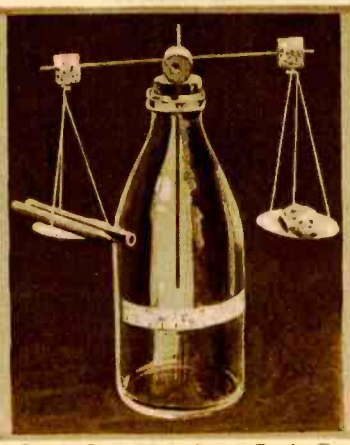


Burning the String, the Apple Will Fall Toward the Edge of the Knife and Cut Into Two Pieces.

Try to Brush a Coin from the Empty Hand. The First Hairs of the Brush Press it Down.

A Long Piece of Wire Is Twisted Around a Pencil, Forming a Spring; a Scale Can Be Made Thus.

Take a Paper Bag and Put Two Heavy Books Upon It; Blow Into Bag.

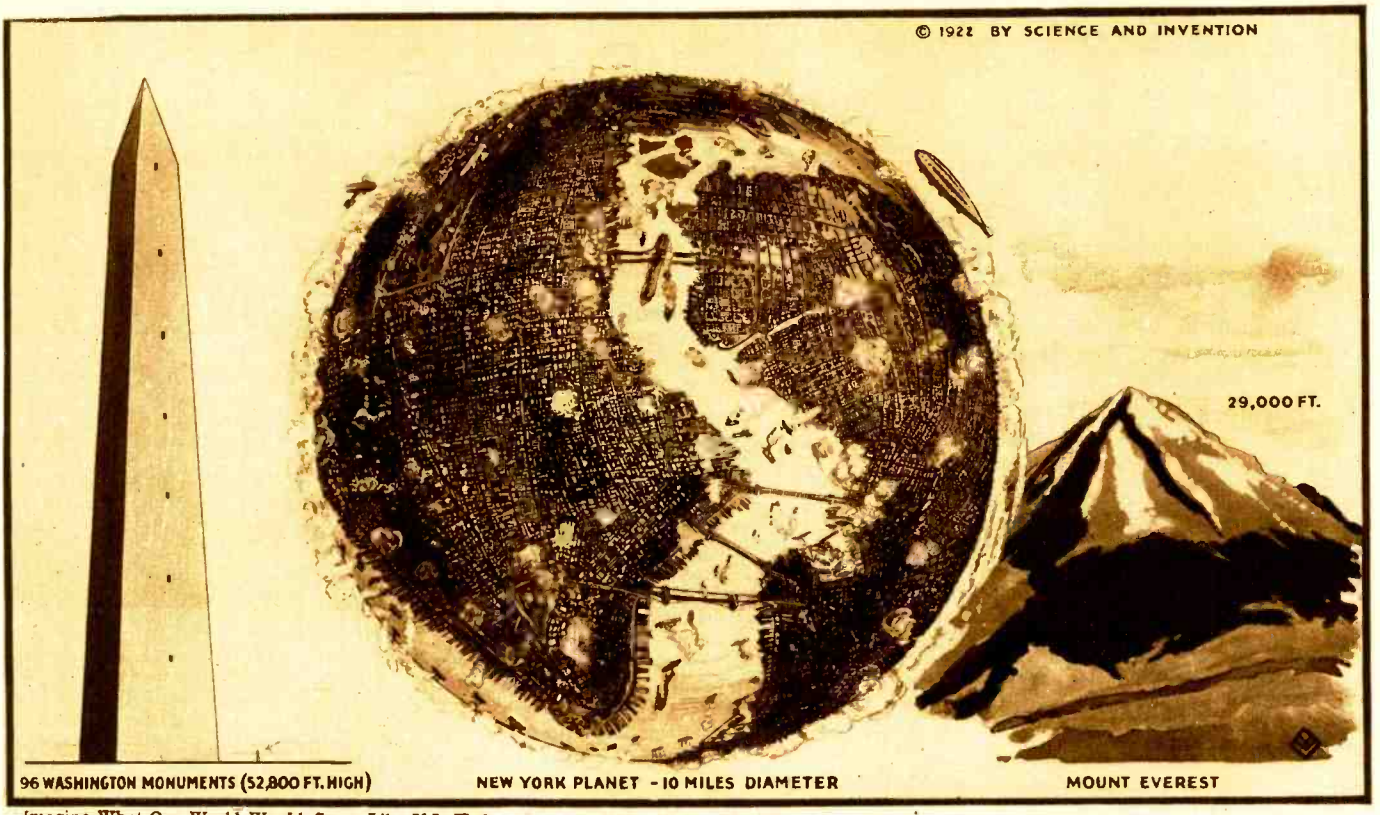


A Disk of Strong Cardboard Attached to a Sewing Machine Gives a Rotary Saw. At High Speed It Will Cut a Pencil.

A Simple Scale Made from a Bottle, Two Knitting Needles and Three Corks. The Center Cork Can Rest on the Bottle Neck.

To Magnetize With a Bar Magnet, Stroke the Steel from the Middle With Opposite Ends.

PHOTOS BY INTERNATIONAL



Imagine What Our World Would Seem Like If It Had an Area no Greater Than That Covered by New York City. New York City Covers an Area of 318 Square Miles, Which Would Give a Sphere Ten Miles in Diameter, Equivalent to Ninety-six Washington Monuments Piled One on Top of Another. The Diameter of This Miniature World Would Be a Little Less Than Twice the Height of Mt. Everest, and if Each One of Us Were to Be Reduced in Stature, According to the Proportions of This New York Planet, a Man Who Formerly Stood 5½ ft. in Height, Would Become a Veritable Ant, about Eight One-hundreths of an Inch Tall.

If New York City Were Our World

By CHARLES NEVERS HOLMES

THE total surface-area of our whole world approximates 197,000,000 square miles. That is, its diameter is 7,918 miles, its circumference about 25,000 miles, and its volume about 260,000,000,000 cubic miles. Now, according to the last *World's Almanac*, the surface-area of New York City approximates 318 square miles. That is to say, were New York City to take the place of our Earth, and to become a tiny world, the diameter of such a sphere would be a trifle more than ten miles, and, accordingly, its circumference a little more than thirty-one miles. And its volume would be about 533 cubic miles.

This very minute New York planet, were it to contain upon its surface the same physical features that our present world contains—were it to be an exact tiny replica of our Earth—would possess a land area of only 91 square miles and a water area of 227 square miles. Our present United States has an area approximating 3,000,000 square miles, while our minute New York planet would exhibit a United States area of a little less than five square miles. In fact, upon this new planet, the state of New York would possess only 8/100ths of a square mile, and the city of New York about 1/2000ths of a square mile.

And other terrestrial physical features would also be greatly minimized. For example, the Mississippi river's total length of 4,200 miles would be shortened to five and one-quarter miles, while the Hudson river would be less than one-half mile in length. Then, Mount Everest, whose height is about 29,000 feet, would become less than a hill, a mound about thirty-six feet high, and our own Washington monument would be a little taller than eight inches. And if each one of us were to be reduced in size, according to the proportion of this New York planet, a man who formerly stood 5½ feet in height, would become a veritable ant, about 8/100ths of an inch tall.

If, however, each of us were not reduced in size, remaining unchanged from what we are today, the boroughs of Manhattan, The Bronx, Brooklyn, Queens and Richmond would be, to say the least, rather uncomfortably crowded. Our world's present population approximates 1,700,000,000 people, and, were all of this population to dwell upon the 318 square miles of this new planet, provided it were all dry land, each of its square miles would have to contain about 5,340,000 inhabitants. Now, inasmuch as there are 27,878,400 square feet in a square mile, each New Yorker would possess only a little more than five square feet in which to live.

A Bird Chemist

There is a bird found in Australia, that great land of curious animals and birds, that seems, by what it does, to have received at some time in the lives of its ancestors instruction as to the good and bad effects of organic cases.

This bird, known as the Megapodius, is not only a chemist, but also a builder of nests that in proportion to its size, when compared with man, makes the efforts of the latter seem pygmy-like. This bird, about the size of a partridge, and weighing about two pounds, builds a nest fourteen feet high, with a circumference of one hundred and fifty feet. A man weighs on an average 130 pounds, and in order to build a structure corresponding to the nest of the bird, he would have to accumulate a mountain of earth which would be almost double the height and bulk of one of the great pyramids of Egypt.

The mighty task completed, the workman confides its eggs to it. The female usually lays eight, which she disposes in a circle in the center of the nest among the herbs and leaves which lie heaped up at this spot. The eggs are placed at exactly equal distances from each other, and in a vertical position. When the laying is completed, the Megapodius abandons its masterpiece and its offspring, Nature having revealed to it that it is no longer useful to them.

Endowed with a marvelous chemical instinct, this bird only collects such a mass of vegetable matter that it may safely commit the hatching of the eggs to the fermentation they produce. It is, in fact, on the heat so engendered that the bird relies for supplying her place, the mother thus substituting a chemical process for her own cares.

Réaumur proposed to leave the incubation of the common hen's eggs to the heat of manure, but they were poisoned by its mephitic vapors. The Megapodius employs the fermentation of grass and leaves.

Everything in the history of this bird is wonderful. Instead of being born naked, or covered with down, and of issuing from the egg incapable of procuring its subsistence, the young bird, when it breaks its shell, is already provided with feathers fitted for flight. *Contributed by WM. R. REINICH.*

The Radio Explorers

By ROBERT C. PARKER

BUSINESS was slack at the garage. There wasn't any very important work to do so the boss had set us to work cleaning up the shop just to keep us busy. I was going thru a pile of junk to pick out any pieces that might possibly be used again when Henry Asher walked in.

Henry and I had been friends in the university, and the only reason that I didn't greet him with open arms was that I was all covered with grease. But I was awfully glad to see him. We shook hands and began to ask each other questions as fast as we could talk.

We hadn't seen each other since we had graduated from the university two years before. I had joined the army shortly after that and had gone into the aviation service. I had seen some service in France and had brought down one German plane, but hadn't distinguished myself very much.

Henry had, he told me, joined the navy as a radio man. He had been discharged three months before and had come here to see me on business. He didn't say then what it was, but we made arrangements to meet after supper.

I was a member of a club and, as I usually went to the club house to spend the evening, I invited Henry to come there to talk over his business. We were to meet at 7:30, but I went about a quarter of an hour earlier sit and read awhile before he came. I tried to read, but memories of our college days began to come back to me, so I dropped the book and abandoned myself to old times.

Henry and I, as I have said, had been close friends at the university; we had been room mates our first year. He had always been deeply interested in wireless. He had spent a great deal of money in fixing up a wireless outfit and had been constantly making and trying out new instruments. He was more interested in the instruments, I think, than in the messages. I remembered his having made an instrument to detect metal ores, which, so far as I could remember it, was simply a pair of coils set at right angles to each other, one of them connected to a phone and the other to the secondary of a small induction coil. When he sent an intermittent current into one of them from the induction coil you could hear nothing in the phone so long as there was no metal near, but when you brought a piece of iron or nickel close to it the metal would be magnetized and would make a current in the other coil; the current went thru the phones and sounded a note in them. He worked with the machine until he got it sensitized enough to detect a five cent piece in your pocket ten feet away, but it was never of any practical value.

Just then Henry walked in. He sat down beside me, offered me a cigar, and lighted one himself.

"Herbert," he began, "I've found an easy way to make a fortune for both of us, but I need some one to help me. Since you and I are old friends I have decided to let you in on it."

It sounded as if he wanted to sell me some stock in an oil well, but I was mistaken.

"While I was in the navy," he went on, "I managed to get enough spare time to make some experiments. I've invented a machine that will detect precious metals at a distance."

I thought of the instrument he had made at the university and almost had to laugh. He saw my smile and guessed what I was thinking of.

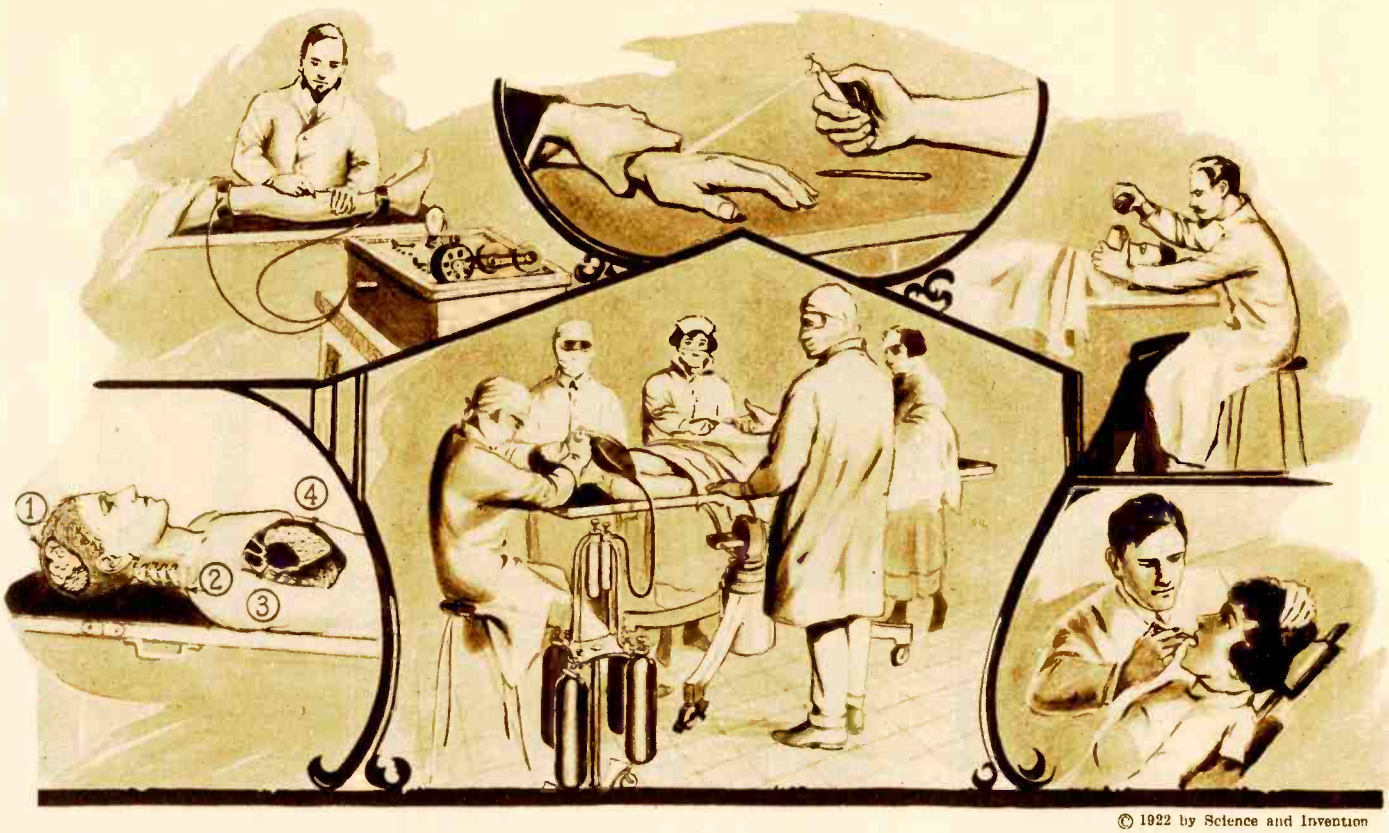
"Yes, I know what's on your mind," he said, "but that's not what I'm talking about. This is something entirely new. Do you know anything about wireless?"

I did know a little about it, so I nodded.

"I guess you know," he continued, "that the shortest wave length used in wireless is about 150 meters. The wave length of commercial stations runs all the way up to 15,000 meters. You know, too, that there was a lot of trouble caused during the war by the Germans getting messages that were supposed to be secret. We used a private code, of course, but there has

(*Continued on page* 83)

"'While I Was in the Navy', He Went On, 'I Managed to Get Spare Time to Make Experiments. I Have Invented a Machine That Will Detect Precious Metals at a Distance.....I sat Down at the Opposite Side of the Room With the Vials Containing the Metal Salts in My Pocket. He Kept On Turning the Dial Slowly. Suddenly a Smile Came Over His Face. 'Strontium', He Said. He Went On Turning for a Second or Two More and Added, 'Barium' Then, Almost at Once He Said, 'Cerium, Too' ".



Upper Row Left to Right: At First We See the Method of Anesthetizing the Leg for Surgical Procedure by Means of the Abrams Electric Machine. To the Right of This, the Method of Producing Local Anesthesia by Means of Ethyl Chloride, and at the Extreme Right is the Method of Inducing Anesthesia by Dropping Ether Upon a Mask Arranged Over the Nose and Mouth. In the Lower Row at the Left is a Semi-Diagrammatic Sketch Showing the Organs Affected by General Anesthetics. 1—The Brain; 2—Spinal Column; 3—the Heart; and 4—the Lungs. These Are Not Affected in Similar Order by Ether and Chloroform. The Order is Described in the Article, However. In the Center is the Modern Anesthetizing Apparatus Sketched in Actual Use at One of the Large New York City Hospitals. Gas Tanks Are Seen in the Foreground Communicating by Means of Rubber Tubes to the Aspirator. At the Lower Right is the Production of Local Anesthesia by Means of Hypodermic Injections of Cocaine or Novo-caine.

Anesthetics and Their Action

By JOSEPH H. KRAUS

WHO amongst us has not been subjected to the action of an anesthetic, either general or local? More and more people in the United States experience the benefit of anesthetics yearly, but few if any of us are fully aware of just how the different anesthetics act. It is a well known fact among the medical profession that the exact changes in the nerves which, as everyone knows, send to the brain impressions of pain, have not been determined. But the nerve centers of the brain are acted upon by certain drugs, whose effects are known. In this short article we will discuss the several anesthetics rather briefly.

A Picture of an Anesthetized Patient

The patient lies upon the operating table and a mask is placed over his nose and mouth. A towel may be wrapped around the face, partially covering it to prevent irritating effects of the liquid anesthetics. A few drops of chloroform or ether are allowed to fall upon the mask and the patient is told to breathe deeply. Several deep breaths and a condition of cloudiness results. Consciousness has vanished and ideas seem fogged. At first there may be loud talking and laughing among women and children, while a man may present a state of delirium. But as sufficient of the anesthetic passes into the blood, complete unconsciousness ensues and the patient lies motionless without any sensation whatever. In the initial state of clouded consciousness minor operations may be performed without pain, even if the patient is not fully asleep. To differentiate between chloroform or ether anesthesia, let us visualize the effects of each.

The Action of All the Most Important Local and General Anesthetics

Chloroform

Chloroform is a colorless fluid, boiling at 62° C. It has a sweetish odor and taste. It is neither explosive nor inflammable. It should never be used in a room where gas jets are openly burning as phosgene and hydrochloric acid, both very irritating to the membranes of the nose and mouth, are formed. If applied to the skin, it causes a marked coolness at first, then the formation of blisters. Chloroform is permitted to drop at the rate of 20 drops per minute upon the mask covering the nose, which rate is gradually increased to 60 drops a minute, until the patient is anesthetized, after which period the number of drops is diminished. The pulse may drop to 50 beats per minute. With chloroform the blood pressure falls, unless the anesthetic is slowly administered.

The patient then falls under its influence 30 to 35 minutes after its administration is begun. At first the patient may exhibit scarcely any fall in blood pressure, but as the inhalation of chloroform is continued over a larger period of time the blood pressure invariably falls. In one hour this pressure will drop to one-halt of its original force and in two and a half hours to one-third of its original pressure. Chloroform also weakens the heart action, particularly if too large a quantity of the anesthetic reaches it at one time. The chloroform vapor enters the blood thru respiratory action. It is inhaled and passes into the blood thru the walls of the lung tissues and blood vessels, in the same manner as the oxygen in the air passes into the blood and the carbon dioxide passes out of it. This falling of the blood pressure and the danger of failure of heart action are the greatest dangers incident to its prolonged use.

Chloroform poisoning may produce one of two effects. If too large an amount of chloroform reaches the heart suddenly, the functions of that organ may stop. The face assumes a pallor and the lips become blue; the pupils of the eye may suddenly dilate; then asphyxia or suffocation occurs, while breathing may continue for quite a while after the heart stops. Massages of the heart rarely help. Too large an amount of chloroform has killed it. Adrenalin or camphor is sometimes injected directly into the heart with a long-nosed syringe thru an incision made in the chest wall. On the other hand, the heart may continue to beat, but breathing stops. Should the latter occur, artificial respiration will sometimes bring the patient around.

Ether

This is a clear, colorless fluid which boils at 36° or 37° C. It has a peculiar smell and burning taste. In general, it also affects at first the pain centers of the cerebrum (a part of the brain) and then acts upon the spinal cord. The heart and blood pressure are generally maintained at the normal level or higher than normal, which accounts for the fact that so many patients feel better and stronger after

(*Continued on page* 98)

The Specially Prepared Diagram at the Top Shows How the Color Organ Produces the Marvelous Interblending Color Effects on a Ground Glass or Cloth Screen; While the Six Lower Photos Show Some of the Different Image Effects Obtained. The Center Photo Shows the Keyboard of the Color Organ.

The Color Organ

OFTEN one associates the term "organ" with music; yet an organ, or at least that is what it is called, playing in colors only, has recently appeared to entertain audiences in many theaters in New York, and will undoubtedly make theater-goers out of town wonder what it is all about, just as it did in the "greatest" city.

"Pretty; but what is it all about?" is an expression heard everywhere as one leaves the theater, and what the colors mean is rather difficult to explain. Sunsets have a very wonderful effect, as do beautiful dawn scenes, but they are Nature's scenery. There the colors are not nearly as vivid, as contrasting nor as geometrical as they are in the Color Organ devised by Thomas Wilfred.

At first we see, in viewing the stage, a fine pearly substance, like light, which spreads over the entire surface of what one would ordinarily call an opaque motion picture screen. Slowly and indistinctly a form begins to develop. It shapes itself into an almost geometrical design, and then swells out gradually. It is green in color at first, as it twists and spirals and spreads over a screen. Suddenly a reddish spot is discernible. The red increases in size until it almost covers the entire area, and then—darkness ensues. Again, a mass in the center will form. It divides. The background which had become blue, changes to orange. Slowly this mass spreads and falls in glowing green with a strange blending of the green and orange. It stops on both sides as the center fades away. Then the sides swell and grow larger. They revolve slowly and fade. A vivid purple bursts from above and blends into a carmine red color which moves from the center downward to the base of the screen and fades as it reaches that point.

After sitting thru one of these performances and watching the blending of the colors, one's appetite for color music has been thoroly appeased. Of course, there are those futurists who "interpret" the color music for the regular organ, and who thought it was a pleasant substitute; but to the majority, it fell far short of this point.

Mr. Wilfred claims that the compositions bear no relation to music or sound at all, and in this statement he is thoroly in accord with the opinion of the writer! The effects, as one would summarize them, are beautiful, mobile color combinations intended more for the extreme modernist than for the real lover of art.

To some individuals red suggests sweet peace, to others rage of passion and rampant, to still others warmth and comfort, and last but not least, hate. Therefore, the effect on different individuals would depend upon their interpretation of the colors and the forms and shapes of the colored masses.

Mr. Wilfred would say nothing at all about the "*Clavilux*," for that is what he calls his instrument, and refuses to give any information as to the manner in which it is worked. Nevertheless, the author of this article managed to get information which even the inventor himself would not give and, therefore, the following details with reference to the mechanism employed are given.

The organ itself has four spot lights secured to one side. These spot lights are provided in front with a screen divided into three parts; the top third is covered with a colored gelatine, and the middle third is blank, while the lower third of the same screen is colored differently.

These screens slide up and down in front of the spot lights. In front of the lamp of the spot light is a prism which may be inclined or twisted, and the prism may likewise be shifted with regard to its proximity or height, in front of the lamp of the spot light. All four spot lights are focussed upon the center of the screen, so that one image may be projected over the other, and so that their colors may be varied as desired or combined if thought favorable.

Attached to the moving color screen is a thin wire cable whose end is attached to a drum and is well counterbalanced by a weight. These drums are clearly shown in our photograph, and the inventor, by playing upon them, shifts the screens up or down by moving any one of the five disks, causing the cable to take up or release the sliding color screen.

The intensity of the light is varied by six rheostats, three at the right and three at the left of the player. Two flood lights form the background lighting effect of the device. These are located at either end of the screen and are operated in a similar manner to the color apparatus.

It stands to reason that many combinations are possible with prisms which can be shifted in front of the light, with objects which may likewise be moved, and with a three-color screen varying from perfectly transparent to a very intense color at both ends, which moves in front of the flood light, and with regulating rheostats to vary the intensity of the light, and four different form-throwing spot lights.

Mr. Wilfred requires a current supply of two hundred amperes when installing his instrument. Just why he demands a two-hundred ampere switch and fuses, and only uses about eighty or one hundred as shown by ammeter readings, is rather difficult to understand.

The instrument is played by all five fingers on the white disks, which are shown in the photo, and which are numbered to correspond with the code music sheet prearranged by the inventor. Both hands may be used to operate the disks, or one hand may control the rheostats on either side of the player, who sits sideways with respect to the screen and the audience. Further details of a color organ are given on *Latest Patents* page.

How to Apply Imagination to Inventions

By JAY G. HOBSON

There are two kinds of imagination with which inventors are anointed. One is the flighty, impossible, transient kind; and the other is the practical, workable, down-to-earth kind that matures into a finished conception when the test of logic is applied.

Those who let their imaginations run away with them into the far-fetched, complicated, impractical ideas cannot hope to arrive at a successful improvement pregnant of any worth-while results.

It is one thing to close the eyes and dream of having some successful creations, and quite another to dream or imagine them, set them down into workable form and reap the benefits that invariably result from conscientious attention to details, and the painstaking labor for perfection of the article or machine that is desired to be sold.

The inventor will always get out of his imagination and creative efforts exactly as much as he puts into them. In other words if he uses the slogan: "How little for how much." The law of compensation will most assuredly reward him with the amount for the "little much" that he gave to the idea.

But, on the other hand, if the inventor adopts the slogan: "How much for how little," and sticks to it thru thick and thin, and truly strives to put MUCH into his idea for the LITTLE that it returns him, he will be happily rewarded with a better invention, greater fame and a larger fortune than is possible under any other principle.

Adopt the slogan: "Not how little for how much, but how much for how little." tack it on tight to your memory, read it at least once a day, practice it as you read it, and dollars to doughnuts you'll be more successful with your inventions and imaginations than otherwise. Learn to study everything you see—why and how does it work? New ideas form from such observations.

One Broadside Lifts Five Leviathans From Sea

By GRASER SCHORNSTHEIMER
NAVAL EXPERT

IT is provided in the naval treaty that the United States may complete two of the battleships of the 1916 program. This came about as a result of the clash with Japan over their newest and largest battleship, the *Mutsu*, which that nation may now retain. The British may build two entirely new ships, as none are under construction in British shipyards.

We will complete two battleships of the *West Virginia* type. They are the *Colorado*, building at the yard of the New York Shipbuilding Company at Camden, New Jersey, and the *West Virginia*, building in the yard of the Newport News Shipbuilding Company. The first vessel is close to 80 per cent. complete and the second about 65 per cent. finished. It will cost about $7,000,000 to complete both ships, about $55,000,000 having already been spent on them. The *Colorado* should be finished this year and *West Virginia* next.

They are very fine ships of excellent design. The *West Virginia* is 624 feet long, over all, and 600 feet long on her designed water line at normal load displacement. The water line beam is 97 feet 3½ inches and her mean draft is 30 feet 6 inches. The displacement with the normal load of food, supplies and oil aboard is 32,600 tons, as compared with 35,000 tons for the Japanese *Mutsu*, and 43,000 tons for the British ship *Hood*. The full load displacement of our ship is a little better than 33,500 tons. In this state the vessel will draw about 32 feet of water.

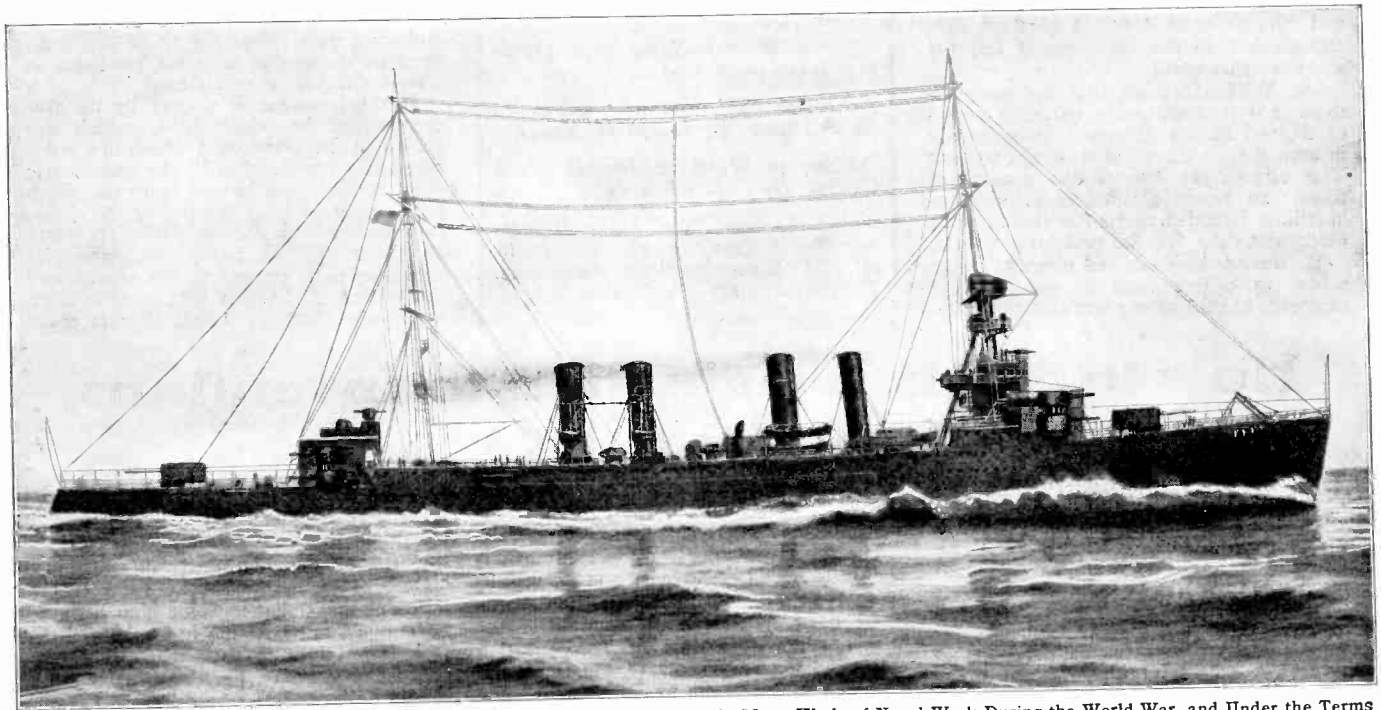
High freeboard will characterize the vessel, giving her great seaworthiness and she will be a very stable gun platform, a vital feature for any type of warship. Also, she will have the clipper bow, which sets Yankee warships in a class apart. The fine hull lines will probably allow her to exceed her designed speed by a knot or so.

The mechanical equipment of these vessels is the best made by man. The main engines of the *West Virginia* will be General Electric steam turbines, while those of the *Colorado* will be Westinghouse steam turbines. The boilers will be fitted to burn oil only. Great electric generating sets will be driven by the turbines and they will supply the electric power for the electric motors, which in turn drive the vessel's four great propellers. These motors will have a shaft horse power of only 28,900 to drive these 32,600-ton ships at a speed of 21 knots, and they can be controlled from the bridge by practically the same apparatus with which the motorman of the subway train controls its speed! Also, the vessels will have electric steering devices, controlled from the bridge, making them electric ships in all that it implies. And all these things contribute to the tactical value of the ships.

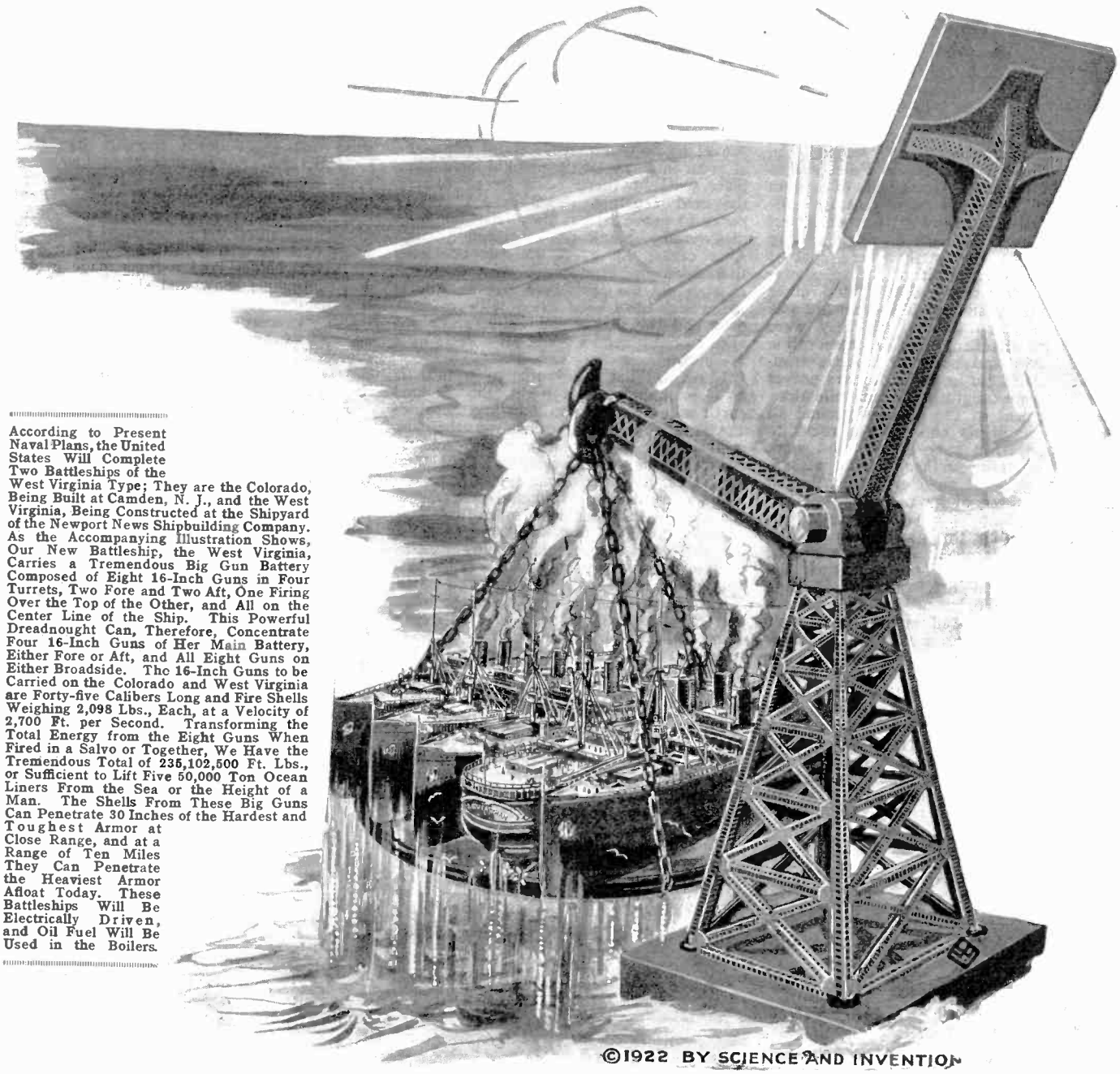
The electric drive and control enables a ship to maneuver very rapidly at the control of the officers on the bridge or in the conning tower. A mine field is sighted near at hand while the vessel is running at full speed. Within a few hundred feet the vessel can be turning and reversing and so is out of danger. This could not be done under the old systems. And then, the same situation presents itself in dodging torpedoes and aircraft bombs. The electric drive is really a part of the ship's protection, as it makes the vessels doubly difficult targets.

But the main battery of the *West Virginia* is marvelous. She carries eight 16-inch guns in four turrets, two forward and two aft, one firing over the top of the other and all on the center line of the ship. Thus it is possible to concentrate four 16-inch guns either fore or aft, and all of the eight guns on either broadside. Gunnery officers agree that this arrangement is by far the best, making for superior accuracy.

The 16-inch guns carried on this vessel are 45 calibers long and fire shells weighing 2,098 pounds each at a velocity or speed of about 2,700 feet each second. Trans-



Fast Armored Scout Cruisers Demonstrated That They Were Extremely Valuable in Many Kinds of Naval Work During the World War, and Under the Terms of the Naval Treaty Recently Signed by All of the Big Powers, the United States Is Allowed Ten Scout Cruisers, and This Number of These Fast Terrors of the Sea Are Under Construction. The Appearance of These Scout Cruisers Is Seen From the Above Official Naval Photograph. They Will Be the Finest Scouts Afloat, Measuring 555.5 Ft. Long Over All, with a Beam of 55 Ft., and a Draft of 14¼ Ft., at a Normal Displacement of 7,500 Tons. These Ships Will Not Be Electrically Driven Owing to the Greater Weight of the Machinery for the Comparatively Smaller Weight of These Vessels. They are Designed to Be Driven by Steam Turbines, Using Oil as Fuel in the Boilers, the Turbines Developing 90,000 Horse-power to Give a Speed of 33.7 Knots. It Is Hopeful, as Mr. Schornstheimer Points Out, That Congress Will Provide a Sufficient Appropriation to Cover the Construction and Completion of These Ten Scout Cruisers.



According to Present Naval Plans, the United States Will Complete Two Battleships of the West Virginia Type; They are the Colorado, Being Built at Camden, N. J., and the West Virginia, Being Constructed at the Shipyard of the Newport News Shipbuilding Company. As the Accompanying Illustration Shows, Our New Battleship, the West Virginia, Carries a Tremendous Big Gun Battery Composed of Eight 16-Inch Guns in Four Turrets, Two Fore and Two Aft, One Firing Over the Top of the Other, and All on the Center Line of the Ship. This Powerful Dreadnought Can, Therefore, Concentrate Four 16-Inch Guns of Her Main Battery, Either Fore or Aft, and All Eight Guns on Either Broadside. The 16-Inch Guns to be Carried on the Colorado and West Virginia are Forty-five Calibers Long and Fire Shells Weighing 2,098 Lbs., Each, at a Velocity of 2,700 Ft. per Second. Transforming the Total Energy from the Eight Guns When Fired in a Salvo or Together, We Have the Tremendous Total of 235,102,500 Ft. Lbs., or Sufficient to Lift Five 50,000 Ton Ocean Liners From the Sea or the Height of a Man. The Shells From These Big Guns Can Penetrate 30 Inches of the Hardest and Toughest Armor at Close Range, and at a Range of Ten Miles They Can Penetrate the Heaviest Armor Afloat Today. These Battleships Will Be Electrically Driven, and Oil Fuel Will Be Used in the Boilers.

form this into foot-pounds—235,102,500 or 117,551 foot-tons—and we have enough energy to lift five leviathans five feet in the air at one blast of the *West Virginia's* main 16-inch battery. These guns can penetrate 30 inches of the hardest and toughest armor at close range, and at a range of ten miles they can penetrate the heaviest armor afloat today.

Fourteen 51-caliber 5-inch guns compose the secondary or anti-destroyer and anti-submarine battery. They are mounted seven on each beam and are capable of scoring many hits, as the rate of fire of these guns is very high. Their projectile is large enough to put any destroyer out of commission or to destroy any submarine with a single hit.

Today, much attention is being given to defense against aircraft. True, we have found that if a battleship of a semi-obsolete type does not resist air attack or even maneuver against it, the ship will be sunk. But a thoroly modern ship, like the *West Virginia,* is capable of maneuvering rapidly against them, and she also carries four of our new semi-automatic 3-inch, 50-caliber anti-aircraft guns on high angle mounts. These guns are extremely rapid firers and much more dependable than automatics. They can keep far more than the bombing area over the ship filled with shell fragments. And as the bombing area over the attacked vessel is the only place from where a hit can be scored by aircraft, it is doubtful if an enemy would risk sending planes against such vessels.

The ships' torpedo batteries consist of but two submerged torpedo tubes each. Compared to the more recent vessels in the British and Japanese navies, this is not a heavy battery, but it must be remembered that this vessel is one of the 1916 program and that ordinarily a battleship is built in three years, not six. In addition to the guns mentioned above, the *West Virginia* carries four supplementary 6-pounders which may be used for off-shore work and saluting.

Both the *Colorado* and *West Virginia* are very well protected. The armor consists of the usual heavy belt, barbette, conning tower and turret armor, supplemented by special deck protection of heat treated steel. It is said that there are no less than three heavy decks protecting the vitals of the ships. It is to be seen from this that aircraft bombs would have great difficulty in penetrating. The protection against bombs, torpedoes and mines is unique. There are no less than three separate and distinct hulls.

About 1,400 officers and men will be necessary for the crew of the *West Virginia.* But with Congress cutting the allowance of men for the navy to less than half what it should be, it is doubtful if these new ships, the finest we will have, if Congress lets us have them, will receive their full complements. Possibly they will be unable to put to sea because of the lack of fuel as well as men. This is a condition in which every layman should interest himself. We are having a reduction of armaments by international agreement, but Congress is disarming the United States without any international agreement on the subject by not allowing the navy to maintain the ratio and ships provided in the Naval Treaty.

These vessels will not be the most powerful ships in the world. However, they will be the most powerful ships we may have under the Naval Treaty and they must be completed.

Many times has it been charged that our naval authorities demanded too much, that they have asked for ships for which there was no need. The Disarmament Conference proved the contrary. For many years the General Board has recommended aircraft carriers, fast cruisers and flotilla leaders without success. Congress would not believe that they were necessary. At present the British, Japanese, French and Italians have these ships, and so it was only fair that the United States was allowed to build them by the Naval Treaty.

(*Continued on page 62*)

A Tropical North Pole

By C. S. CORRIGAN, C.E.

EVERY school boy knows the climate of the North Pole used to be tropical. Great beds of coal in the far north prove that for millions of years in the Carboniferous Age its climate was just as warm as any other part of the earth where coal is found. The various plants and trees preserved in glaciers in Alaska and other arctic countries show that the climate was super-tropical up to the day they were frozen; the excellent state of preservation of dinosaurs and other prehistoric tropical animals found in arctic glaciers proves that they were caught in the ice while alive. The movement of the glaciers ground all vegetation, animals and surface rocks to powder, so it is only a few that were lifted clear of the surface by side pressure before the general movement started, that have been preserved for us.

It is less than fifty years since it was first shown that the glaciers in ancient times covered a great deal more of the earth's surface than at present; their deposits of glacial drift and the cutting effect of their movements have been so extensively mapped and studied that their location and area is quite definitely known, but the number of glacier periods and the cause of their forming is still a matter of dispute among scientists.

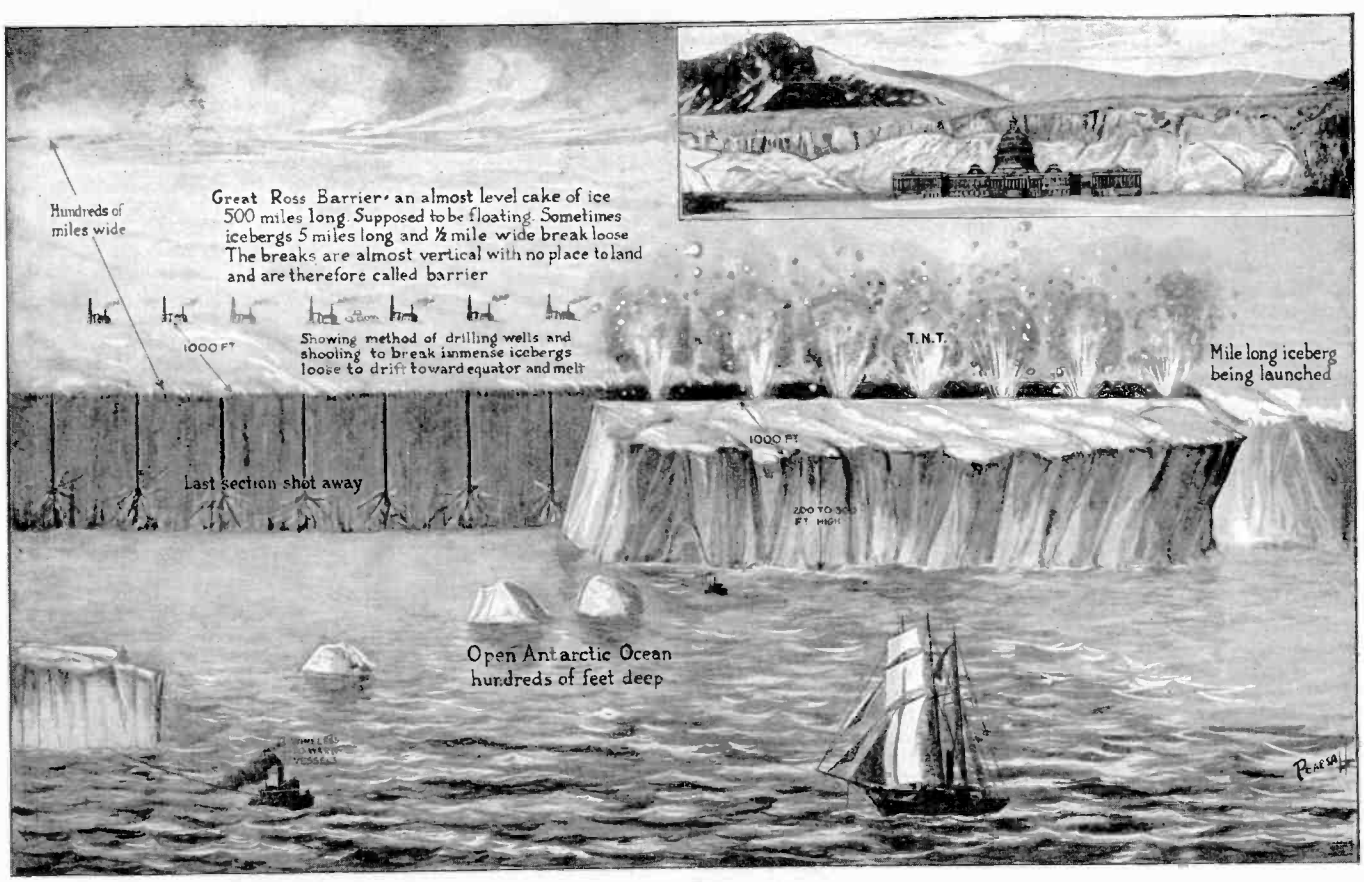
Some geologists claim there have been many glacial periods; others say only one. Some astronomers claim they were caused by great variations in the earth's orbit, or of the equinoxes; some figure there is a conical movement of the earth's axis that would bring a glacial period every 31,000 years; no regular movements of the earth, at great intervals of time, could have taken place without there being more than a thousand separate strata in sedimentary rocks to prove it, but they have not been discovered. Some think glacial periods were caused by great volcanic eruptions that filled the atmosphere with dust and so shut out the sun's heat. If so, glacial ice would have been filled with volcanic dust and the plants and animals covered with it, but glacial ice and all objects in it are clean.

Knowing that when the sun's heat is at a minimum, as at night, the air and earth cool quickly; also knowing there are at times gigantic eruptions on the sun, such as sun-spots, that are dark and so reduce the amount of heat and light coming to us, it seems to me the only logical explanation of the origin and progress of the last (if there has been more than one) glacial period, is that 40,000 years or so ago there was such an exceedingly gigantic eruption, or sun-spot, that the sun's heat was practically shut off from the earth. Then in a few hours an awful sleet storm started at both poles, and covered everything with ice, like sleet storms do nowadays. The cold wave extended so far and lasted so long that nearly all the water vapor in the atmosphere was precipitated and covered the land with ice.

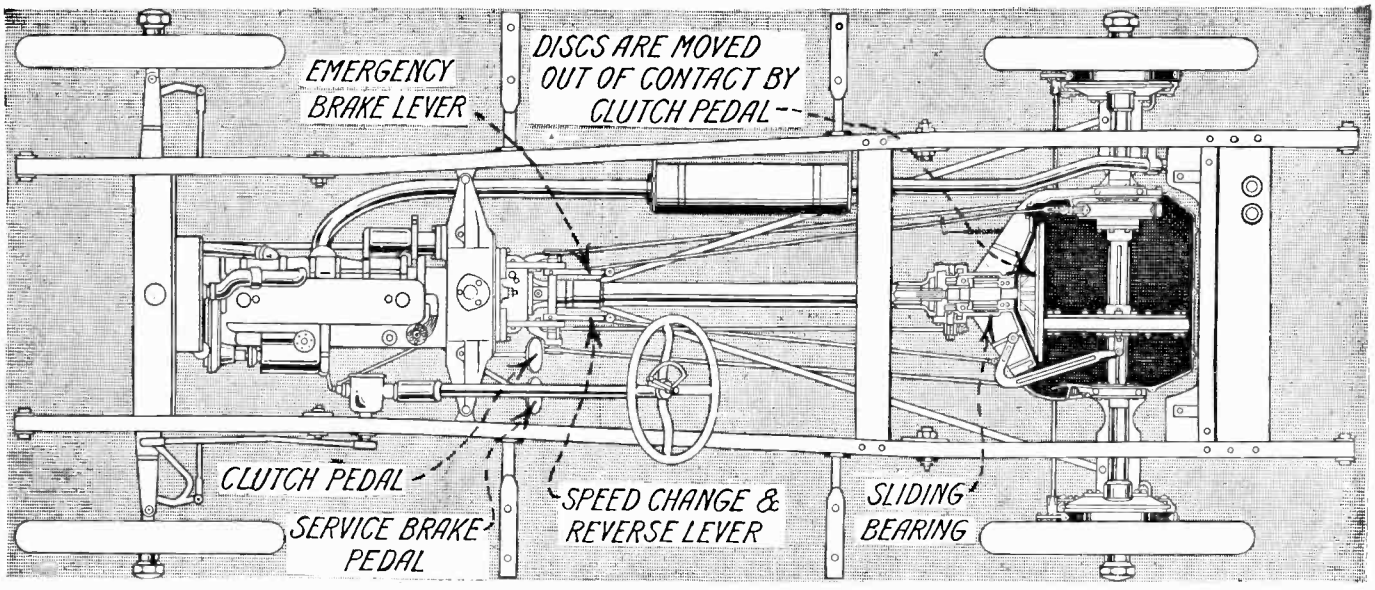
However, there was enough warmth near the equator to keep things from freezing solid, or all animal life would have been destroyed; as water does not freeze until cooled to its entire depth, it probably took a long time for the great lakes to turn to solid ice; great ocean currents like the Gulf Stream and Japan current kept the polar oceans warm, so probably they were not frozen much more than at present. The scarcity of water vapor in the atmosphere greatly increased the evaporation from the warm oceans; then the rapid flow of warm air to the colder land regions made great and continuous snow and sleet storms, so the original ice glacier, only a few feet thick, was soon covered with mountains of snow, that by its own weight was compressed into ice until the glacier was thousands of feet thick, and weighed more than a hundred million billion tons.

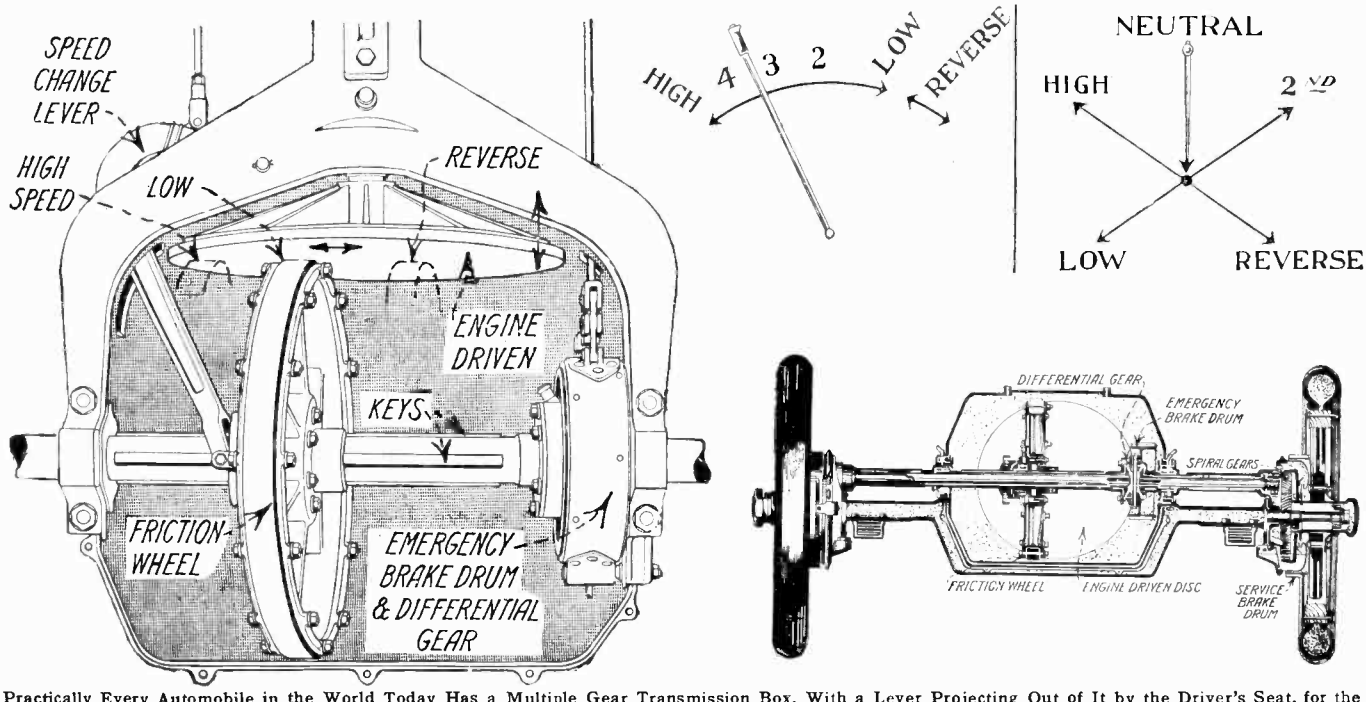
The gigantic sun-spot may have lasted a week, or a month; at any rate it was only a short time before the sun regained its full light and heat-giving power; but ice does not melt as quickly as it forms. It takes ten thousand times as much heat to melt a cubic foot of ice as to raise the temperature of a cubic foot of air from 32° F. (freezing) to 88° F., the average tropical temperature; so although the sun immediately began melting the glacier in the torrid zone, much faster during the day than it re-formed during the night, and much more of it each summer than was made each winter, it took at least ten thousand years to make the permanent glacier recede as far north as the Great Lakes, for estimates based on our most reliable data show it would have taken that long to move the glacial drift we find in Illinois, Ohio and New York the 300 miles it came from its original location in Canada.

(*Continued on page 75*)



It May Be That in Years to Come Engineers will Go Northward for Their Ice and Start Breaking Up the Huge Glaciers in Some Such Fashion as That Illustrated, the Huge Blocks of Ice Being Towed to Warmer Climes Where They Can Be Broken Up for Everyday Use. The Vast Extent and Height of One of These Glaciers Is Seen from the Accompanying General View, as well as from the Insert Picture, Which Shows the Comparative Size of the Capitol at Washington, Standing 287 Ft. High, with the Huge Ice Cliff of the Child's Glacier, Measuring 250 to 350 Ft. in Height.





Practically Every Automobile in the World Today Has a Multiple Gear Transmission Box, With a Lever Projecting Out of It by the Driver's Seat, for the Purpose of Obtaining Various Speeds. Here Is a Car That Is Different, and It Represents One of the Very Latest Developments in Friction Drive, Which Eliminates the Awkward Gear Shift. Not Only Does This Car Drive Much Simpler Than Gear Shift Types, but Where Three Speeds Only Are Obtainable With the Average Auto, This Car Has a Hundred and More Different Speeds Available at Any Instant. This Car Can Be Stopped in a Very Short Space, Simply by Shifting to the Reverse Position Quickly This Is Always Liable to Strip the Teeth from the Gears in the Ordinary Car.

Gearless Friction Drive Car

PRACTICALLY all of the motor cars designed for pleasure as well as for trucking in this country have either a three or four speed gear shift transmission linking the engine with the rear driving wheels. As has been pointed out in a previous article in this journal, the gear shift car is not the best solution of the problem in hand, for the reason that there are power transmission losses in these gears, and secondly, that it is more or less difficult to learn to drive and handle such a car. Mr. C. W. Kelsey, of Newark, N. J., has designed and is building a new motor car, having a perfected friction transmission of the type shown in the accompanying drawings. We have always had great faith in a motor car, especially for those built for pleasure, that would be as simple and natural to drive as our express wagon, in which we used to coast down hills when we were kids.

This is the exact idea that Mr. Kelsey set out to meet, and while we have had friction transmission cars before, we were particularly imprest with this latest design of this type of automobile, after inspecting it at the automobile show in New York City a short time ago. There are no universal joints, connecting shafts out of line with each other, in this car to waste power, such as we have in the ordinary car, which are both awkward and wasteful in transmitting power. The engine is coupled directly to the driving shaft without any universal joints, and on the rear end of this shaft is mounted on run-way bearings a powerful, round, flat driving disc, as the drawing shows. A clutch pedal moves this disc into or away from contact with the sturdy friction wheel, which is slidably mounted on a jack shaft, containing besides a differential gear an emergency brake drum also, as shown in the illustration. There are two foot-pedals, one for the friction disc clutch effect, and one for operating the service brakes on the rear wheels; besides these there are but two levers, one, which is rarely used, is for controlling the emergency brake, and the second lever is for the speed changes and reversing. This lever has a button in the handle, and it is used as follows:

With most friction drive cars, it has generally been the plan to effect the changing of the speed by simply moving the friction wheel control lever back and forth, once the clutch had been let in by releasing the foot clutch pedal. But Mr. Kelsey has designed his car somewhat differently. You press in the clutch pedal, as in all other cars, to disengage the disc and friction wheel, while the car is standing still, and you move the speed control lever forward to the desired speed at which you want to start off, say five to eight miles an hour, and then let in the clutch by releasing the foot pressure. When you want to change

(*Continued on page* 64)

Popular Astronomy

By ISABEL M. LEWIS, M. A.

of U. S. Naval Observatory, Washington, D. C.

Oxygen and Water Vapor Absent from Atmosphere of Venus

BY the application of a new method Drs. St. John and Nicholson of Mt. Wilson Observatory have shown recently that not even a trace of the lines of oxygen and water vapor are to be found in the spectrum of Venus.

In the spectrum of the sky, which is the spectrum of sunlight that has passed thru the earth's atmosphere, there are a number of lines known as *telluric lines* that originate in our own atmosphere. These are dark lines produced by absorption of the sun's rays by elements that exist in the gaseous envelope of the earth. Now the spectrum of Venus should contain all of these lines that originate in our own atmosphere, since the light from the planet must pass thru the atmosphere before it reaches our eyes. It should contain in addition lines of elements that exist in the atmosphere of Venus, for the light that we receive from Venus is reflected sunlight that has penetrated to a greater or less depth into the atmosphere of Venus before it is reflected to us.

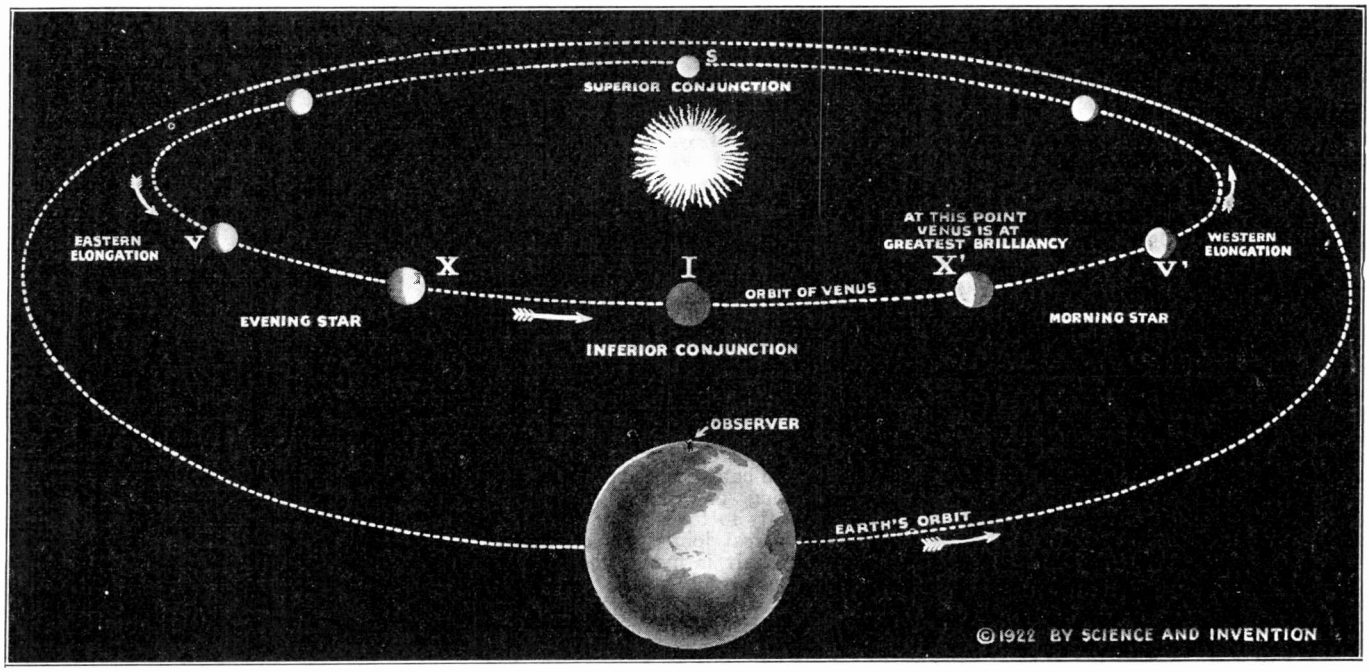
In the past, spectra of Venus have been taken with a dispersion so low that lines of the same elements existing in our atmosphere and in the atmosphere of Venus coincided. If certain substances, say oxygen and water vapor, existed in the atmosphere of Venus their presence would be revealed to us only thru increase in the *intensity* of the lines of the same substances in our own atmosphere. This method did not give satisfactory evidence either in favor of or against the possibility of the presence of oxygen in the atmosphere of Venus.

By increasing the dispersion of the lines of the spectrum, which can be accomplished by using a train of prisms, instead of a single prism at a sacrifice of a certain per cent. in brightness or intensity of all the lines, it is possible to separate the lines of the elements that originate in the atmosphere of Venus from the lines of elements that originate in our own atmosphere. The large relative motions of the earth and Venus in their orbits cause the lines originating in the atmosphere of Venus to be completely separated from corresponding lines of the same elements originating in the atmosphere of the earth, provided a sufficiently great dispersion of all spectral lines is employed.

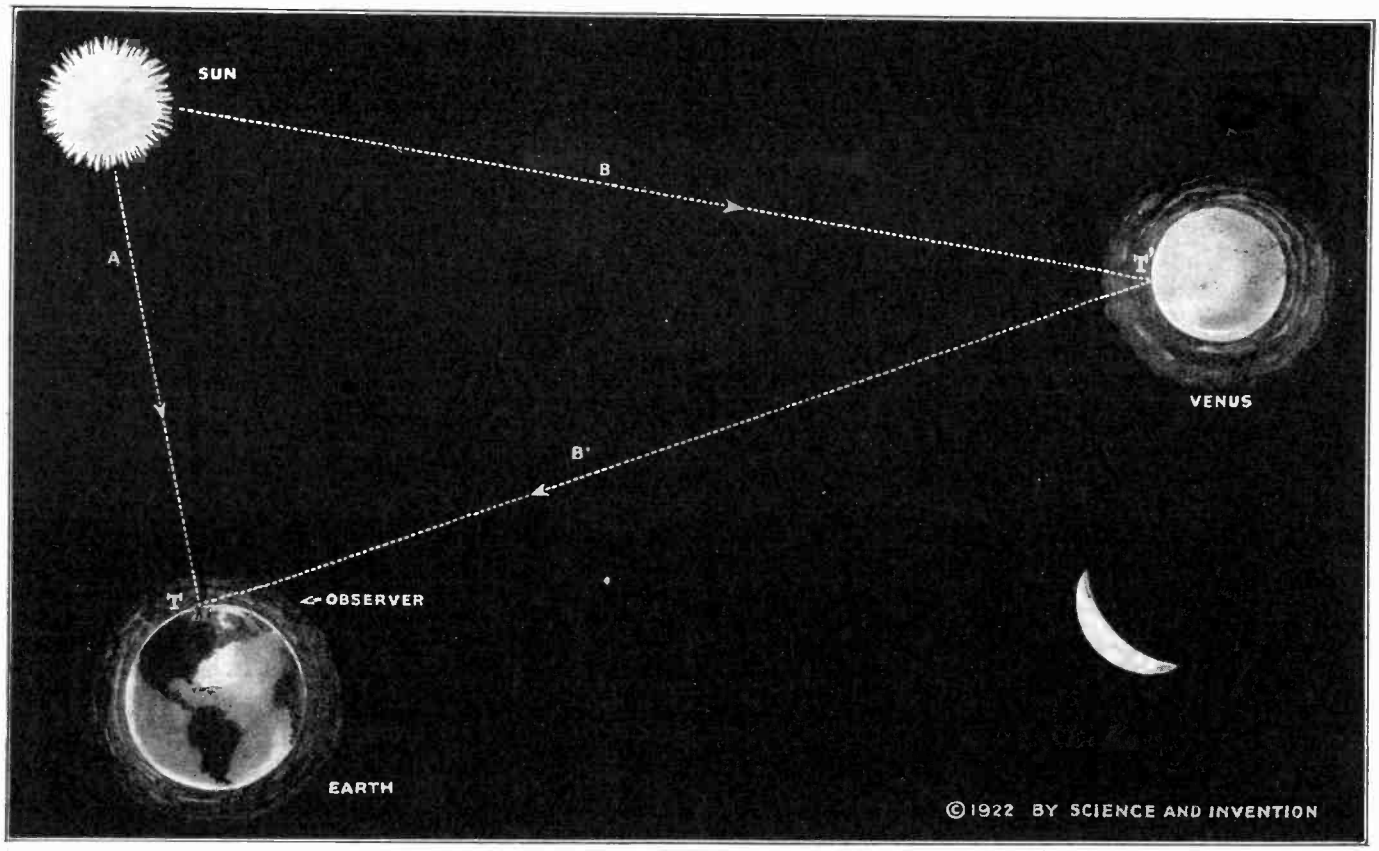
By using this method Drs. St. John and Nicholson were able to separate completely the lines of elements and compounds in the atmosphere of Venus from the corresponding lines of elements in the earth's atmosphere. They found out in this way that water vapor and oxygen were entirely absent from the spectrum of Venus. This was a most surprising discovery since it has generally been considered that the high reflective power of this planet arises from the presence of dense clouds in its atmosphere. That Venus possesses an atmosphere that is at least as dense as that of our own planet there is not the slightest doubt. There is abundant proof of this fact. Upon the rare occasions when this planet has transited the sun, a luminous ring due to the presence of an atmosphere, has always been observed surrounding it. Moreover, when the planet is near inferior conjunction with the sun and shows the crescent phase, the horns of the crescent are seen to extend considerably beyond its diameter. Also when the planet is very nearly in line with the sun, a thin line of light has been seen at times about its circumference due to the shining of sunlight thru its atmosphere. To this we may add the observations of faint lights on the side of the planet turned away from the sun which have been attributed to electrical displays in the planet's atmosphere similar to the auroral displays on our own planet. The *albedo* or reflecting power of Venus, moreover, is much higher than that of the surfaces of Mercury and the moon which have practically no atmospheres and reflect light to us from a rough surface unclothed by extensive atmospheric gases. The reflective power of Venus is about equal to that of white thunderheads brilliantly illuminated by a summer sun. The absence of any definite markings on the planet's surface is additional proof that we are looking upon a dense atmospheric covering rather than upon the actual surface of the planet.

It is possible that the failure to find either water vapor or oxygen in the extensive atmosphere of Venus may arise from the fact that these substances lie close to the surface of the planet and their presence is masked by the intensity of the reflected light from the outer layers of the planet's atmosphere. In the case of our own planet it is known that a very high percentage of the light from the sun that enters the outer atmosphere is reflected back into spaces without first penetrating to any great depth in the atmosphere. If we were viewing our own planet from another world, particularly a world clothed with a dense atmosphere of its own, such as Venus, it is doubtful if we would be able to make out any detail on its surface. Undoubtedly a large percentage of the light that is reflected from this planet, the earth, to Venus has never penetrated the lower strata of our atmosphere.

In our atmosphere water vapor and clouds lie close to the surface. Clouds are rarely found at higher elevations than about seven miles. It is uncertain to what height the oxygen in the air extends, tho of course it is far more extensively distributed than water vapor and occurs in great abundance in the lower atmosphere. It thins out rapidly with elevation above the surface, however, and there is not a



This Picture Diagram Shows the Different Positions of the Planet Venus With Respect to the Earth and Sun When Venus Is at Different Points in Its Orbit. At Superior Conjunction Venus' Disk Is Fully Illuminated by the Sun and This Phase Corresponds to That of the Full Moon. We Now See the Full Disk of Venus, but Being That It Is So Far Away and in Direct Line With the Sun It Is Not Ideal for Observation. At Inferior Conjunction on the Other Hand, Venus Is in Front of the Sun and for That Reason Not Illuminated. In Order to See It, We Have to Look Right Into the Sun and the Planet, Therefore, Is Invisible to Us. Its Greatest Brilliancy Is 36 Days Before or After Inferior Conjunction. We Now See the Planet Venus in the Form of a Crescent, the Same as the Crescent. Moon.



A—Direct Ray from Sun to Earth; the Spectrum of This Ray Contains Telluric Lines T Due to Absorption by Elements in Earth's Atmosphere. B—Direct Ray From Sun to Venus; the Spectrum of This Ray Contains Lines T¹ Due to Absorption of Light by Elements in Atmosphere of Venus. B¹—Reflected Ray From Venus to Earth; Spectrum Contains Lines T and T¹ Due to Absorption by Elements in Atmospheres of Both Planets. If Venus Is Moving Toward Earth Lines in Atmosphere of Venus T¹ Are Displaced Toward Violet End of Spectrum. If Venus Is Receding From Earth Lines T¹ Are Displaced Toward Red End of Spectrum. As a Result Lines of the "Same" Elements in Both Atmospheres Are Separated in the Spectrum if a Wide Dispersion of the Spectrum Is Used.

sufficient supply of it at an elevation of five or six miles to support human life for any length of time. The composition of our outer atmosphere is not known definitely but it is generally believed that there is an extensive outer shell of hydrogen surrounding the lower denser atmosphere of the earth.

It has been estimated that the atmosphere of Venus extends to a height of about four hundred miles above the surface of the planet and that it is even more extensive than our own atmosphere and of as great if not greater density. Water vapor and oxygen might lie, then, within a comparatively thin layer five miles or so in depth, close to the surface of the planet.

It is interesting to consider in connection with this question of the composition of the atmosphere of Venus the following theory of the possible origin of the oxygen in the earth's atmosphere that has been advanced recently by the Mt. Wilson astronomers.

It is well-known that in the earth's crust there are large quantities of unoxidized material. The product of volcanic eruptions also contain much free sulphur and unoxidized compounds such, for instance, as carbon monoxide. This suggests that the atmosphere of the earth was originally deficient in oxygen. This is borne out by the fact that the outer layers of the atmosphere of the sun are known to contain at present very little free oxygen, tho *oxides* of titanium and magnesium occur in sun spots. As the planets are believed to have been expelled from the sun by some cataclysmic outburst aeons ago, it is conceivable that they contained little free oxygen in their atmospheres at the time of their origin, because there was little free oxygen in the solar atmosphere with which to endow them at that time.

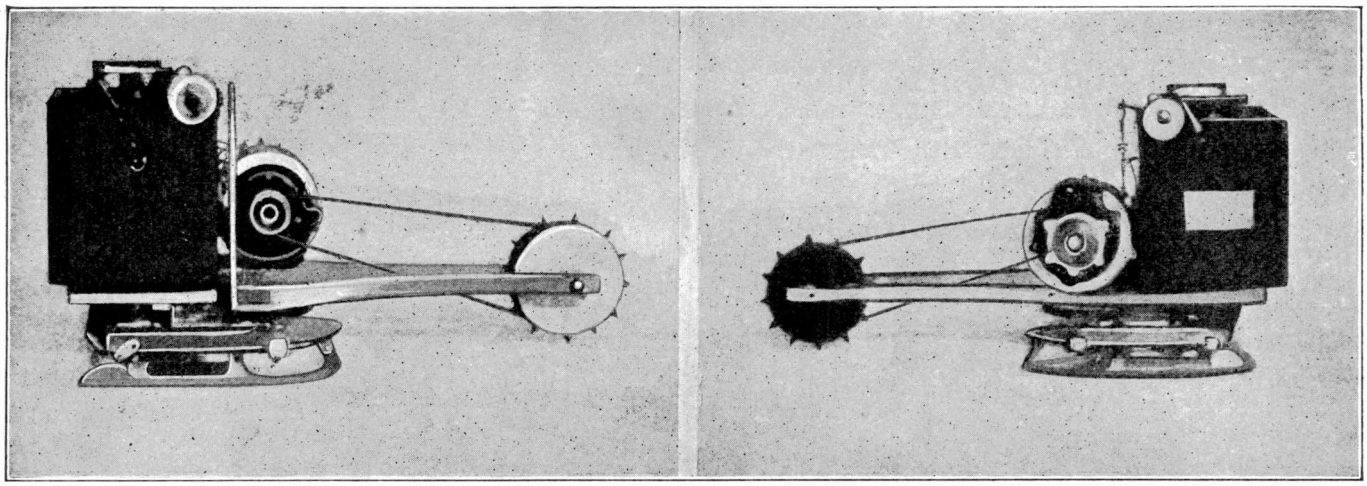
How then did the earth obtain its present abundant supply of oxygen? Conceivably as a product of plant growth in past geological ages, it has been suggested. Oxygen is a product of plant growth and there is sufficient carbonaceous residue in the form of coal in the sedimentary rocks of the earth's surface, it has been calculated, to account for the present supply of oxygen in the air. Has the earth, then, produced its own atmosphere in the past as a product of vegetable growth in geological times?

If this is so the other planets were probably likewise deficient in oxygen at the time of their origin and the discovery of oxygen in their atmospheres would be an indication of vegetational growth in past ages. Certain planets are known definitely to be incapable of supporting any form of life at the present time. The major planets Jupiter, Saturn, Uranus and Neptune are largely in a gaseous state at the present time and have no surface crusts so life of any form on these planets would be impossible. Mercury and the moon have such a small mass and their gravitational attraction is therefore so low that they could not retain extensive atmospheres permanently even if they were originally endowed with them. Venus and Mercury are the only two planets in the solar system that may have surface conditions at all similar to those on our own planet and it has generally been considered that, of the two, Venus is more likely to be in a condition suited for the support of life than is Mars. The discovery of the absence of the two prime essentials to life in the atmosphere of Venus is for that reason a decided surprise provided the light that has been analyzed comes to us directly from the surface of the planet or from the layers of its atmosphere close to its surface.

It is possible that surface conditions on Venus may be radically different from what they are on our own planet. It is still unknown whether Venus has a long or short period of rotation since it is not possible to observe definite markings on its surface by which the rotation period may be determined. The evidence at present seems to be in favor of the long rotation period. That is it is believed that the period of the planet's rotation on its axis equals the period of its revolution around the sun. In that case the planet always keeps the same face turned toward the sun, and conditions on the surface of the planet would be very different from what they are on the earth. On one side of the planet the sun would never rise and on the other side it would never set. There would be no seasonal changes and the temperature would be constant at any one place thruout the year since the planet's orbit is nearly circular. There would be a tremendous flow of air-currents from the hot illuminated side of the planet to the cold unilluminated side but it would not necessarily follow that all the water vapor would be deposited on the dark side in the form of ice and snow as some have maintained. The moisture-ladened currents would probably lose most of their contents by precipitation before they reached the side of the planet turned away from the sun. The circulation of air-currents between the hot and cold sides of the planet would tend to equalize the temperature and with the acid of the blanketing effect of the atmosphere might permit the development of vegetational growth on the side turned toward the sun. The dark side of the planet deprived of direct light and heat from the sun would be unsuited to the development of organic life.

It has been suggested by certain astronomers that the atmosphere of Venus may be filled with dense dust-clouds raised by the great winds that continually sweep the surface of this planet as a result of the great inequalities of temperature that exist on the two sides. A dust-ladened atmosphere might also result from excessive and continual outbursts of volcanic activity. On our own planet the effect of an unusual quantity of volcanic dust in the air is to lower the surface temperature by shutting out more of the short wave length radiation of the sun.

(*Continued on page* 65)



These Two Photos Show Opposite Side Views of the Electric Ice Skates Built by Mr. E. J. Kimble, Who Was Awarded the First Prize of $35.00, and Who, Moreover, Was the Only Contestant Submitting Manuscript and Illustrations of the Ice Skates and Which He Actually Built. Mr. Kimble Made Ten Miles an Hour With These Skates, Using a 1/5th H. P. Motor and Storage Battery, with Belt Drive, Which Is Very Commendable Indeed.

Electric Ice Skates Contest

$35.00 FIRST PRIZE AWARDED TO ERNEST J. KIMBLE

(ONLY ARTICLE SUBMITTED)

I HAVE often thought that some of the ideas which you published were more or less dreams, one of the most plausible, however, being the construction of Electric Ice Skates. Inasmuch as it would do no harm to try to build such skates, I made an attempt at constructing a pair and was rather surprised at the phenomenal results I obtained. The boys around here are now delegating me to build similar skates for them.

My construction varies slightly from that described in your article. Instead of rigidly securing the skate to a frame, I made a wooden base as illustrated in the accompanying diagram. Upon one end of this was mounted a wooden wheel (covered on both sides with tin), into which nails were driven. Rigidly secured to this wheel was a wooden disk grooved for a belt. The entire rig was carried by an ordinary carriage bolt for axle or shaft.

Of course, I realized that if I had used ball bearings, and constructed my device along finer lines, using say, a one-quarter horse power motor, and a chain as you suggested, I would have obtained better results; but the ice here does not last very long and it was imperative that the skates be built speedily and given a thoro test before the spring thaws broke up the skating grounds.

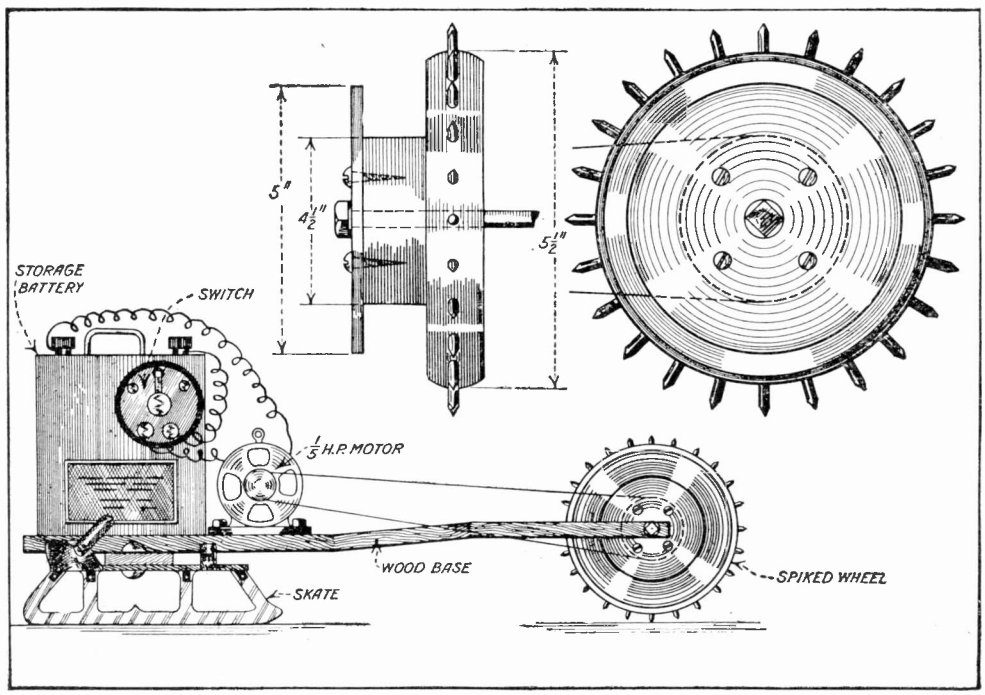
I then cut two pieces of wood to conform almost with the shape of a shoe, and clamped these into the regular skate clamps. Into each of these wooden blocks I drilled a hole three-quarters of an inch in diameter and inserted carriage bolts. These bolts were further secured to the motor plate and battery holder. This left the skates free to move in any direction and with sufficient play to even permit of their tilting, in order to execute the sharper curves.

An old pair of shoes were rigidly secured to the wooden pieces held in the skate clamps. I then obtained a one-fifth horse power motor which was fastened to the base and placed a storage battery in back of this. This motor was likewise fitted with a pulley wheel. At first I did not care to place a resistance into the circuit in order to gradually increase the speed of the motor as I was in a hurry to give the skates a test.

After I had made all arrangements for a clear pond, and signed my will, I stooped forward, reached over and turned on the switch. The motor started, the belt slipped around, and I went off with a slight jar to the tune of ten miles an hour. I found that the spiked wheel worked very effectively, and the leather belt slipped just enough to permit rounding curves without decreasing speed, and also when starting and stopping the device.

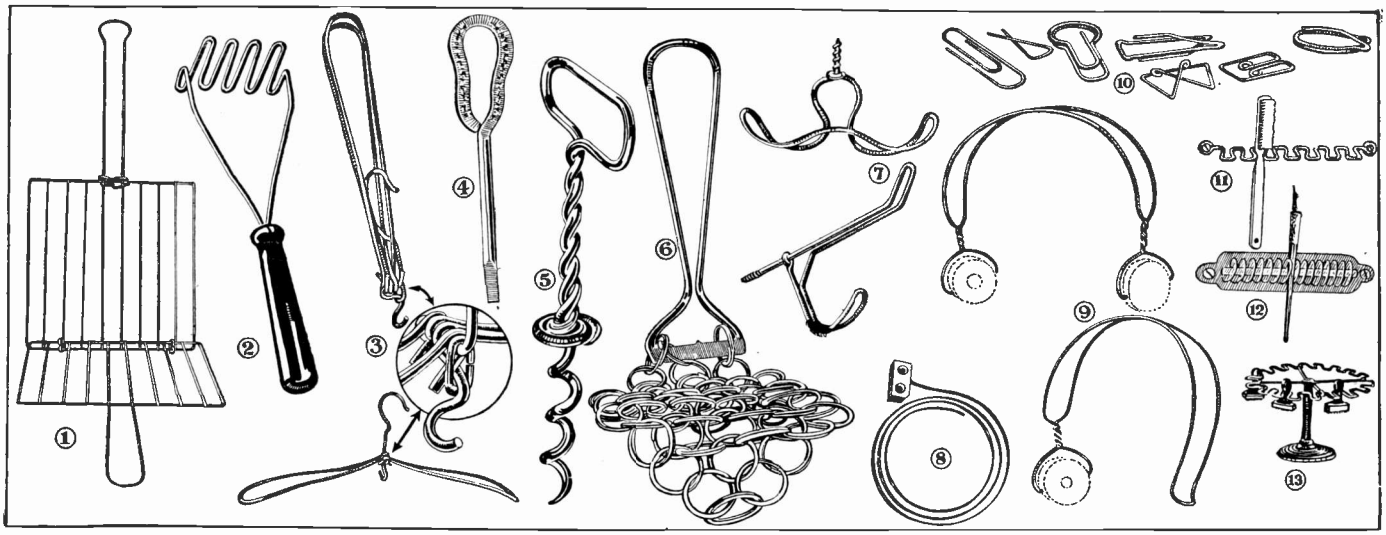
The battery consumption was very slight and I had many enjoyable afternoons buzzing around the pond without any exertion, except that of carting the battery and skates back and forth to and from the lake.

(*Editor's Note.*—Mr. Kimble is certainly to be commended on the simple manner in which he built his successful electric ice skates, here illustrated and described by himself. The editors who designed the original electric ice skates thought that the chain drive was one of the best, but this is not so easy to apply, especially in country districts where it is not always possible to pick up the necessary sprockets, etc. The belt drive is a very good solution of the problem, and either a round or flat belt could be used, but preferably the flat belt, we think. The wedge-shaped leather belt, built in sections, as used on several automobiles for driving the cooling fan, would prove very good for this purpose.



This Drawing Shows How Mr. Kimble, Prize Winner of the "Electric Ice Skates" Contest, Rigged Up His Belt Drive and Spiked Wheel With a 1/5th H. P., 6-Volt Motor, Operating From a 6-Volt Storage Battery. The Wooden Frame Was Bent, but Several Other Ways of Getting Around This Difficulty Are Possible.

$100.00 "Bent Wire" Contest



Simple Commercial Articles Bent From Wire and Which Have Made Money for the Inventors and Manufacturers Thereof: 1—Steak and Chop Broiler; 2—Potato Masher; 3—Folding Coat Hanger; 4—Screw Driver; 5—An Excellent Example of Bent and Twisted Wire in the Form of a Corkscrew (But as One of Our Staff Remarked, What Good Is It Now?); 6—Pot and Pan Cleaner, a Scraper Being Formed at the Bottom of the Wire Handle Where the Rings Join It; 7—Coat Hooks; 8—Clock Chime Made of Flat Steel Wire; 9—Single and Double Radio Receiver Head Bands; 10—Several Forms of Paper Clips; 11—Tooth Brush Holder; 12—Pen and Pencil Holder; 13—Rubber Stamp Holder.

TO most people a piece of bent wire suggests no remarkable possibilities. To others, who have imagination, it means a great deal. The other day, a negro elevator man who had been gazing at a wire fence across the way from the building where he was operating his elevator, thought that the same fence held undreamt of possibilities, so when he was not too busy running his elevator, he thought intensely, and after obtaining a few feet of the said fence wire, he finally contrived a mouse trap which he patented in short order. He is now drawing fine royalties from the results of his fruitful meditations.

In our illustration, herewith, we show a number of articles, all of which are made of bent wire. In figure 1 we see a household utility for broiling steaks made entirely out of wire. In figure 2 is shown a potato masher, while figure 3 depicts a collapsible coat hanger. Figure 4 illustrates a screw driver and figure 5 is a drawing of a corkscrew. Figure 6 is another household utility for scraping and cleaning pots and pans, the entire device being made of wire. Figure 7 consists of two coat hangers. A clock gong made of flat steel wire is found in figure 8. This is used in clock chimes. Figure 9 shows a possible idea for telephone receiver head bands, while figure 10 portrays a number of paper clips such as are used in every office now. All of these are of wire. The toothbrush holder shown in figure 11 and the pen holder shown in figure 12 as well as the rubber stamp holder in figure 13 are all made of the same material.

These are only a few ideas which we have picked out at random but there are several million more. As a matter of fact, there is no end of variety to what can or cannot be made successfully from wire. We have no doubt that our readers will be able to devise something new and interesting that can be made from ordinary wire. The one thing that is necessary in order to win a prize is *originality*. In other words, the idea must be new. The article, appliance, or whatever else it may be must not have been made before. Variations of existing devices will not be favored when the judges come to selecting the prize winners.

$100.00 IN PRIZES

First prize	$50.00 in gold
Second prize	$20.00 in gold
Third prize	$15.00 in gold
Fourth prize	$10.00 in gold
Fifth prize	$ 5.00 in gold
Total	$100.00

It should be borne in mind that the first prize will be given to a contrivance which proves to be, in the eyes of the judges, the most practical. This may be a household appliance or some utility article that is practical and can be used by everyone.

It is not absolutely necessary that a model of the idea be submitted with the entry, but if the idea is complicated, and cannot be clearly shown either in a drawing, or photograph, a model would be desirable. Such a model can be made of light wire, if it is impossible to make it in heavy wire without expensive tools. In all events a complete sketch must be furnished by the contestant, a clear photograph being desirable in case the model is not submitted, and if the contestant has actually made the article.

Manuscripts entered in this contest cannot be returned. We reserve ourselves the right to publish all worthy ideas that do not win a prize by paying regular space rates.

In publishing the articles all rights revert to the publishers except patent rights which revert back to the inventor or designer. Use only one side of the sheet in writing, and use ink or typewriting. Penciled matter cannot be considered. Contestants can enter more than one idea into this contest. It is open freely to everyone except to manufacturers already producing wire articles.

All prizes will be paid upon publication. This contest closes at noon, June 15th, at which time all entries will have to be in, in order to be qualified. Should two contestants submit the same idea, the same prize will then be paid to both. Address all communications to *Editor "Bent Wire Contest,"* care of this publication.

Washing Dishes Hard On Women

WHY some persons require more food than others was recently explained in a scientific manner by Dr. Thorne N. Carpenter, physiological chemist of the Carnegie nutrition laboratory. He told what kind of work consumed the greater amount of energy, putting dishwashing ahead of other forms of household duties for women and sawing wood as the hardest work for men.

Ironing is less hard than dishwashing, said Dr. Carpenter, and washing is next. In order, other tasks requiring less energy were sweeping, dressing an infant, sewing, crocheting and knitting.

The easiest task in his list of occupations of men was that of a tailor. In order other tasks requiring more and more energy in the form of food were bookbinding, shoemaking, metal work, painting, carpenter work and chiseling a tombstone, with wood sawing as the hardest.

Chewing gum requires much energy and should become a habit of those who would be thin, he said. A man of sedentary occupation, such as bookkeeper, needs to eat more meat in order to provide bodily warmth than a man engaged in hard outdoor labor. The latter is kept warm by his hard work and should have more of a vegetarian diet.

The amount of energy required to climb to the top of the Washington Monument, some 555 feet, would be provided by eating half a doughnut, or six unsalted peanuts, or five olives, or four pretzels. Every time one consumes an ice cream soda, it requires the same amount of energy in the form of heat to raise it to the temperature of the body as would be consumed in lifting a ton of coal three stories high, he declared.

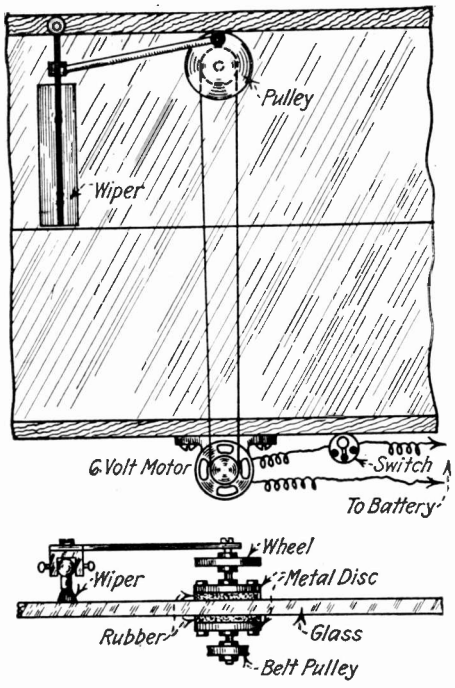
The lecturer confirmed as a result obtained by scientific experiment the popular belief that persons get fat because they eat more than they need. As he stated it, more calories are consumed than the body utilizes in work, and the oversupply is stored.

MOTOR HINTS

First Prize $25.00

ELECTRIC WINDSHIELD WIPER

This description and diagram is of an automatic, quiet and efficient windshield wiper which I have made and used on my car for some time.

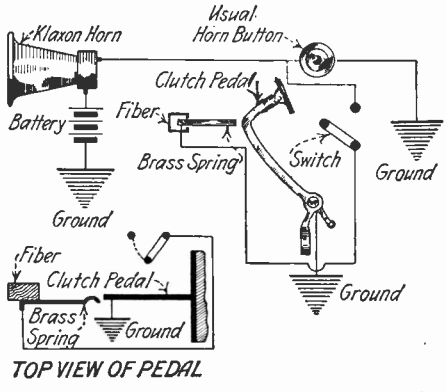


Automatic Windshield Wiper, Comprising a Standard Wiper With a Belt Pulley and Crank Shaft Arrangement as Illustrated. A Small Battery Motor Placed Under the Cowl, With Its Pulley Projecting Thru the Dash, Drives the Upper Pulley by a Round Leather Belt.

A small six-volt motor is mounted in the center or just below the center of the windshield. This is connected to a two-inch pulley which is fastened to one end of a small axle. This passes thru two metal discs which are mounted on opposite sides of the windshield. On the other end of the axle is fastened a small wheel which is connected to an ordinary windshield wiper by means of a connecting rod. All metal parts must be kept free from the glass by rubber bases to eliminate vibration and unnecessary noise.

The electric current may be taken direct from the battery or tapped from the dash-light.

Contributed by
B. H. BUTTERFIELD.



When Driving in Heavy Traffic it is Often Desirable to Keep Both Hands on the Wheel and Still be Able to Sound the Horn. This Can be Done by Simply Pushing in a Trifle on the Clutch Pedal, When the Auxiliary Contact Spring for the Horn Circuit Here Shown is Used. When the Usual Horn Button is to be Employed, the Pedal Circuit Switch is Opened.

NOTICE TO CONTRIBUTORS

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

ELECTRICITY ON THE CAR

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

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

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

The following prizes will be paid:

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

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

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

Second Prize $15.00

FOOT SWITCH FOR HORN

In the illustration below is shown a device which I have found very useful while driving an automobile in heavy traffic. One often gets into a position where he has to have both hands on the steering wheel and blow the horn at the same time, to warn people in front of him.

The diagram shows a horn circuit whereby the horn can be blown by merely pressing down the clutch pedal a little way. When you do not desire to use the clutch pedal to blow the horn, open the switch as shown, and the horn can then be blown by the horn button originally installed on the machine. Now when you get into heavy traffic, simply close the switch in circuit with the clutch pedal and keep your left foot on the clutch. When you desire to blow the horn, press down the clutch pedal slightly with your foot. The pedal will then make contact with the spring at the end where the spring is bent, causing the horn to blow. When you desire to stop, press the pedal down and the spring will no longer make contact with the pedal and, therefore, the horn will not blow while you are stopping.

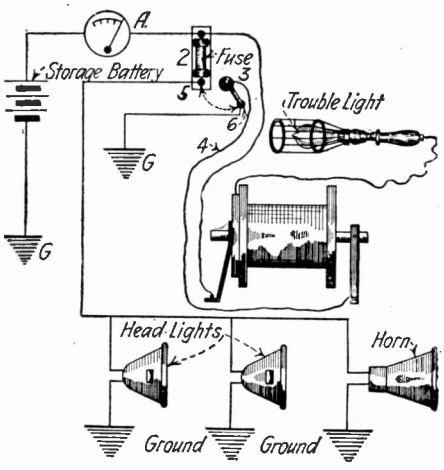
Contributed by HAROLD KAECK.

Third Prize $10.00

AUTOMATIC AUTO TROUBLE LIGHT

The automatic automobile trouble light consists of trouble lamp 1, fuse and fuse cut-out 2, wire reel switch 3, contact 6, and necessary wiring.

When switch 3 is in the automatic position, thereby making contact between 5 on fuse, and a short-circuit or ground takes place in any part of wiring on the automobile, fuse 2 will blow, thereby lighting trouble light 1. By grasping trouble light and releasing same from its clip holder one is enabled to carry the trouble light to any part of the automobile owing to twelve feet of flexible wire being wound on reel. As soon as short-circuit or ground is removed and a new fuse installed, trouble light will automatically extinguish and running lights will light. If it should be desired to make use of trouble light to make



Automatic Trouble Light—When the Fuse Blows Thru Some Fault in the Circuit, Such as a "Ground" or Short-Circuit, the Trouble Light Automatically Lights Up. If This Trouble Lamp is to be Used Otherwise, it Can be Lighted by Simply Turning the Switch Lever 3, to Point 6, Instead of Point 5, at One End of the Fuse. Six to Ten Feet of Flexible Cord is Reeled up on the Drum, Current Being Fed to This Cord Through Two Brushes, Via the Shaft and an Insulated Contact Ring and Brush on One Side of the Drum.

mechanical repairs without interfering with the running lights, it is only necessary to turn switch 3, thereby making contact between blade and contact 6, at the same time breaking contact at 5.

When switch 3 is in the automatic position trouble light is shunted across fuse and will light as soon as fuse is blown. When the switch is on the "on" position, contact between 5 and 3 is broken and contact is made between 3 and 6.

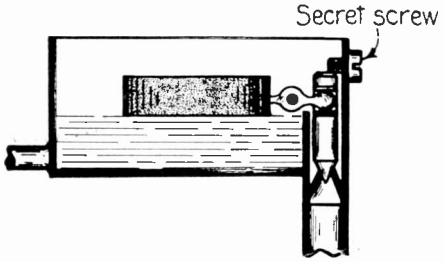
This outfit can readily be installed on all electrically equipped cars, all connections being made behind the dashboard without running any wires to the storage battery.

Contributed by FRANK G. DuROY.

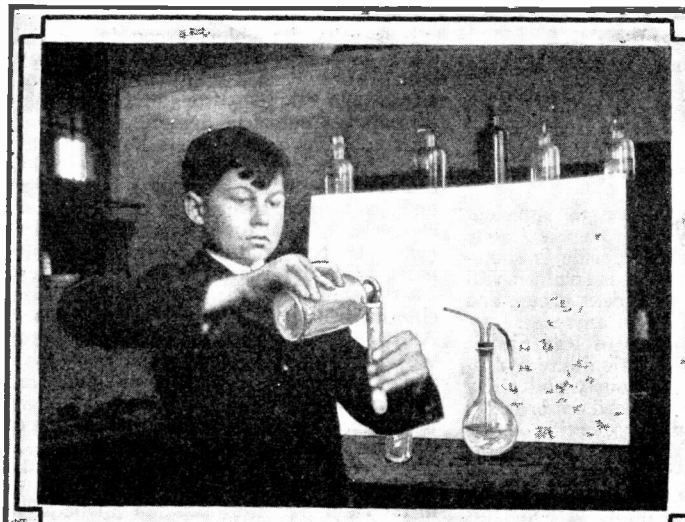
CARBURETOR LOCK

My idea is illustrated in the cut below. Drill and tap a small hole on a level with the top of the float valve in the carburetor. When the valve is seated or the natural position on the engine is stopped, put a small brass screw thru the hole and screw it tight. This screw should be just long enough to hold the valve down. One or two turns to the left releases the valve. When the screw is tightened it appears to be part of the carburetor and will fool any petty thief.

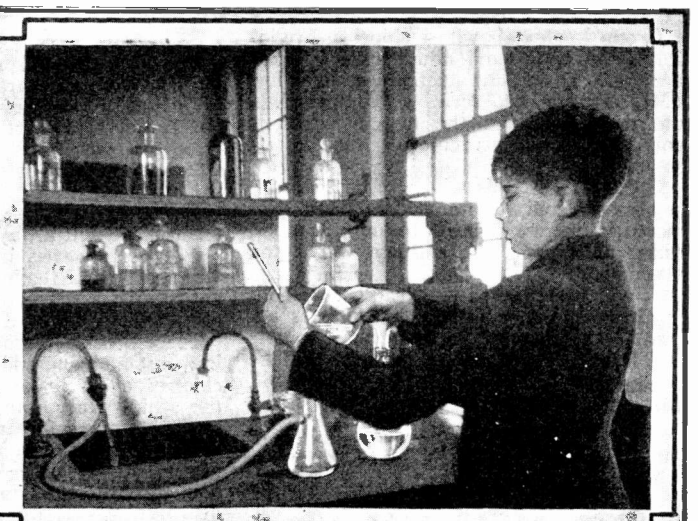
Contributed by
T. HARTLEY HALSTEAD.



A Thief-Proof Stunt Which Will Foil Many an Attempt at Stealing the Car, in the Form of an Innocent Looking Screw Threaded in the Side of the Carburetor Shell, so That a Couple of Turns With a Screw Driver Will Release the Float and Valve When the Car is to be Started by the Owner. Normally, the Screw Would Pass Unsuspected and Appear to be Part of the Carburetor Assembly.



Student Performing Experiment in Precipitating Lead Chlorides



Using the Spigot Suction Pump to Filter by Vacuum

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

THERE is no division of chemistry which appeals so strongly to the beginner as that of *qualitative analysis.* When he reaches this point in his chemical career, he begins to think he is becoming a real chemist. And it is certainly true that qualitative analysis is of fundamental importance. It logically follows the elementary course and precedes quantitative and special work. Any student who has consistently followed this series of articles, which have now been running for more than two years, is ready to take up qualitative work. Especially is this true if in conjunction with them he has studied some standard book. It cannot be emphasized too strongly that any real success in chemistry must have a broad foundation and a thoro knowledge of fundamental principles. Learn all about general chemistry. Make your information just as complete as possible. A mere analyst simply follows a mechanical routine. He may be very skillful, but he must unite with this skill breadth of knowledge, if he is to do any of the big things in the chemical world. When your knowledge and technical training are so full and accurate that you can solve, first-hand, real industrial problems that are presenting themselves to manufacturers every day, then you can command your own salary.

Purpose of Qualitative Analysis: Qualitative analysis seeks to discover what elements and chemical groups are present in some substance and also what ones are absent. It is just as important, and frequently more so, to know what is absent from a given sample as to know what is present. Often the purpose of a qualitative analysis is to determine what impurities may be present in a substance the general composition of which is known. For instance, you might wish to determine the presence of charcoal in manganese dioxide, or that of alum in baking powder. The applications of this interesting branch of chemistry are innumerable.

Methods of Procedure: Before we start upon the preliminary work of analysis, it will be best to review briefly the general methods of manipulation.

Precipitation is one of the most frequently used methods of separating and detecting substances. Before you can recognize the presence of an element you must get it into the form of some compound whose characteristics are well known and which serve to identify it with certainty.

Qualitative Analysis Paper I

Such compounds are most often insoluble substances called precipitates. Precipitation is the process of bringing together two solutions and obtaining an insoluble compound. For example, if we add a solution of barium chloride to a solution of sodium sulfate, we shall obtain a precipitate of white, insoluble barium sulfate.

Filtration: After a precipitate has been formed it is usually necessary to separate it from the liquid in which it is suspended. This process consists in pouring the liquid containing the precipitate upon a folded filter paper placed in a funnel. In doing this allow the mixture to flow down a glass stirring rod, so as to avoid spattering; keep the rod down in the funnel. (See Figure 1.) To prepare the filter paper so that it will fit your funnel, fold it in half, and then fold it in half again. When you open it, there will be three thicknesses of paper on one side and one on the other. It will then exactly fit your funnel, and to promote rapid filtration this folding must be done neatly and carefully. As you put the filter in your funnel, fit it down to the sides of the glass and, holding it there with the forefinger, wet it.

Suction filtering is highly desirable as a time saver. When precipitates are heavy, as they are bound to be in the work that follows in this and succeeding papers, ordinary filtration is a very slow and tedious process. But if you have running water and a faucet, preferably of the goose-neck type, it is a simple matter to use an aspirator and greatly hasten the operation. For this it will be necessary to have a side-neck Erlenmeyer flask and a small aspirator to attach to the faucet. Place a one-holed rubber stopper carrying a funnel in the mouth of the flask and connect the side-neck to the aspirator by means of rubber tubing. Place the mixture to be filtered in the funnel, being careful not to allow it to come above the filter paper. Then turn on a small stream of water; this produces suction beneath the filter and greatly hastens the process. If the suction is made too great, a hole will appear in the tip of the filter and the process will have to be repeated. A double thickness of paper is sometimes useful in avoiding this. See Figure 2.

Decantation consists in allowing a liquid containing a precipitate to settle and then pouring off the clear liquid. This may be done to advantage where the precipitate is heavy and quickly settles. Decantation and filtration may often be combined.

Washing precipitates is one of the most vital processes in qualitative analysis. After you have your precipitate upon the filter, it will still be saturated with the liquid from which it has just been filtered and this must be removed. This is accomplished by filling the filter four or five times, generally with *hot* water, and allowing it to run completely thru after each addition. The washings are usually tested with a suitable reagent to determine when the process is complete.

Right here is a good place to emphasize the fact that in qualitative analysis the utmost cleanliness must be observed at all times. Apparatus must be perfectly clean and the water used for all purposes ought to be distilled. Distilled water may be unavailable, however, but that need not discourage anyone from carrying out these experiments.

Reagents are the chemical substances used in bringing about the reactions employed in the processes of analysis. These will be mostly in the form of solutions, and as the work proceeds the experimenter should provide at his laboratory desk neatly labeled reagent bottles, which will always be ready for use. After pasting the labels on the bottles it is best to shellac them so as to prevent the liquids from removing the ink or label.

The blowpipe, as we shall see, will be frequently employed to give important indications of substances which may be present.

Detection of Metals

Qualitative analysis proper has to do with the detection of the metals and acid radicals of inorganic compounds. This work can be arranged into a very systematic course of procedure. Organic analysis is a much more difficult process because of the almost infinite number of organic substances. But we shall not have anything to do with that branch of the work for some time.

The first division of qualitative analysis comprises the systematic determination of the metals. For this purpose the metals are divided into five groups depending upon the solubilities of certain classes of their compounds. This classification follows:

Group I. Metals whose chlorides are insoluble in water and dilute acids. These are lead, silver and mercurous mercury. (Mercury has two series of compounds—the mercurous and the mercuric. It is only the mercurous chloride that is insoluble.)

Group II. Metals whose sulfides are insoluble in cold, dilute acids. These are mercuric mercury, lead, bismuth, copper, cadmium, arsenic, tin, antimony, gold and platinum.

It will be observed that lead occurs both in Group I and in Group II. This is because lead chloride is somewhat soluble and therefore not all of the lead will be precipitated in Group I. Some of it will pass on into the second group.

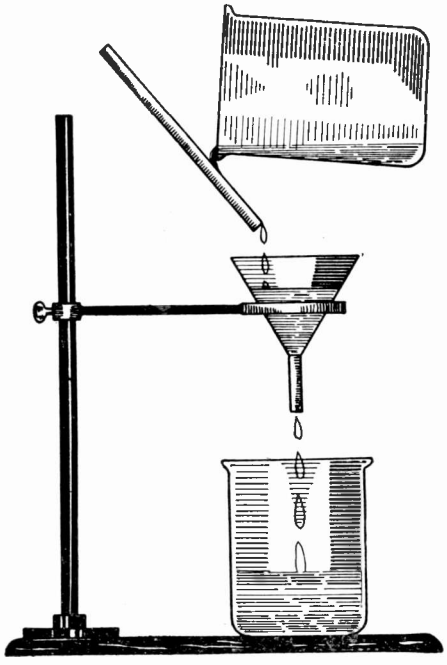


Fig. 1. Filtering. The Liquid Is Allowed to Flow Down a Glass Rod and Drip from the End.

Group III. Metals whose hydroxides or sulfides are insoluble in ammonium hydroxide. These metals include chromium, aluminum, iron; cobalt, nickel, manganese and zinc.

Group IV. Metals whose carbonates are insoluble in ammonium chloride. There are three metals in this group—barium, strontium and calcium.

Group V. Metals whose chlorides, sulfides and carbonates are soluble in ammonium chloride. These are magnesium, sodium, potassium and ammonium. Altho the ammonium radical is not an element, it behaves like a metal and therefore is classed as one.

Group I

We shall make some preliminary tests to determine the characteristic reactions of the metals of this group. It will be worth your while to keep a very accurate record in which you tell exactly what you do, what results you obtain and what conclusions you draw.

Lead: If lead is present in sufficient quantity, it will always be found in Group I. Since, however, lead chloride is somewhat soluble, if the amount is small, it will not be discovered until the next group, and some will be found there in any case.

Place 3 cc. of a solution of lead nitrate in a test tube and add a little dilute hydrochloric acid. Shake vigorously and allow the white precipitate of lead chloride to settle. Pour off, or in scientific terms *decant,* the clear liquid. Add water to the precipitate remaining in the test tube and boil. Continue to do this until it has all dissolved, saving the solution. Divide this solution into three portions. Into one pass hydrogen sulfide gas and obtain a precipitate of black lead sulfide. (In the next paper we shall describe how to prepare hydrogen sulfide.) Into the second portion pour a little dilute sulfuric acid and a white precipitate of lead sulfate will be obtained. Into the third portion pour a solution of potassium chromate or dichromate, either one, and you will obtain a yellow precipitate of lead chromate, better known as *chrome yellow.*

These tests are characteristic of lead, the last being the most decisive one.

Silver: To 3 cc. of a solution of silver nitrate add a little dilute hydrochloric acid. Shake the test tube, allow the white, curdy precipitate of silver chloride to settle and decant the clear liquid. Boil the precipitate with water as in the case of lead. Does it seem to dissolve? Filter, catching the filtrate in a clean test tube and obtaining the silver chloride upon the filter paper.

Into the filtrate pass hydrogen sulfide. If you have added enough hydrochloric acid to obtain complete precipitation of the silver as chloride, you will obtain no precipitate here. This shows that silver chloride, unlike lead chloride, is not soluble in hot water.

Thru the precipitate of silver chloride on the filter paper pour ammonium hydroxide, catching the solution which passes thru in a clean test tube or small beaker. The silver chloride will dissolve in the ammonia, forming a double compound of the two substances. Add to the solution a little dilute nitric acid and immediately the white silver chloride will be thrown down again.

If silver chloride is obtained at this point, it is taken as proof that silver is present. As additional evidence, filter off the precipitate and expose it to diffused sunlight. It will turn purplish in color.

Mercury: If mercury is present in mercurous salts, its chloride can be precipitated as lead and silver chlorides have been. To 3 cc. of a solution of mercurous nitrate add dilute hydrochloric acid, being sure that a sufficient amount of acid has been added to precipitate all of the mercury. As before shake the test tube, allow the contents to settle, pour off the clear liquid and, to be sure precipitation has been complete, add a little more hydrochloric acid. If precipitation should occur, add more acid and repeat the above process. To the combined precipitates of mercurous chloride add about 10 cc. of water and boil. Allow the precipitate to settle and decant the clear liquid. Repeat this twice more and then finally a third time, this time filtering and catching the filtrate in a clean test tube. Test this filtrate with hydrogen sulfide. No precipitate should occur. If it should it would indicate that mercuric salts were present with the mercurous nitrate and that they had not all been removed in the previous washing.

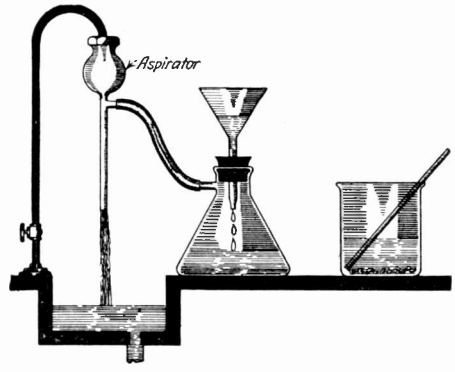


Fig. 2. Filtering with the Aid of Suction.

Now add ammonium hydroxide to the mercurous chloride on the filter paper. It immediately turns black, forming a mixture of mercuric ammonium chloride and mercury. This is usually considered sufficient proof of the presence of mercurous mercury. If you like you may dissolve the black mixture by boiling it with dilute aqua regia, *i. e.,* a mixture of concentrated hydrochloric and nitric acids to which a little water has been added. The filter paper and contents may be boiled. Then filter and add a solution of stannous chloride. The mercurous chloride will be reprecipitated, and if enough stannous chloride is added mercury itself will be obtained

In the next article in this series we shall start with the separation of a mixture of these three metals of Group I and then proceed with the other groups in order. Following that we shall take up the analysis of acids and finally the systematic analysis of unknown substances.

(To be continued)

Copper and Other Ores Located Scientifically

Dr. G. M. Butler, of the College of Mines and Engineering and Arizona Bureau of Mines, the University of Arizona, Tucson, stated in answer to our special request for more detailed information regarding the newly reported method for locating ore:

"In reply to your inquiry of recent date in which you ask information concerning the ore-locating device developed by the Arizona Bureau of Mines, I wish to say that we have been conducting experiments with it for over a year, and now feel convinced that it is practical. Our work has been almost entirely confined, however, to copper ores, but we are satisfied that it will operate equally well on pyritic gold ores. We expect to continue our experiments for several months more, and hope to have an opportunity to ascertain whether it can or cannot be used to locate deposits of other metals.

"No description of the process or apparatus will be issued until it is known that our application for patent has been received and filed in the Patent Office at Washington. Neither will any attempt be made to use the apparatus commercially until more information concerning its possibilities and limitations has been secured. It is possible, however, that one or more companies will be formed next summer to use the process commercially, and I shall be very glad to hand your name to the officers of such companies, when formed. The University will never use the process for the benefit of individuals, and may make no attempt to benefit financially in any way from the invention. It will, however, probably retain sufficient control over the invention so that it will not be used by incompetent or dishonest people.

"The process is not applicable, so far as is now known, to the location of oxidized ores, nor can it at present be used where there are numerous metallic connections between the surface and underground sulphide ore bodies.

"The apparatus used is comparatively expensive and delicate, and a high degree of technical skill is necessary to utilize it satisfactorily. For these reasons, it is presumed that mining companies will employ men trained in the use of the method rather than attempt to use it themselves. The expense of the work may then easily run up into thousands of dollars, but under suitable conditions may readily result in the saving of vast sums of money and the more complete development of our mineral resources."

Experimental Electro-Chemistry

By RAYMOND B. WAILES

FIRST PAPER OF A NEW SERIES

WHEN two such notables as the chemical and electrical engineer pool their wisdom, things are bound to happen. The science of electro-chemistry, so important to everyday life, is a result of such pooling. Electro-chemistry has to do with the invisible, but not the mysterious. Altho the

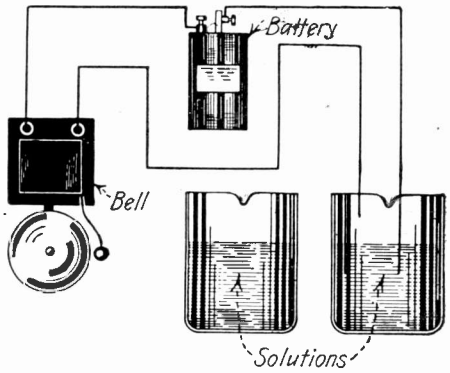


Fig. 1 One of the Simplest Tests That Can Be Made in Electro-chemistry Is to Determine Which Solutions Will Ionize, or in Other Words, Become Electrolytes. If the Solution Ionizes, and Is, Therefore, an Electrolyte, the Bell Will Ring; Otherwise, It Will Not. In Other Words, Some Solutions Are Electrically Conductive, While Others Are Not.

ion which plays such an important part in electrolytic or electro-chemical processes has never been seen, many proofs are available which show its actual presence, its isolation and even its rate of movement.

Of the many substances which could be used to show the laws of electrolytic dissociation and electrolysis, ordinary salt is amongst the most common.

Common table salt is a chemical compound of sodium and chlorine and is called sodium chloride. A compound containing two or more elements and of the smallest part of the whole capable of entering into a chemical reaction is called a *molecule*. An *element* is a substance which cannot be subdivided into other simpler substances. Sulphur, radium, oxygen, lead, hydrogen, sodium, copper, chlorine, are all elements. When they enter into a chemical reaction they are called *atoms*. So, table salt contains the atoms sodium (abbreviated Na) and chlorine (abbreviated Cl). The chemical composition of salt is written NaCl.

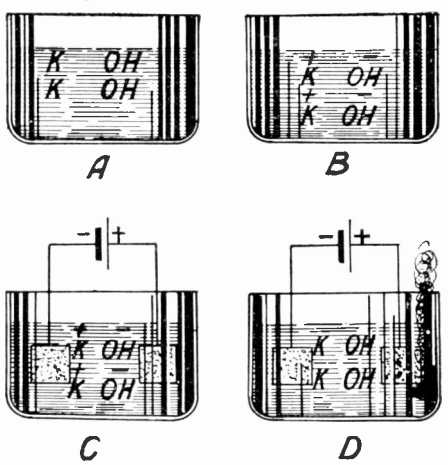


Fig. 2 A Shows Two Molecules of Potassium Hydroxide (Caustic Potash), Not Yet Dissolved in Water. B, the Molecules Dissolved, and the Formation of Ions. C, the Migration of Ions Toward Unlike Charged Electrodes. D, the Liberation of Atoms, or the Neutralization of the Charges Upon the Ions.

Dissociation

Certain substances, like sodium chloride, when dissolved in water, partly *dissociate*, or form *ions*. An ion is an atom or unsaturated group of atoms having an electrical charge, which may be either positive or negative. An unsaturated group of atoms, such as OH, is called a *radical*. Here, the hydroxyl radical is designated, the O being oxygen and the H hydrogen—both elements.

The small electrical charge which is formed on the surface of the ions when certain substances begin to dissociate, greatly modify the properties of the elements and radicals in the molecule of the substance. In many cases, the original identity of the atom is entirely lost.

When sodium chloride, or common salt, dissociates in water, the sodium atom acquires a positive charge of electricity and becomes an ion, and the chlorine atom acquires a negative charge of electricity, also becoming an ion. An ion with a positive charge of electricity is called a *cation*, but if it has a negative charge it is called an *anion*.

We all know the old rule, "Like charges of electricity or magnetism repel each other, and unlike charges attract." So it is with ions differently charged as in the case of sodium and chlorine. In order to separate the two ions, or break the former molecule apart, the process of *electrolysis* is used. When a substance dissociates it does not mean that the ions are lying idle, waiting to be dipped from the water, or again that the molecule is torn asunder, ready for easy picking. Sometimes the energy required to unlock or separate them is enormous. If the water is evaporated, and the salt is left high and dry, the molecule is simply formed again. It will yield ions again when dissolved.

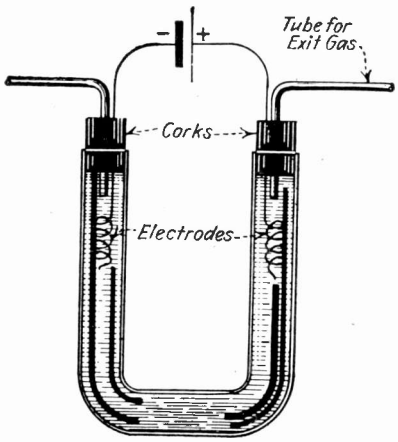
It must not be understood that all substances which dissolve in water yield ions. Sugar dissolves in water but ions are not formed. How, then, can ions be detected?

The universal property of substances capable of dissociating or yielding ions is their property to conduct electricity. Our figure 1 shows several beakers or glasses filled with solutions of common substances. The bell or buzzer is connected with the battery. When the free ends of the wires are touched together the bell will ring, showing electrical conductivity thru the circuit. If one of the beakers or glasses contains an *electrolyte*, or substance which contains ions, and the free ends of the wires are dipped into it, the bell will ring. Substances which, when dissolved in water, do not cause the bell to ring when the wires are immersed into it, are called *non-electrolytes*. Sugar is an example of this class, because it does not *ionize* when dissolved in water. A short list of non-electrolytes and electrolytes are given herewith:

Electrolytes	*Non-Electrolytes*
Salt	Alcohol
All acids,	Benzene
Caustic soda	Glycerine
Potassium nitrate	Gasoline
Sodium acetate	Sugar
Barium chloride	
Rochelle salts	

Caustic potash or potassium hydroxide has the formula KOH. Here K is potassium and the OH oxygen and hydrogen respectively. When dissolved in water it dissociates, conducts electricity, and is therefore an electrolyte and therefore contains ions. In figure 2 A, is shown a battery or other jar containing water, with two molecules of potassium ready to be dropped into and dissolved in the water. At B, fig. 2, the two molecules are shown dissolved in the water. They are now ions, as can be seen by their electrical charges. The dissociated molecule could now be written

$$\begin{matrix} + & - \\ K & OH \\ + & - \\ K & OH \end{matrix}$$

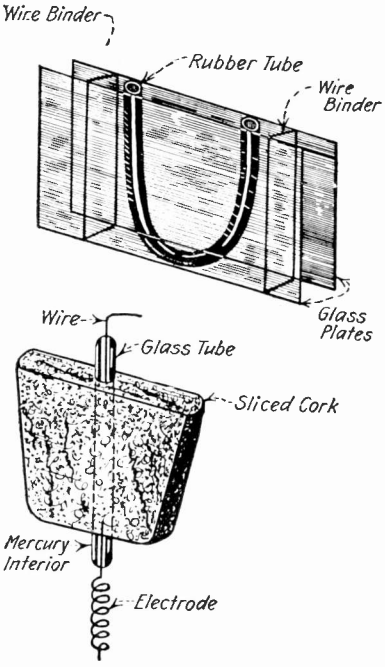


The U-tube Form of Electrolytic Cell. The Bent Exit Tubes Facilitate the Collecting of Gaseous Products. Spiral Wire Electrodes Are Convenient in This Form of Tube. Fig. 3.

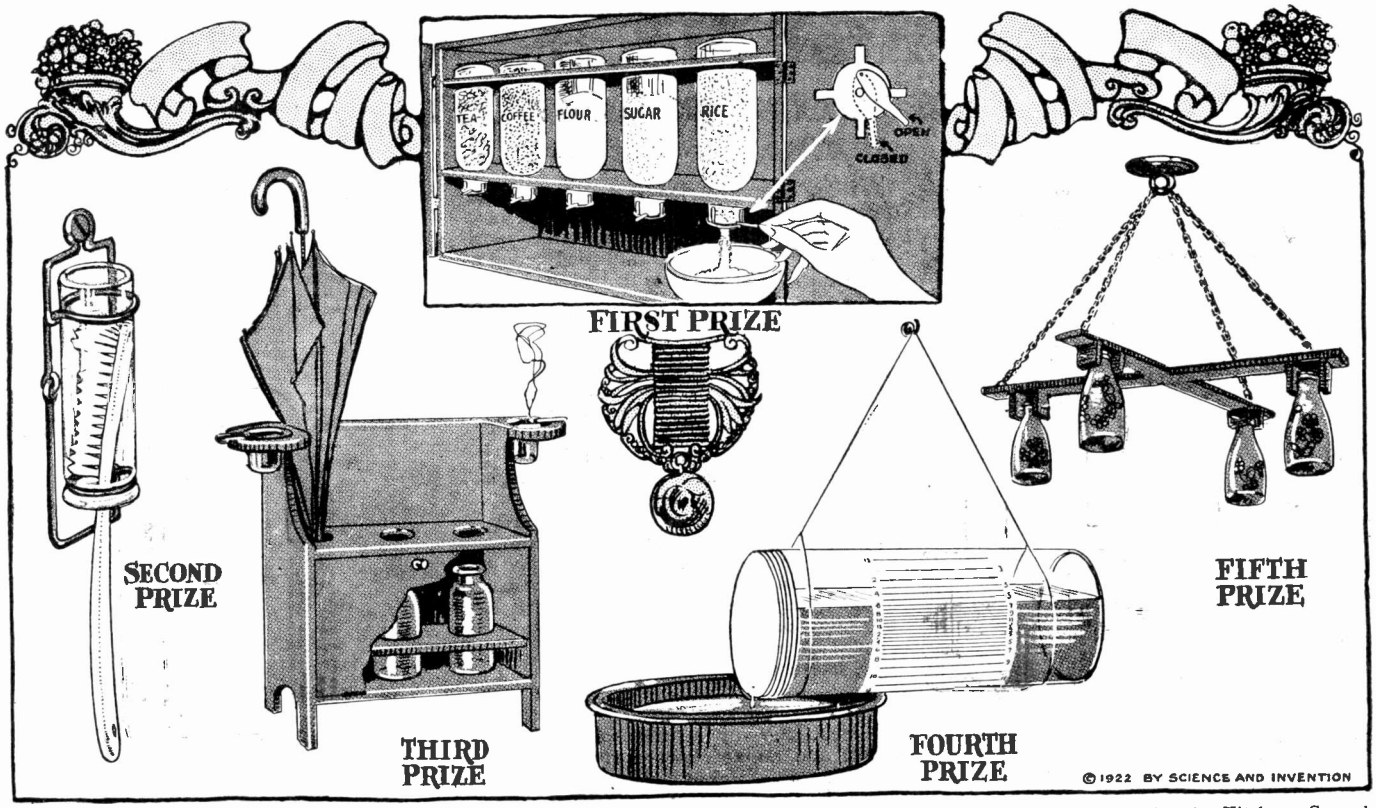
the potassium has a positive charge, and the OH radical, or hydroxyl group, a negative charge.

Now, if two metal plates or electrodes connected to a battery are inserted into the liquid or electrolyte, the positively charged $^{++}$ ions (KK) will be attracted to the negative pole, or cathode, and the negative ions $^{--}$ (OH OH) will be attracted to the positive electrode, or anode, as shown at C, figure 2. This is in accord with the old rule, given above. Now, as soon as the charged ions come into contact with opposite charges of electricity—those on the electrodes—they lose their charge, and become molecules (D, fig. 2).

(*Continued on page* 68)



Above—a Simple and Easily Made Experimental Electrolytic Cell. The Glass Plates Enable Non-distorted Vision. The Rubber Tube Should Be Soft and Pliable. Below—an Electrode for Use in the Experimental Cell. Fig. 4.



Here Are the Prize Winners; First Prize of $50.00 Goes to Mr. Joseph Piva for His Idea of a Coffee, Sugar and Spice Dispenser for the Kitchen; Second Prize of $20.00 Was Won by Rolla Harrison for His Tooth Brush Holder; Third Prize of $15.00 Goes to Adolph F. Lonk, for His Umbrella Stand and Ash Receiver Made From Old Bottles; Fourth Prize of $10.00 Was Awarded to Irving A. Goetz, 13 Years Old, for His Suggestion of a Water Bottle Clock; the Fifth Prize of $5.00 Goes to Roy L. Girding for His Bottle Chandelier Idea.

Results of the $100.00 "Old Bottle" Prize Contest

IN our February issue, we announced our $100.00 prize contest and we mentioned there that we wanted original ideas on what to do with old bottles. In our rules for the contest, we said as follows:

Rules of the Contest

Only ideas for using bottles for other purposes than what they were intended for can be considered. In other words, we cannot consider ideas wherein bottles are used purely as containers as, for instance, filling with different solutions or materials. Such ideas are obvious.

No ideas involving bottles used as chemical glassware can be considered, as it is obvious that almost any bottle can be easily converted into a chemical bottle and many bottles are so used now. If, however, the contestant sends in a novel chemical experiment that employs a bottle in a new way, such an idea will be considered, but would have to be quite original. Not all cases where a bottle is filled with a liquid would be ruled out. We have shown on this page a bottle filled with a red liquid, it also containing an electric lamp. The combination is for a photographic developing room. Here, you see, is a combination where the bottle is a container, not only for a liquid, but for a lamp as well. Such a combination would, therefore, be allowable.

Bear in mind that the first prize will be given to the contributor who sends in an idea that proves to be, in the eyes of the judges, the most practical. Remember that we want PRACTICAL ideas, and many practical objects can be made from old bottles. It is a test of your ingenuity to find the best one.

In the judges' opinion the prize winner should have designed a practical household utility fit for the masses rather than individuals, and, therefore, variable condensers and such, unless extremely ingenious, were not contained in those selected.

The design of bottle lamp for household use for instance appears about 300 times. The tops or bottoms of bottles in brick walls, around flower beds, in concrete walks and on the roofs of houses appear at least 180 times.

Four or five ships in bottles were noted and candle stick holders came in dozen lots. Bottles as barometers occurred four times, and bottles as door-stops about 135 times.

Some designs submitted showed exceptional pains taken by contestants in illustrating their prize (?) winning ideas. Bottles as galvanometers or electroscopes, grease-guns, static machines, scales, boil eradicators, flower holders, shelf holders, and vases, occur scores of times. Bottles for signs occur 94 times, the hour glass about twenty-nine times, storage batteries, knobs, insulators, and fly catchers at least sixty times. Strange to relate women took a great part in this contest and there are about 85 entries from the fair sex.

In response to our announcement of this contest there were received over 4,600 replies of all sorts of devices, many of them duplicates.

In awarding the prizes, the judges have been mindful of carrying out the rules of the contest to the best of their ability. In other words, they have awarded the prizes to *practical ideas* as much as it was possible to do so. The prizes follow, herewith. The balance of the other ideas will be published from time to time in the magazine.

PRIZE WINNERS

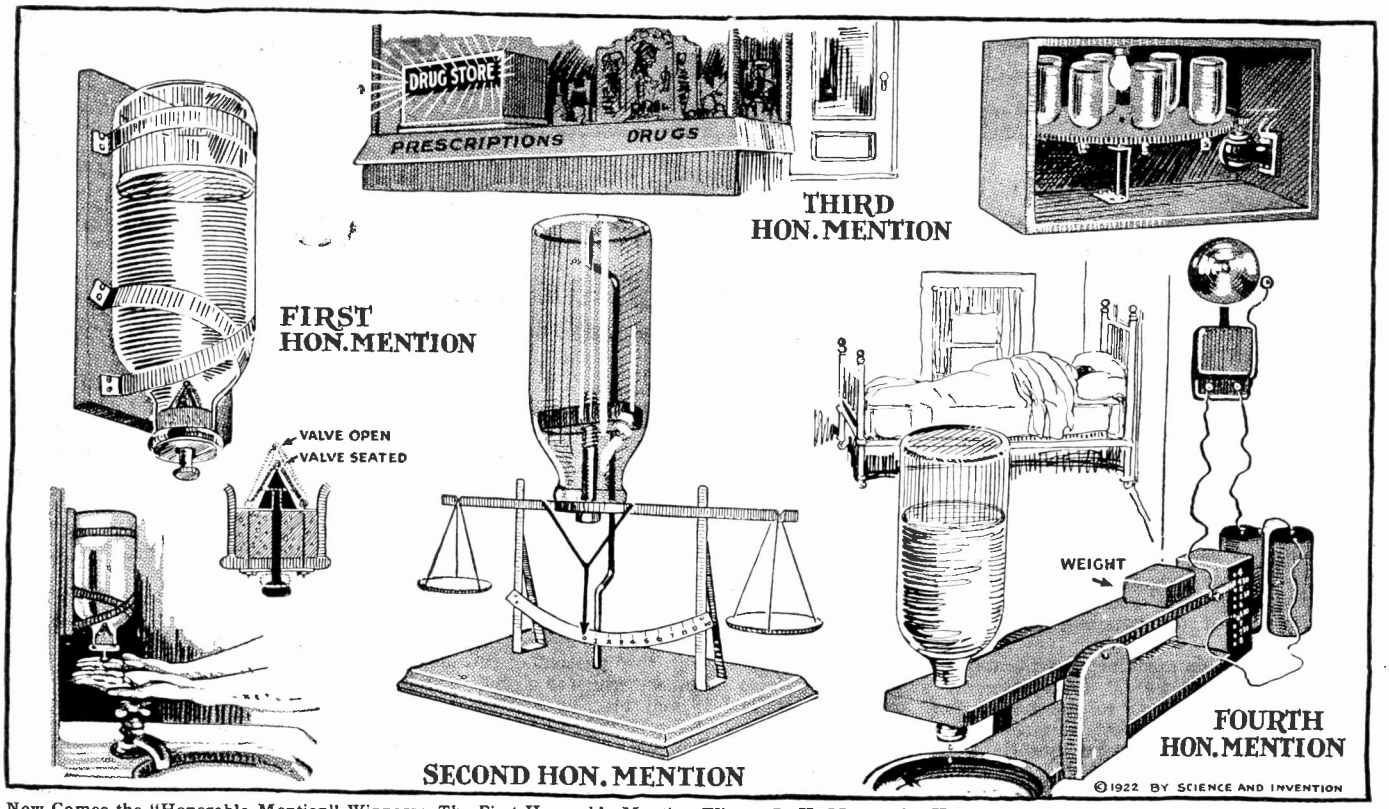
First Prize $50.00

Behold, all ye accumulators of ye olde wine bottles, milk bottles, medicine bottles, pill bottles, and *sawed off* bottles. We present the first prize winner, Joseph Piva, hailing from New Bedford, Massachusetts, who has designed what, in the opinion of ye judges, is ye best conglomeration of old bottles for practical use. This he built for his mother, and has had wonderful success with it. Fifty dollars in gold rolls in his direction. His construction data follows:

"I secured a board ⅜ inch thick, and cut one piece 25 inches long and 7 inches wide. This piece is the back of the box. The sides are made in a similar manner, and are 7 inches long and 6 inches wide. The top, likewise, 6 inches wide and 25 inches long, is then fitted in place. Into another board holes are cut, 2 inches in diameter, for the reception of the bottles. The entire device was then fitted with doors, so as to make a neat appearing cupboard, or it may be decorated and left open as desired. Over the mouth of each of the bottles I fitted a brass clamp. I have subsequently seen clamps of this type which may be purchased at the local 5c-10c stores, called sanitary milk tops, and made of aluminum. These clamp over the mouth of the bottle, and have secured to them a sliding shutter-like device, closing an opening in the top. With the aluminum tops, it would be necessary to secure the sliding shutter more rigidly, in that it fits quite loosely. The bottles are then labeled appropriately, and when mother desires some coffee, tea or flour, she steps over to the cupboard, moves the shutter sideways, and the contents pour out into the receptacle held below, much the same as fruit juice extracts are dispensed in the old style soda water fountains."

Second Prize $20.00

The second on the list is a Middletown, Ohio, youth by the name of Rolla Harrison, who has made use of the pill bottle. Securing several of these with mouths just a trifle narrower than the thickness of a



Now Comes the "Honorable Mention" Winners: The First Honorable Mention Winner Is H. Matzuo for His Invention of a Bottle Soap Dispenser. (Note the Clever Valve Easily Made by Anyone.) The Second Honorable Mention Is Awarded to L. Lesser for His Balance or Scale Made From a Bottle; Third Honorable Mention Is Awarded to Jesus Auzures for His Window Display Sign Made From Old Bottles; While the Fourth Honorable Mention Goes to R. J. Shryock for His Automatic Time Switch for Closing or Opening Alarm or Other Electric Circuits.

tooth brush from the back to the end of the bristles, he made a wire holder with a single piece of stiff wire. He says: "This kind of a tooth brush holder keeps the tooth brush clean, when Mary rinses it out, and as it is forced into the bottle, some of the excess moisture is squeezed out. The tooth brush maintains its position because of the slightly constricted neck of the bottle. Inasmuch as there is plenty of air space, the tooth brush dries readily, and is constantly sanitary." This contributor has attempted quite a few of our contests, and it is with great satisfaction that we learn of his success in the present one. Try, try again is a very good motto, which he evidently observed to his own benefit.

Third Prize $15.00

Our third prize winner is Otto F. Lonk, a retired, or, had we better say, ex-service army man, who submitted his ideas by the yard. One of these "took" exactly like a vaccination. Otto had his ideas on a dozen or more sheets of paper, pasted together, end on end. Neat sketches accompanied each typewritten suggestion. The device is an umbrella stand and ash receiver for hallways. He places milk bottles and small tablet bottles conveniently in a stand so that dripping umbrellas, or half consumed cigars and cigarettes may be deposited at the entrance. Otto gets two months army pay, $15.00 in gold. Seven dollars and fifty cents is all he had left after he paid war risk insurance, sent an allotment home, and paid 25 cents for a package of donated cigarettes.

Fourth Prize $10.00

The fourth prize, $10.00 in gold, will seem mighty big to Irving A. Goetz, thirteen years old. He entered with a suggestion of a clock. This clock is an ordinary fruit jar, into which two tiny holes have been punched. The jar is filled with colored water or old tea, the rubber fruit jar ring put in place, the cap screwed on tightly, and the whole suspended. On the outside of the bottle is a scale, divided up into hours, which has been graduated with another clock, and as the water drips out into a pan below, the time is automatically registered.

Fifth Prize $5.00

Roy L. Girding, from Philadelphia, Tennessee, takes the fifth award with a *bottle chandelier*.

Cutting off the bottoms of the bottles, he fastened them to two wooden cross-pieces suspended by a chain from the ceiling. In cutting the bottles, he used a thin emery rod, and ground a line all the way around the lower portion of a bottle, then gently tapping this with a piece of wood it broke on the ground line These he painted, and decorated. In using different colored wine bottles, the decorative effects were very pretty. Heavy glue was placed on the point of break, so that no injury would befall one from the slightly roughened edges. In inserting the socket, the wire is first led through the neck of the bottle, the socket attached, and then the wire drawn up tight. The bottles can be secured by their necks from pieces of wire. The outside of the bottle should be given a coat of shellac after it is painted, to prevent the paint from wearing off. The ingenious feature which Mr. Girding suggested was to glue dried flowers to the outside of the bottles.

Honorable Mention Awards

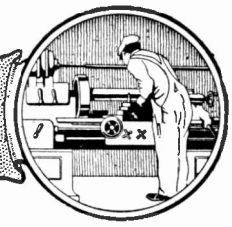
As is generally the custom in our prize contests we mention those suggestions, which, had the contest carried further prizes, would have been next in line for awards. The *first* of these is H. Matzuo, of New York City, who turned his old bottles into soap dispensers, by simply fastening a one-hole stopper into the neck, and securing to this a wooden or rubber peg made as illustrated. This was held in place by springs, jogging the peg up and down, permitted sufficient soap water to exude from the bottle.

A balance made from a bottle was the *second* honorable mention selected by the judges. This was designed by L. Lesser, also of New York City. He says, "First procure a rather wide-mouthed bottle, cover this with a piece of cardboard, and accurately locate the center, then punch a hole there. Thru this lower a small bob or piece of wood, having a drop of ink at the bottom, and lightly touch the bottom of the glass bottle. This leaves a mark in the dead center. Drill at this point with a file or drill, so as to make an indentation. Now secure a piece of wood, and cut this to the inside diameter of the bottle; this need not be very wide. The wood is drilled in the center for a screw. A cross-beam with a screw in its exact center is now placed over the mouth of the bottle, and the bottle and cross beam inverted. By "fishing" around for a while, the screw will find its way into the hole of the wood piece, where it is tightened. A bent rod then serves as the pivot point, and a scale is secured to the base upon which this pivot is mounted. It may be necessary to balance this with pieces of tinfoil, but when once accurately balanced it makes a very good scale because of this low center of gravity."

From Mexico City, Mexico, comes a letter from Jesus Auzures, considered by the judges as worthy of *third* honorable mention. This is a window display sign. The sign is painted on the front glass window of the box. Within the box is a rotary disc, turned by a small electric motor, thru either a frictional or geared drive. In the center is an incandescent lamp, and upon the disc are mounted the bottles, filled with colored liquids, blue, red, green, etc. These bottles then form a veritable merry-go-round, and the light shining thru them produces many colored effects. The appearance of the sign is greatly enhanced by placing mirrors within the box, so that all the colors are constantly being reflected and blend with each other.

R. J. Shryock, who comes from Lexington, Massachusetts or Kentucky, or any other Lexington, in that the state from whence he hails was omitted from his entry, takes the *fourth* honorable mention with a switch. This is simply a bottle filled with water on one end of the beam of a balance. The other end is weighted. A small hole is then made in the cork, or a needle valve inserted into it. The apparatus is hooked up to any kind of signal desired, and as the water leaks out of the bottle the weight follows which will either make or break an electrical circuit, causing the current to be shut off or turned on at a predetermined period as desired.

THE CONSTRUCTOR



Motorcycle Engined Monoplane

By WILLIAM J. BEACH

(WHO HAS BUILT AND FLOWN AIRPLANES OF THIS TYPE.)

THE monoplane herewith illustrated and described has been designed expressly for a two-cylinder motorcycle engine developing 12 to 16 H. P., which power will permit of a cruising speed of 50 to 55 M. P. H. while a maximum speed of 62 M. P. H. may be attained.

The design and general arrangement is the simplest possible, thus enabling those who already possess some knowledge of airplanes and of the handling of tools to construct it.

The cost of this machine, less the motor, should not exceed $65.00 (sixty-five dollars). With reference to the motor the writer would suggest that a racing type, over-head valve motor be used if such can be procured.

The first parts to be made are the wing beams which consist of three pieces of clear, straight-grained spruce, 1¼" thick, placed vertically, having pieces 3" by ⅝" extending along top and bottom, glued and screwed, thus forming I-beams as shown in Figs. 4, 5 and 6. The beams are held apart by solid compression ribs from which points the bracing cables are attached, the said cables should be of heavy steel wire.

The ribs are cut to fit the I-beams and lightened as in Fig. 5, all ribs and intermediate nose pieces are made from white pine ⅛" thick having capping pieces ⅝" by ⅛", top and bottom secured with glue and brads.

Figs. 4 and 5 show the method of fixing both the leading and trailing edges.

Hard-wood blocks are fitted at points where the beam braces, bolt holes for the diagonal struts, beam plates and aileron hinges are located.

Before covering the wings the aileron control guides and cables should be placed in position.

The ailerons, elevators, etc., are made by forming a box section and allowing the rib members to enter the same as illustrated in Figs. 4 and 12.

The fuselage is made from 1" square spruce (tapered towards the tail ends) having vertical and cross members as in Figs. 7 and 8; all are braced with steel wire, using automobile spokes shortened and converted into turn-buckles.

The method of securing the vertical and cross members to the longerons is similar to that employed in the earlier days of the art, and is suggested in this particular instance, due to its simplicity which is clearly presented in Figs. 13 and 14. To get the clips thru the ends of the vertical and cross pieces a ⅛" slot is made which is again filled with a wooden block after the clips are in position; the ends are bored and provided with dowel pins, the points of which are received by a recess formed in the longeron; it is obvious that one clip must be larger than the other to prevent interference in passing thru the longeron.

The tail skid as shown in Fig. 11 is made from oak and pivoted on a 1" tubular transverse member.

The blocks shown in Figs. 9 and 10 are secured at their respective positions in the fuselage for attaching the wings to; these blocks should be made from two boards glued and dowelled together to obtain the maximum of strength, after which they may be lightened as shown.

The diagonal struts are of spruce 1" and ½" thick, streamlined and provided with suitable metal fittings at each end for bolting to the wing beams and fuselage.

The deck piece forming the cock-pit is of veneer reinforced with spruce strips on the under side.

The under-carriage is made from two pieces of spruce glued together and having a suitably shaped piece of metal sandwiched and bolted between the two pieces of spruce, at and immediately above the slot in which the 1¼" axle is located and provided with the usual rubber cord shock absorbers; the under-carriage is streamlined, likewise the axle if desired.

The wheels are standard 26" by 2½" and may be disced with fabric or tin to reduce head resistance.

The controls may be operated by the usual stick method, or a wheel may be employed, as the builder prefers.

All surfaces and fuselage are covered with a suitable fabric; a good quality of unbleached muslin will answer the purpose admirably. Irish linen or standard *airplane cloth* is used on commercial airplane wings.

In covering the wings the cloth should be sewn to the ribs and a reinforcing strip placed over each rib and along the leading edge.

All covered surfaces are given four (4) coats of airplane *dope*, then spar varnished.

An aluminum cowling is arranged around the nose of the fuselage and provided with louvres and an air duct as is shown in Figs. 1, 2 and 3.

The wings are set at an angle of three degrees of incidence, while no dihedral is necessary with this particular depth, curve and camber aerofoil.

The engine is provided with propeller five feet in diameter and of three and one-half foot pitch, which will take this little monoplane into the air without any difficulty and allow him who would fly to wing his way.

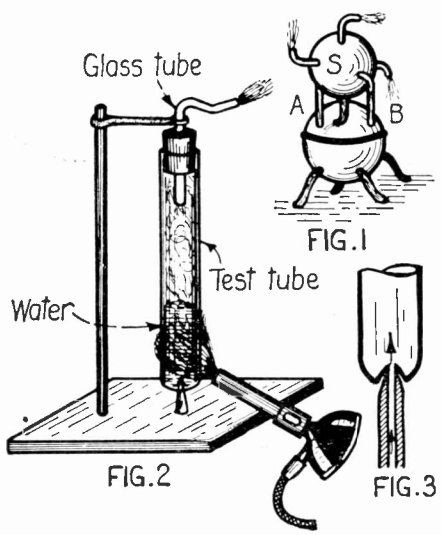
[*Additional information concerning blueprints and parts, wooden propeller, can be obtained from the author at nominal expense. Send stamped and self-addressed envelope for author's address.—Editor.*]

A Modern Hero's Steam Engine

One of the very earliest forms of steam engines is known as the Aeolipile or Hero's Steam Engine. It dates back to about 130 B.C. The original form is shown in Fig. 1. Water is heated in the boiler and the steam thus generated passes thru the pipes A and B into the sphere S. The reaction of the escaping steam gives the sphere a continuous circular motion as the radiating pipes retreat from the escaping steam.

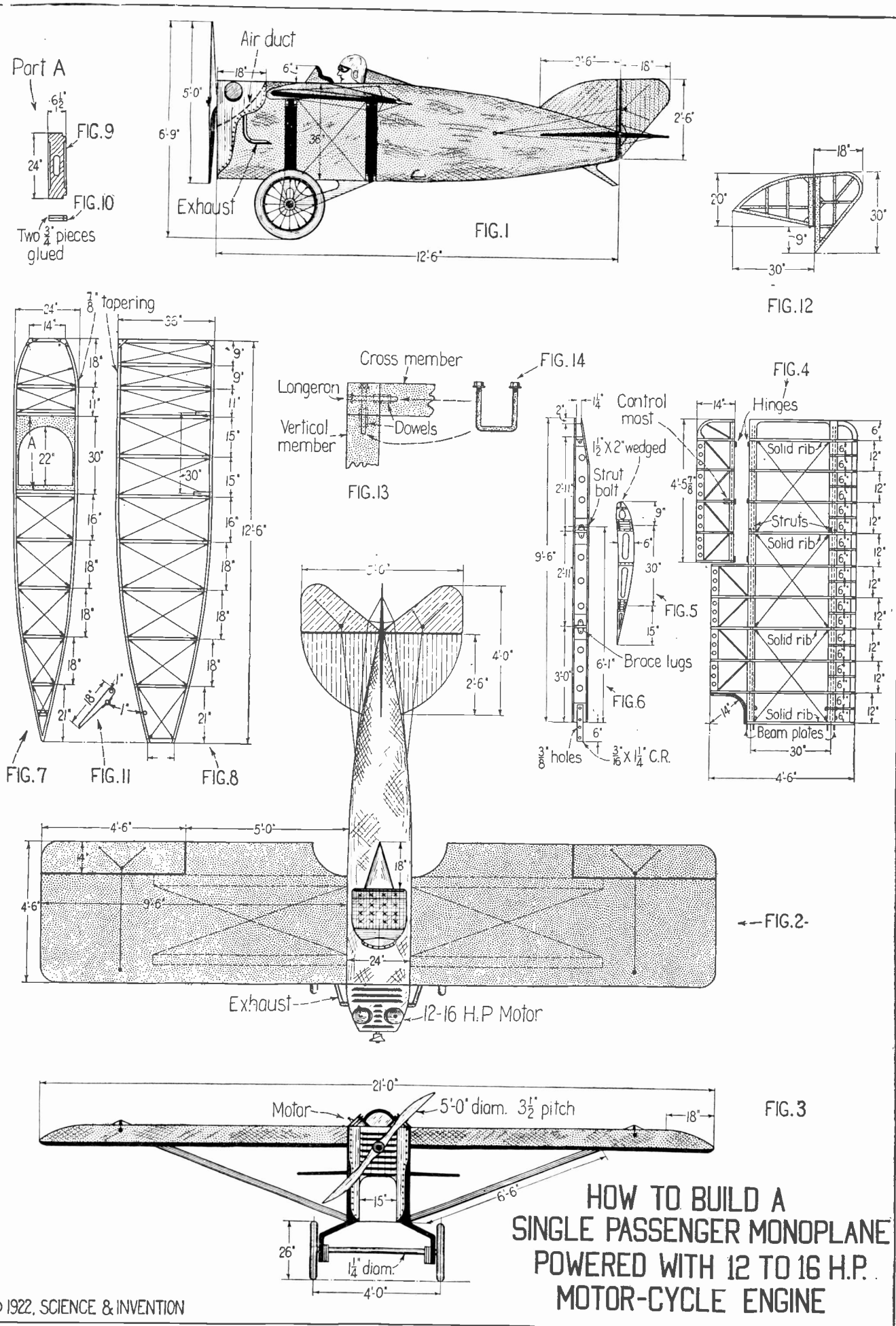
The modern form of Hero's Steam Engine can be made with a test tube, and a short piece of glass tubing. The bottom of the test tube is heated in a Bunsen burner flame and pushed in slightly with the pointed end of a nail. This makes a pivot for the test tube to rest upon. The short piece of glass tubing is bent forming two right angles in different planes, and the end drawn to a point. It is then inserted in the test tube thru a one-hole stopper. The arrangement is then set up as shown in Fig. 2. The test tube is filled about one-third full of water and heated with a Bunsen burner. The reaction of the escaping steam causes it to rotate very rapidly.

This device can be modified by drilling a small hole in the bottom of the test tube. It is then arranged to rest lightly on a glass tube of suitable size thru which steam is passed from a boiler. A small brass cylinder similar to a small bicycle pump works just as well and a hole can be drilled in it easier than a test tube. If sufficient gas pressure is available it will operate with gas. The gas can be lighted and a very brilliant effect produced.



One of the Very Earliest Forms of Prime Movers—Hero's Steam Engine. It Dates Back to About 130 B. C. The Original Form is Shown in Fig. 1. Water is Heated in the Boiler and the Steam Thus Generated Passes Thru the Pipes A and B Into the Sphere S. The Reaction of the Escaping Steam Gives the Sphere a Continuous Circular Motion as the Radiating Pipes Retreat from the Escaping Steam. A Modern Form of Hero's Steam Turbine Can be Made with a Glass Test Tube and a Short Piece of Glass Tube Bent to Form Two Right Angles, as Shown in Fig. 2. The Test Tube Rotates on a Point Resting in a Depression Made in the Bottom of the Tube. Fig. 3 Shows How Compressed Air or Steam from a Separate Boiler May be Passed Up Into the Test Tube, from a Hollow Point and Hole in the Base of the Tube.

Contributed by F. C. HENDERSHOT.



HOW TO BUILD A SINGLE PASSENGER MONOPLANE POWERED WITH 12 TO 16 H.P. MOTOR-CYCLE ENGINE

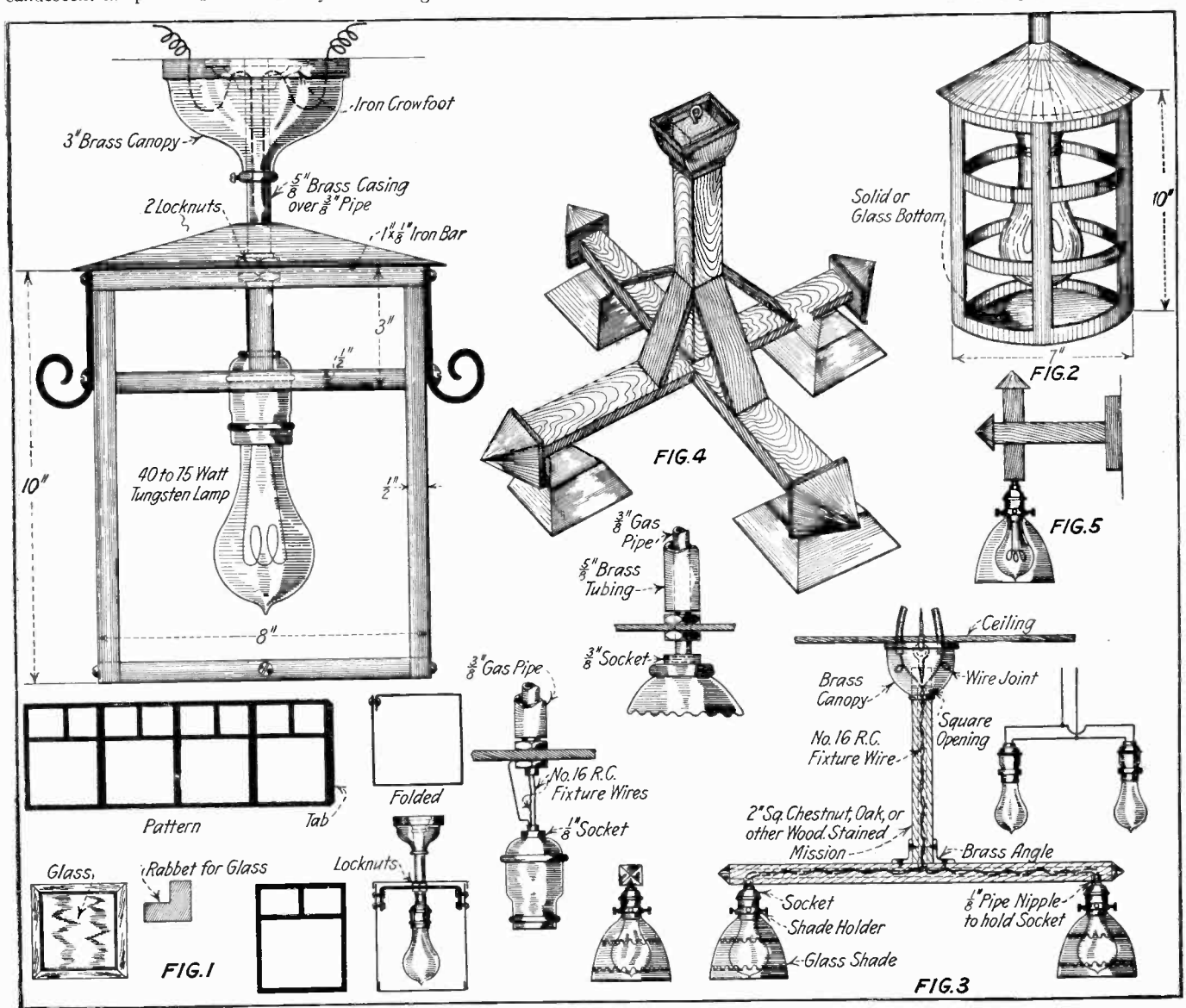
A Home-Made Airplane is no Doubt One of the Most Interesting of All Pieces of Machinery to Everyone. This Miniature Airplane, Suitable for Carrying One Passenger, is Powered with a Motor-Cycle Engine Developing 12 to 16 Horse-Power. The Parts Necessary for Building This Plane Cost but Very Little, and the Wings Can Be Covered With Unbleached Muslin Treated With Several Coats of "Dope" and Varnish, or if a First-Class Job is Desired, They May be Covered With Good Irish Linen or Standard Airplane Cloth. The Propeller May be Purchased at a Reasonable Cost from Airplane Manufacturing Companies or Specialty Concerns Making Propellers. It is Preferable to Use a New Gasoline Engine, as an Old Motor May Cause Trouble, Once the Machine is in Flight, by Missing Fire or Otherwise Giving Trouble. Stranded Steel Cables Should be Used for All the Controls. Motor-Cycle Wheels May Be Used on the Landing Gear.

Building Your Own Electric Fixtures

ELECTRIC lighting fixtures, especially the Colonial and other interesting types now much in vogue, can be built without a great deal of trouble and their construction does not require a great amount of mechanical or electrical ability. The writer has built several porch lamps of the Colonial type shown at Fig. 1, both round and square forms, and there is a great deal of pleasure and satisfaction in making your own, even tho they do not cost such a large amount if purchased in the fixture shops. One thing about home-made fixtures is that you can build them as large as you want them and the price does not increase very much, but when you ask for extra large fixtures at your dealers, they are liable to ask a disproportionate increase in the price.

The porch lantern shown at Fig. 1 can be made any height or width desired by the builder, but for the average porch one or two of these will be found sufficient, especially if clear window glass is used in them and not some fancy dark red or green glass, which kills one-half to two-thirds the candlepower emitted by the incandescent lamp behind it. Ordinary black sheet iron or better still galvanized sheet iron, where the lantern is to be mounted on open porches subject to rain and sleet, will make a very good job. The corners of the square panels which have to be cut out, may be started with a cold chisel and a hammer by placing the sheet iron over the end of a piece of timber, and the rest of the cutting done with a pair of small tin snips or heavy scissors. In one case, the writer cut out all of the panels with a cold chisel and hammer and then dressed the metal sides up with a wooden mallet on a piece of board, filing the inside edges of the panels a little to smooth up any roughness, owing to the chisel cuts not being regular. It is usually best to lay out the four sides of the lantern all in a row, full sized on a piece of paper, and then to place this over the sheet metal and with a center punch and a hammer punch thru prick marks at the corners of all the panels as well as the outside corners. The lines can then be completed on the sheet metal with a pencil and rule, or the design may be laid out on the sheet metal originally. After cutting all the panels out, the strip of metal containing the four sides of the lantern is bent at the three complete corners, so as to form a square; an extra ½" tab being left on one side in order to rivet this to the remaining free corner, so as to lock the square together. Where extremely good wearing qualities are desired, such a lantern may be made of copper, brass or aluminum sheet. In any case and especially if it is made of galvanized or black sheet iron, it should be given two coats of black paint, preferably a dull black. The iron supporting brace for this lantern is formed of a piece of iron bar 1" wide by ⅛" thick, bent in a vise, and the ends curled up as shown. The top is made of four pieces of sheet iron and the brass canopy is purchased in any fixture or electrical supply shop. No. 16 R. C. fixture wire is passed down thru the pipe supporting the fixture, and an iron crowfoot is placed in the upper end of the pipe as shown, which enables the fixture to be screwed to the wood ceiling of the porch, the wire joints made and the canopy then screwed up against the ceiling. The bottom of the lantern is closed by a square wooden frame rabbeted out to hold a piece of glass. The lamp

(*Continued on page 64*)



Home-made Electric Fixtures, or Gas Fixtures for That Matter, Are Constructed at Very Slight Cost, and You Not Only Have the Satisfaction of Having Something in Your Home That You Have Built With Your Own Hands, But You Can Make the Fixtures in Any Design or Size to Suit Your Fancy. The Veranda and Gate Post Lanterns Shown Here Can Be Built Any Size Desired. The Wooden Chandeliers Can Be Designed Also to Have Any Number of Arms and Lights One May Require.

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.

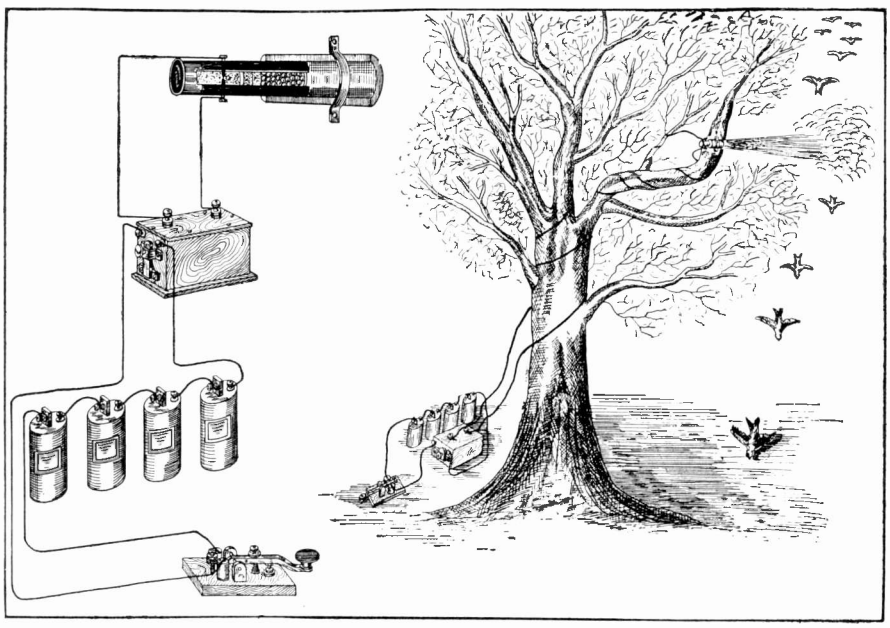
FIRST PRIZE, $15.00

Hunting Without Firearms

In places frequented by many hunters, pigeons and other species of birds fly away whenever they perceive their enemies in the distance, and it is quite impossible to even get a "bead" on the birds. In such cases it is far better to hunt as here described. This has often netted me with a basketful of game while others went home empty handed.

A piece of steel adapted to hold a buckshot cartridge is clamped to any immovable object such as the limb of a tree, and directed toward bait placed on another branch. If desirable, several of these steel barrels may be employed. The cartridge is then perforated near its powdered end, and two small nails or pieces of pointed metal rod are inserted. Copper wires are twisted around these nails, and then brought downward along the trunk of the tree. At the root of the tree a one-quarter inch spark coil is secured, and the wires from the cartridge are attached to the secondary terminals. A storage battery is placed alongside of the spark coil or dry cells may be employed. Two wires then lead away to the distant key. The birds may now be observed thru telescopes, field glasses, or just the naked eye, and the key pressed pronto!

Contributed by
VENENCIO F. LIM.



There are More Ways Then One in Which to Shoot Birds, and by Using Several Shot Gun Shells Rigged Up as Here Shown, With Spark Coil, Batteries and Key, a Number of Shots May be Fired Either Separately or Simultaneously.

SECOND PRIZE $10.00

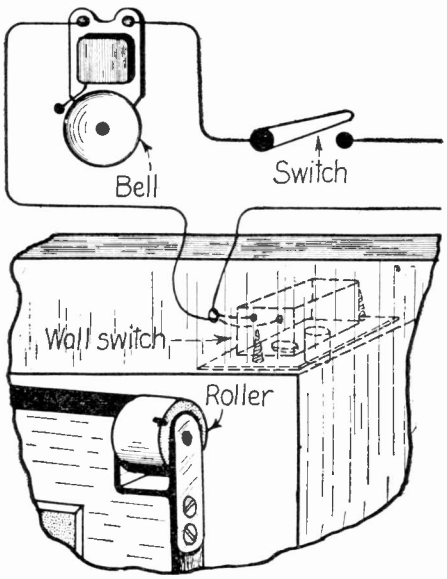
Switch for Burglar Alarm

The drawing shows the installation of an inexpensive burglar alarm system, for either the private home or place of business, and consists chiefly of an electric switch of the two-button type, such as is used for lighting purposes, and a small desk roller.

The alarm bell used in the circuit is made by substituting a brake drum from an automobile wheel for the small bell as a loud ringing gong. This switch is mounted above the exit door or other unguarded window thru which a burglar might seek access. Duplication of the switch alarm can be made to other places and the wires made to connect up these separate switches to the one alarm gong.

In mounting the switch, the roller is placed to traverse the two buttons on the switch in such a position that the last button pushed in closing the door or window is the off button. In consequence opening either pushes the on-button and starts the gong. Once installed no separate work is required to set the alarm, the mere closing up of doors and windows places the alarm circuit in readiness. One switch at the gong, wherever this is desired to be placed, permits of cutting out the gong during the day or period where the protection is not required.

Contributed by G. A. LUERS.



Novel Way To Use a Standard Lighting Switch for Burglar Alarm Switch on Door.

AIR CUSHIONED ROCKING CHAIRS

First secure two clincher bicycle tires. Cut them about two inches longer than the rockers of the chair, in order to let them overlap and act as guards to prevent the rockers from scratching the walls. Next obtain two inner tubes and make them the same length as the rockers. The ends of these tubes must be well vulcanized to prevent leaking. Bore a hole in the middle of each rocker for the valve stem of the inner tube. Fasten the tires on with small wooden screws.

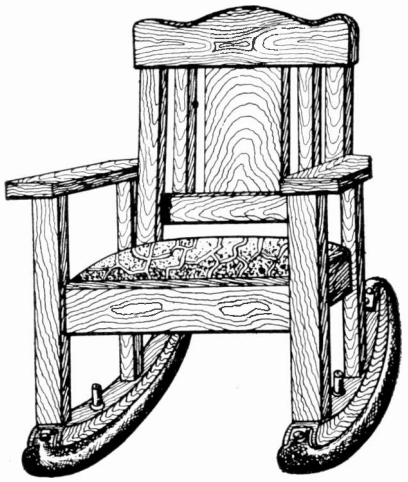
If it is difficult to procure the tires, two or three layers of canvas may be used, and they will work equally well.

When finished, these cushions are especially convenient for the roofs of apartment houses where small pebbles are used as roofing. Being silent, they prevent any noise in the apartment below when used indoors.

Contributed by JOHN K. HEAP.

THIRD PRIZE $5.00

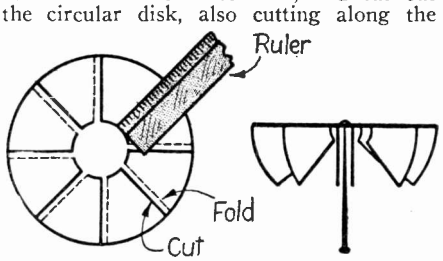
Air Cushioned Chair



At Last We Have It—Grandma's Rocking Chair Fitted With Pneumatic Tires!

A SIMPLE HEAT MOTOR

The following device, no doubt, will please many experimenters. It is so simple that it can be readily constructed by even a child. With the point of a compass on a small card, so that it will not punch a hole in the paper, describe a circle about two inches in diameter. Then draw lines, as shown in the illustration, and cut out the circular disk, also cutting along the



This Experimental Heat Motor is Made From a Piece of Cardboard, Such as a Name Card, the Flaps Being Folded Downward as Shown at the Right. This Fan-like Disk is Now Placed Upon a Pin and the Heat From the Hand is Sufficient to Cause it to Rotate, While the Heat From a Lighted Cigarette or Cigar Will Cause It to Spin Merrily

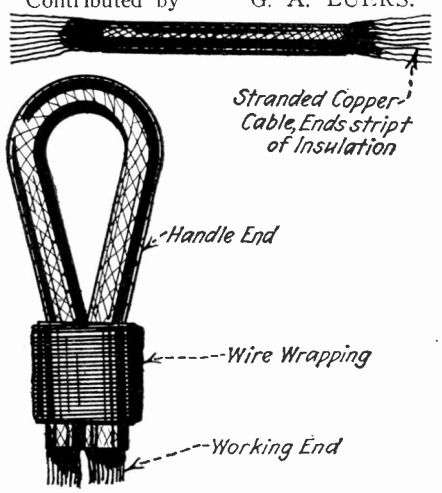
heavy lines in the illustration. Now, with a ruler acting as a guide, fold up the small triangular pieces so formed sharply, which will give the circular disk the appearance of a fan blade. The angle of the fold is about 45°. Then place a lead pencil, having a rounded point, in the centre of the disk, which has been previously located, the disk resting upon a thick blotter, and twirl it lightly, so as to cause an indentation at the center point. If the disk is now placed upon a pin, whose point has been rounded, it will rotate very mysteriously. The cause of the rotation is, of course, due to convection of air currents which are set up, because the heat of the hand is greater than the surrounding atmosphere. If a lighted cigarette or cigar is placed considerably below the revolving disk, its movement is speeded up. If the pin on the other hand should be placed thru a cork and set upon the table, the rotation ceases.

Contributed by ADOLF F. LONK.

STRANDED WIRE AS A SOLDERING ACID BRUSH

For the purpose of applying soldering acid to a piece of work, a brush made from stranded copper wire such as that used for electrical purposes is simple, inasmuch as the part from which it is made is usually available, and in addition the copper wires take up tin which the acid on the brush conveys to the surface, and this is the cause of the solder adhering quicker and better to the work. Strip about an inch at each end of a six inch length of wire, double over and wrap with a piece of copper wire as shown.

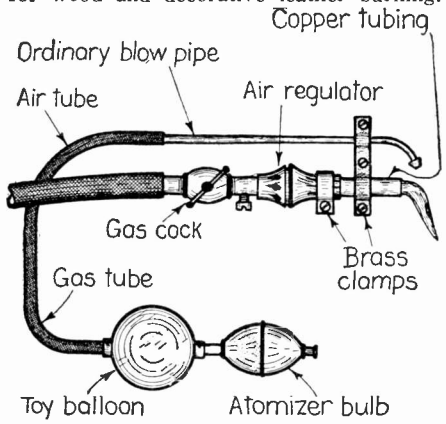
Contributed by G. A. LUERS.



A Piece of Stranded Copper Cable Makes a Good Soldering Acid Brush, the Insulation Being Scraped From Both Ends and the Cable Bound into a Brush With a Piece of Wire or Friction Tape, as Shown

SMALL BLOW TORCH

Altho a constant reader of your publications, I have not yet seen an easily constructed blow pipe similar to the one I made some time ago, from parts lying around my shop. Procuring an old Welsbach gas fixture, I attached an ordinary blow pipe, such as every amateur or chemical experimenter is equipped with, to it, by means of two small brass clips. To this blow pipe I connected a rubber hose. Air was supplied by either of two methods, first by the mouth, or second by means of an atomizer bulb connected to a toy balloon, the latter acting as an equalizing chamber. This construction is very similar to the method employed in the old naphtha burning outfits in vogue several years ago, for wood and decorative leather burning.



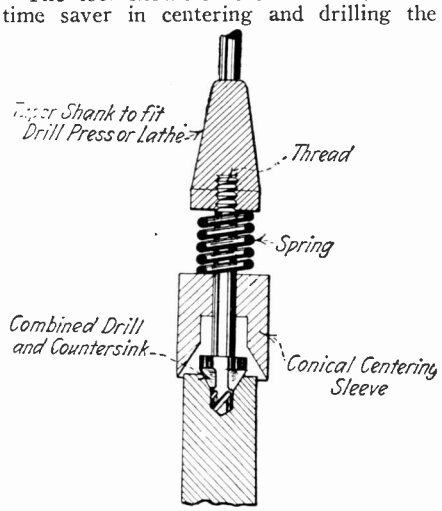
Here is a Simple Air-Blast Blow Torch, Which Can be Built From Odds and Ends at Little or No Cost

The system can be employed for brazing soldering, oxidizing, or reducing metals, and many other purposes.

Contributed by A. J. HYND.

CENTERING BAR STOCK FOR LATHE

The tool shown in the illustration is a time saver in centering and drilling the



A Self-Centering Device Which Can be Fitted to the Combination Drill and Countersink for Centering Round Rods in the Lathe

countersink in the ends of bar stock, to be lathe turned.

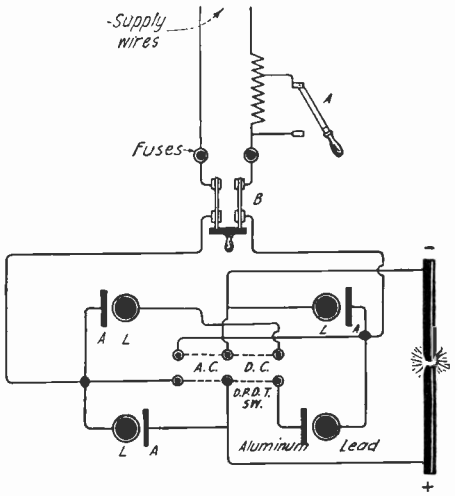
The body or shank of the tool is tapered as usual to fit the lathe or drill press spindle.

A combination drill and countersinking tool is screwed into this, with a sliding cone centering sleeve, which will conform to all sizes of bars within the limits of the cone. A spring normally holds this forward, until pressure is applied to force it back and bring the countersinking tool against the end of the bar. The use of this tool avoids the usual practise of locating the center of the bar, by drawing intersecting lines, and prick punching before drilling. This tool saves the time involved, inasmuch as the stock is centered as rapidly as it can be handled, by simply pressing it into the cone socket of the tool.

Contributed by G. A. LUERS.

ARC-RECTIFIER CIRCUIT

Herewith is a diagram and description of a method for switching a rectifier into or out of an arc light circuit or any other circuit. As a rectifier becomes heated



This Diagram Shows How to Hook Up Electrolytic Rectifier, so that it Can be Switched Into or Out of an Arc Light or Other Circuit

when used to run an arc light for a long period of time, it becomes necessary to devise a switching device by which you can operate on the rectifier, and then switch over onto A. C.

The switch at A is used when you are operating the rectifiers, as the latter has a resistance to overcome, and the switch at A, when closed, passes more current.

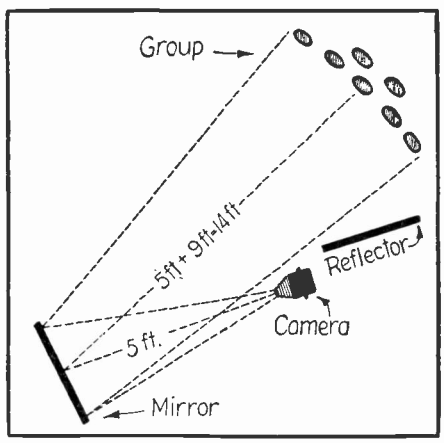
To change from D. C. to A. C., you first pull the switch at A and then throw switch on rectifier to the A. C. side.

Contributed by W. E. WEAVER.

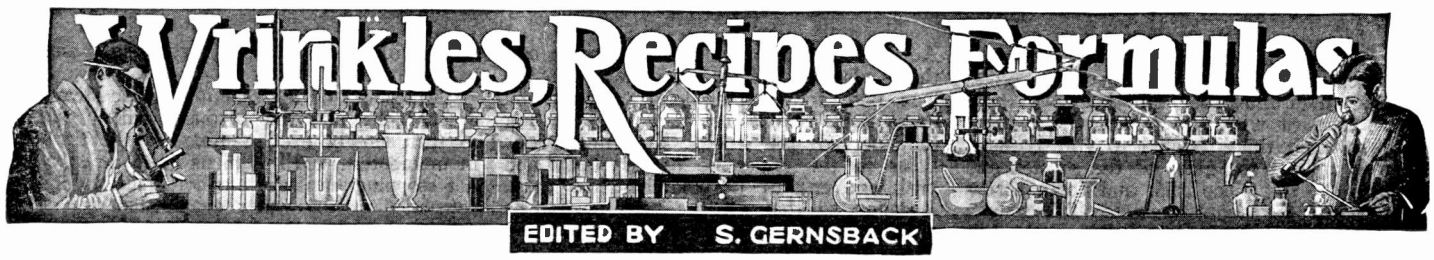
PHOTOGRAPHING INDOORS

A kodak or fixed focus camera has often to be used in a small room and only too often the room is entirely too small for the group. To overcome the difficulty one must only employ a mirror. Set up the mirror at the point of view you would ordinarily choose to snap the group, facing it toward the group. Then place the camera in front of, and to the side of this mirror at an angle of about 45 degrees in such a position, however, that you can see the entire group in the mirror. To get the right focus simply add the distance from the group to the mirror to the distance from there to the camera. Set your focus scale for this total distance and you will get a clear, sharp picture with all of the group included, provided the exposure is correct. The image in this case is reversed, but when printing, place the glossy side and not the rough or emulsion side of the film against the paper.

Contributed by A. SHAAL.



Here is a Clever Dodge in Amateur Photography—How to Snap a Group of People in a Small Room With an Actual Focal Length of 14 Feet, Simply By Using a Mirror



Ten Uses for Old Inner Tubes

$5.00 MONTHLY PRIZE WINNER

Why sell a discarded automobile inner tube to the junkman for a few pennies? You can obtain far better value for it by putting the rubber in it to work around the home or garage. Uses for this rubber are practically unlimited. Next time you have a few moments to spare try to see how many uses you can discover for the rubber in your home or garage. No doubt you will be surprised at your progress.

Ten good uses to which an old inner tube can be put follow:

1. Cut strips crosswise an inch to two inches wide and you have some strong rubber bands that can be used to hold in place properly-folded inner tubes, still in use.

2. Pieces of old inner tubes can be used to advantage in patching worn automobile floor mats. Of course, the patch must be stuck on with rubber cement.

3. An old inner tube, or a section of it, makes a fine thing in which to wrap spare spark plugs. The rubber gives the plugs the best of protection, besides making a compact bundle.

4. A section of a tube slit once lengthwise in a straight line makes a good pad on which to set a flower pot, photograph trays and many other receptacles for liquids that in slipping over might do damage to varnish or paint.

5. To guard woodwork against being marred when pounded with a hammer, a section of a tube can be laid over the spot to be pounded. The hammer will make no imprint through the rubber.

6. A long piece of a tube can be wound tightly around an object that is being glued together to hold the parts in place while the glue is setting.

7. Thick rubber tubing makes a good washer for the top of a metal or rubber hot water bottle.

8. A strip of tube cut the proper size and stuck with cement where it overlaps, makes a good cover for an automobile crank handle, doing away with the necessity of getting a handful of rust when one cranks a machine.

9. The rubber proves ideal for patching automobile tops and side curtains. The patches can be either cemented or sewed on. A little top dressing put on the patch will make it practically unnoticeable.

10. Narrow strips of rubber from a tube, being non-conductors, can be used in many ways for fastening electric current wires in place on the automobile or in the home.

Contributed by
BERNARD G. PRIESTLEY.

$10.00 PRIZE CONTEST

Uses for Old Inner Auto-Tire Tubes

Read the article by Mr. Priestley and send us new uses for old automobile inner tubes. We will pay a prize of $10.00 for the best article. All other accepted articles which do not win a prize will be paid for at the rate of $1.00 each. Contest closes May 20th. If two readers send in the same idea, forming a tie, the same prize will be paid to each.
—WRINKLE EDITOR

Miscellaneous Formulae

Magic Writing

On slips of paper write questions with the following ink: two parts of Sod. Ferrocyanide and one part of Amm. Sulphate dissolved in water. Beneath the questions write the answers with phenolpthalein solution which is invisible. When the paper is brushed with a solution of Sod. Silicate the question disappears and the answer appears in pink writing.

Magic Healing

Run the blunt edge of a knife coated with Sodium Carbonate over your finger which was previously dipped in phenolpthalein solution and the finger will appear to be cut. Then take some tartaric acid and after saying it is a healing powder, rub some over the wound and it will appear to be healed.

Chemical Plants Under Ice

In a medium sized bottle place four teaspoonfuls of water and one teaspoonful of Sodium Silicate. To this solution add a few crystals of copper sulphate and ferrous sulphate. Let it stand still and after the precipitates reach the bottom add about a quarter of an inch of pure acetic acid. After standing for a few hours a white jelly-like mass will form on top of the water glass. This is the "ice" with the plants growing under it and also in it.

Fire Snakes

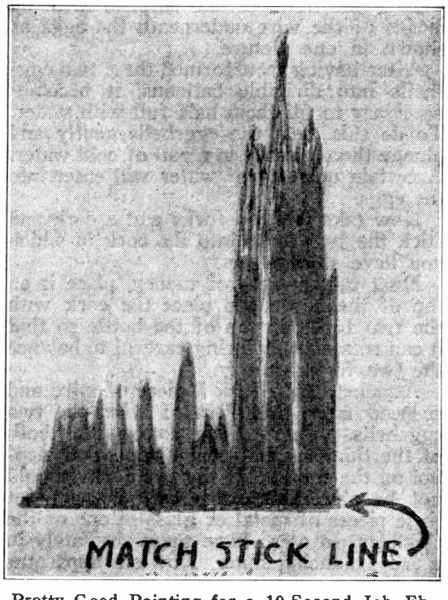
Make a solution of gum arabic by letting stand one spoonful of gum arabic in a tumbler one fourth full of water over night. Then put some mercuric sulphocyanate on a slab and to this add some solution drop by drop, mixing the mass with a spatula until it is about the consistency of dough. Divide this into balls about the size of a pill. When dry and hard, ignite these and they will turn into long snakes. The vapor is poisonous if inhaled in quantity.

Contributed by MAX F. BOGDAS.

EVERYBODY A PAINTER

Without being a painter you can instantly make drawings and paintings as per sketch shown herewith.

Take a piece of paper, a match and a bottle of ink. After dipping the match in the ink, draw a straight line on the paper. Before allowing the ink to dry, rub your hand or a piece of cloth over the line, being careful to make the stroke perpendicular to the line drawn with the match.



Pretty Good Painting for a 10 Second Job, Eh, What? All Done With a Match Dipped in Ink. The Story Tells How.

A very curious effect is obtained; drawings resembling old castles, big towns with chimneys and skyscrapers, etc., are produced. You can improve on these drawings by using your imagination and a pen.

Contributed by HY. DRIN.

Solvent for Stains

SOLVENTS FOR STAINS

Gasoline and benzine are used for dry cleanings; are cheaper and most satisfactory at the present time. Benzine is a more effective solvent than gasoline, occupying a position between gasoline and chloroform. Chloroform has the advantage as a spotting agent in that it acts more quickly, but is more expensive. Carbon tetrachloride is less likely to form rings. Trichloroethylene may take the place of chloroform for general spotting purposes. Alcohol and acetone are best used in mixtures.

A good solvent for varnish stains is acetone, while benzine is a good solvent for hard paints. Acetic ether is valuable for grass stains. Ether is not of much importance in spotting.

Carbon disulphide, fusel oil and oil of mirbane are good solvents, but are disagreeable to work with.

Contributed by WM. R. REINICKE.

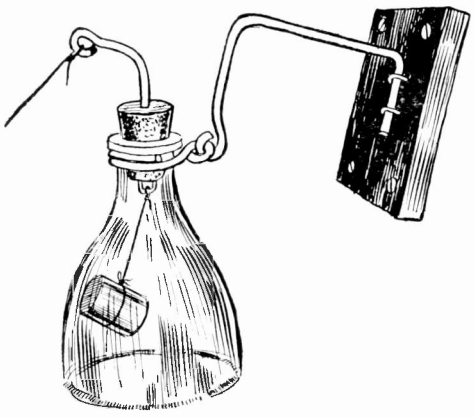
THE BOTTLE-BELL

The writer read about the "Bottle Contest" in your magazine.

Here is a new use for an old beer bottle:

Take an old bottle and cut off the bottom. The best way to do this, I have found, is to file a good scratch where the bottle is to be cut. Tie a string or spring a rubber band around it, a quarter of an

inch from the scratch to give a guide for the cutting. Then with a red hot glass rod, which must be quite heavy to hold the heat, or with a wire about a quarter of an inch thick, heated to full redness, press against the glass of the scratch and move the hot piece back and forth across the bottle for about an inch. Presently a little crack will start, which can be seen



In the Accompanying Illustration, a Novel Use for an Old Bottle is Shown in the Form of a Bell. The Bottle is Attached to a Piece of Board, While a Wooden Clapper is Rigged up With a Piece of String, in the Manner Indicated. Many Other Uses for Old Bottles are Given Elsewhere in This Issue in the "Bottle Contest" Article.

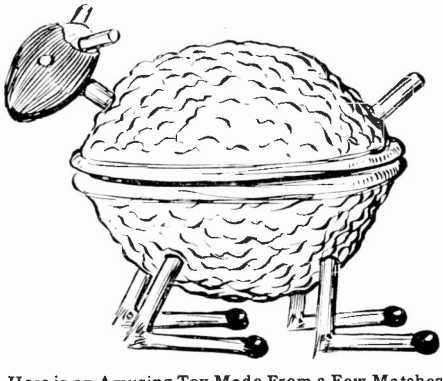
as a bright line; changing the position of the hot rod from time to time, lead the crack around the bottle. It will follow wherever you draw the heated rod. Keep a quarter of an inch away from the string or rubber lest you burn it. A slight stroke with a file will remove the very sharp cutting edge of the bottle when it is separated.

Other methods may be employed to cut the bottle.

Whatever the method employed, the bottle prepared in this way may serve for a great number of purposes. The purpose described in our picture is as a bell. Attach the bottle to a piece of board as shown in the drawing, after having fastened with a piece of string a piece of wood as a clapper on the cork of the bottle.

Contributed by POLY RENE.

AN AMUSING TOY FROM NUT SHELL



Here is an Amusing Toy Made From a Few Matches and a Walnut Shell. The Head of the Animal is Formed From a Hazel or Other Small Nut. Holes are Drilled in the Head and Body, and the Legs and Neck Formed of Matches, as Shown, and a Tail is also Added. When a Drop of Water is Added to the Joints of the Bent Match Legs, the Animal Rises Very Lifelike.

An amusing toy can be made from nuts and a few matches. Select a large nut, such as a walnut, to form the body of an animal. Then, for the head choose a smaller nut like a hazel. Bore a hole in the head and body and insert a small piece of match to keep the two parts together. Add a tail to improve the appearance and this is also secured from a match. For the legs take four rather long matches and break these in half, not actually separating the fibers of the wood. Now make four holes in the underside of the body and push one end of the matches into each. Arrange so that all the bent portion is pointing towards the head of the animal. The other half of the match is gathered up so that the creature when it is stood on a table is in a kneeling position. Now place a drop of water just at each joint and a surprising thing happens. With curious little jerks the legs start to straighten out. This is due to the fact that as the fibers of the wood swell with the moisture the match sticks as a whole start to regain their original position. In the end the quaint little animal is standing perfectly upright.

Contributed by S. LEONARD BASTIN.

VARNISH REMOVER

Paint and varnish removers for woodwork are very numerous. Equal parts of benzol, acetone, and amyl acetate will be found of considerable value. A mixture of paraffin, hard grease, benzol and methyl alcohol in the proportion of one, one, two and two parts respectively, will be found of considerable value. One part of benzine, two parts of benzol, and six parts each of wood alcohol and acetone, make another mixture which is very effective.

WOOD TIGHT VARNISH

Wooden dishes are not always water-tight, but they may be rendered so by applying the following mixture. A half pound of common brown resin is melted, and two ounces of yellow wax are added. When quite fluid, the solution is run rapidly over the surface to be water-proofed, and if the wood is perfectly dry and warm when the preparation is applied, a very serviceable water-tight dish will result.

THE STEAM CAROUSEL

The little trick we will describe herewith is very interesting and if done right will give much enjoyment.

We need for this little experiment a bottle, two forks, two eggs, two thimbles, some wire and a pin.

Take the two eggs and empty the contents of same by drilling a small hole at one extremity of the egg and sucking out the contents. With a pair of pliers, make a harness with some wire around the eggs.

Take the thimbles and suspend them by means of the wire underneath the eggs as shown in our picture.

After having transformed these two eggshells into dirigible balloons, it becomes necessary to fill them half full with water. To do this, heat the eggshells gently and plunge them quickly in a pail of cold water. A certain quantity of water will enter into the eggs.

Now take the two forks and a cork and stick the two forks into the cork in which you have stuck a pin.

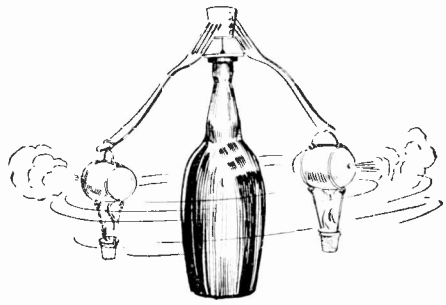
Next take a piece of money, place it on top of the bottle and place the cork with the two forks on top of the bottle so that it can rotate easily, being careful to balance the two forks exactly.

Attach to each fork a piece of wire and suspend from this piece of wire, the two eggshells. Put a little cotton into both of the thimbles and pour some wood alcohol on the cotton. If the two forks should not be absolutely balancing you can put little pieces of metal or glass in one of the thimbles, so as to have them absolutely in a free-balancing state. Now our apparatus is ready to function.

With a match, light the alcohol contained in the thimble and in a few seconds the water contained in the eggshells will begin to boil and you will see a little stream of steam escaping from each one of the holes.

On account of the reaction of the steam against the air, the carousel will begin to turn slowly first, gaining all the time in momentum, until it turns quite quickly, not stopping until the alcohol is absolutely consumed or the water evaporated.

Contributed by ETHEL AMINE.

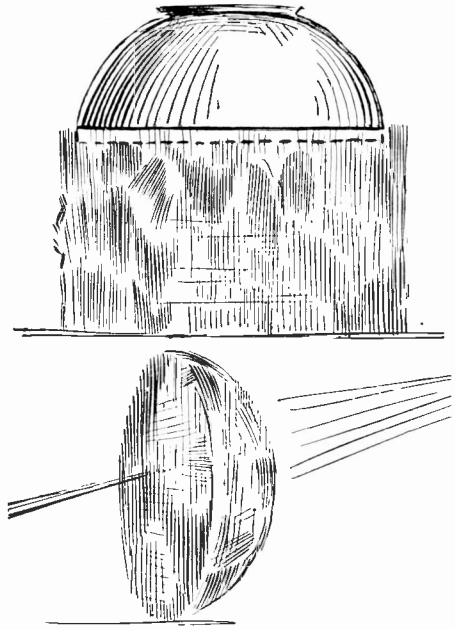


This Miniature Steam Carousel is Made From Two Egg Shells, Two Thimbles, Two Forks, a Pin and a Bottle, With Some Thin Wire or String to Tie the Parts Together. The Eggs are Filled With Water, as Explained in the Article, While Some Cotton Soaked in Wood Alcohol is Placed Beneath Them and Ignited. The Steam Generated in the Egg Boilers Shooting Out From the Small Openings, Causes a Reaction on the Air and the Contraption Whirls Around Merrily.

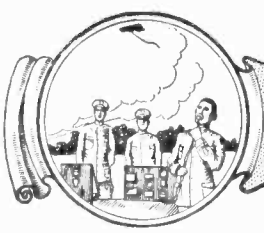
A GIANT ICE LENS

It is possible to make a huge burning glass from ice in this way. Get a block of ice which is roughly cubical in shape and quite flat on one side. Place this flat side downward and then secure a bowl slightly smaller than the block. The bowl should have a smooth rounded inside. With the bowl on the top of the block apply a cloth wrung from very hot water keeping on doing this until the vessel has melted its way down to the bottom of the ice. In this way a piece of ice which is concave on one side will be secured, and the shape enables it to act as a powerful burning glass. Propped up so that the rays of the sun pass thru it, the lens can be used to set on fire anything that will burn. It is interesting to direct the concentrated rays on deep snow or thick ice and watch the rapid manner in which a hole is bored.

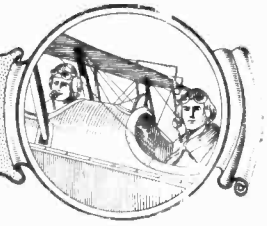
Contributed by S. LEONARD BASTIN.



The Two Drawings Above Show How an "Ice" Lens Can Be Made and Used. All the Effects Obtainable With a Burning Glass, Etc., are Possible With This Lens. A Smooth Porcelain Bowl is Placed on Top of the Ice, and by Applying Cloths Soaked in Very Hot Water, and Then Rung, Over the Bowl and Doing This Repeatedly, the Bowl Eventually Melts Its Way Down to the Bottom of the Ice—and We Then Have an "Ice" Lens to Experiment With.



RADIO DEPARTMENT



Radiophoning From Ship to Shore

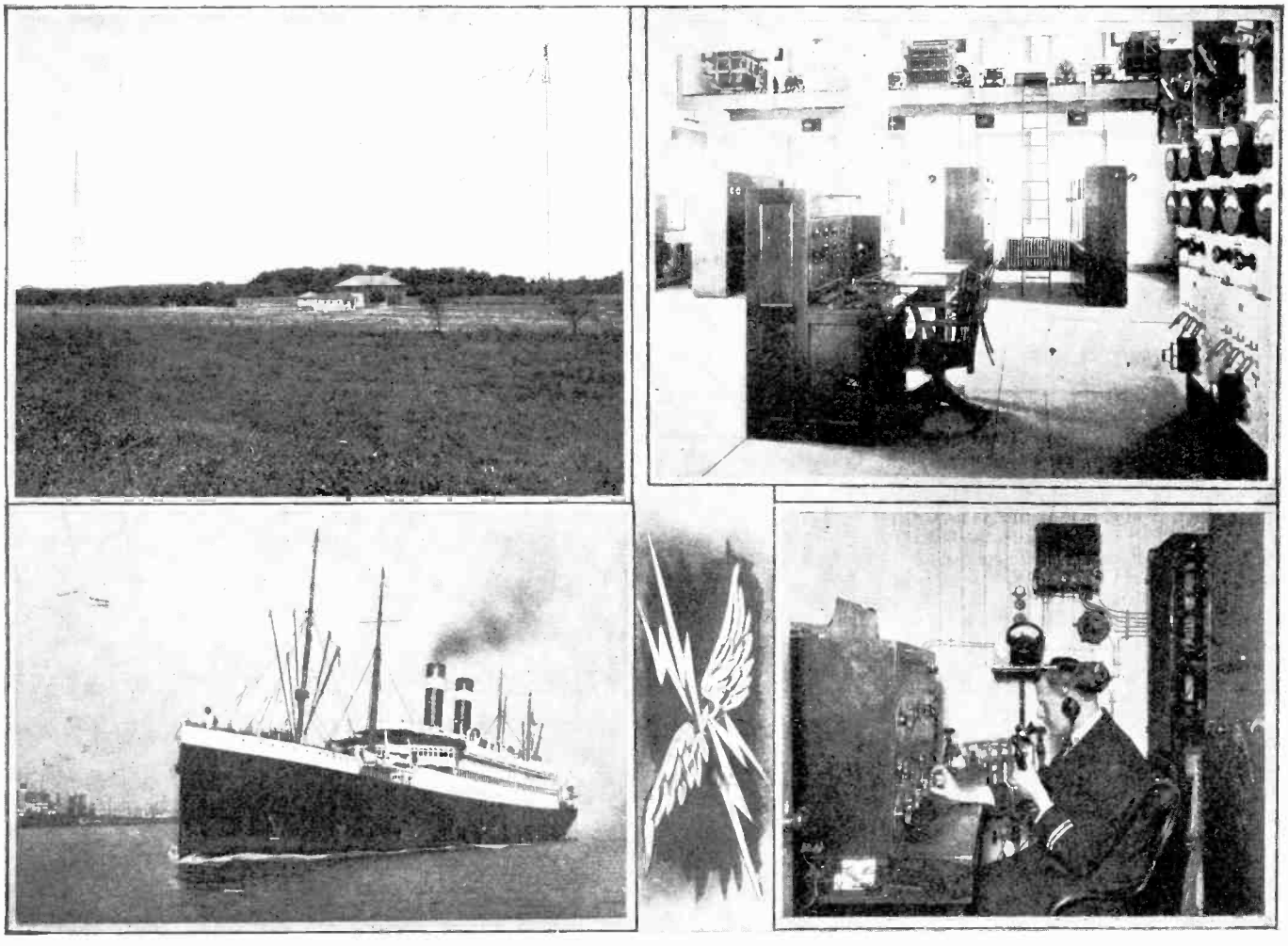
(SPECIALLY PREPARED OFFICIAL ARTICLE)

ON THE evening of March fifth a striking demonstration of telephoning from ship to shore was staged by the engineers of the Bell System and the Radio Corporation of America. Promptly at the appointed time of 7:30 the ship was picked up by the operators of the radio station at Deal Beach and Elberon, New Jersey. At these points wire circuits were joined to the radio equipment, both transmitting and receiving, by means of which speech was conveyed to and from the telephone company's building on Walker Street, New York City. Here a crowd of press representatives and engineers had gathered to witness the demonstration.

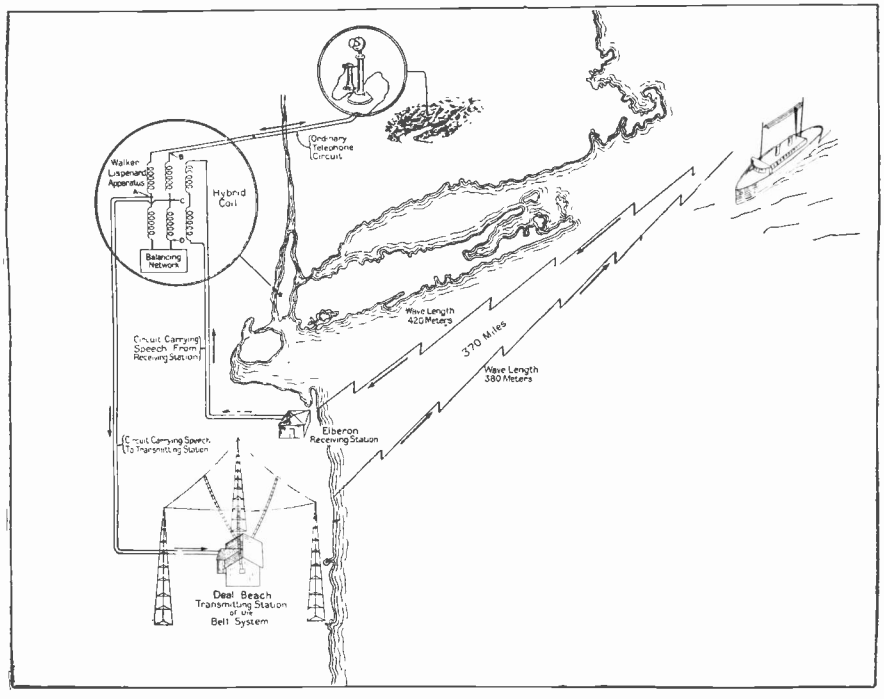
When the wire-radio connection was first established between Walker Street and the ship, which at the time was 370 miles from New York, the transmitting qualities of the ether for radio signals was rather poor. It cleared rapidly, however, and within a few minutes a telephone circuit was completed between the radio stations on the Jersey coast and the New Canaan residence of Mr. H. B. Thayer, President of the American Telephone & Telegraph Company, with the party at Walker Street listening in. Mr. Thayer talked for a brief period with the captain of the ship, expressing his pleasure at their being able to meet and talk under such novel circumstances.

The wire circuit running from New Canaan to the radio station was 95 miles in length; there was no practical reason why it could not have been many times as long. During the demonstration the telephone engineers made the statement that commercial ship-to-shore telephony will be offered to the public whenever the demand is such as to make it practicable. This would enable a business man, at his office in some inland city, to talk directly, as over the ordinary telephone, with his business associate who might be leaving or returning to this country by way of some trans-oceanic steamer.

The accompanying diagram illustrates the circuit arrangements which were used in this novel ship-to-shore demonstration. One of the questions which is most likely to puzzle the uninitiated is that of how the conversations are automatically relayed from the wire circuits to the wireless waves in the ether, and vice versa. Our diagram has been specially constructed to make this point clear. The secret of the marvelous transformation which the voice undergoes in passing from the wires to the ether or in the opposite direction is contained in the *hybrid coil* and *balancing network*, which, in the test of March 5th, were located in the test room of the Walker Street building.



Radiophoning from Ship to Shore and from Shore to Ship Has Become an Accomplished Fact, as was Recently Demonstrated by the Engineers of the A. T. & T. Company. The Two Lower Photos Show the Steamship America from which the Voice was Transmitted to Land and Vice Versa, as well as the Radio Transmitting and Receiving Apparatus on Board the Ship. The Other Two Photos Show the Transmitting Aerial at the Deal Beach, N. J., Station of the A. T. & T. Co., and Also the Interior of the Transmitting Room with the Operator's Desk in the Foreground, the Vacuum Tube Sets in the Background, and the Antenna Connections on the Balcony.



This Diagrammatic Picture Shows How the Combined Wire and Wireless Telephone System Recently Tried Out Between the Steamship America and the New Jersey Coast Transmitting and Receiving Stations of the Bell Telephone Company's Engineers, was Arranged. Simultaneous Transmission and Reception, the Same as on a Regular Telephone System, is Made Possible by Means of the Ingenious "Hybrid" Coil, Which is Fully Described in the Accompanying Story, Specially Written for SCIENCE AND INVENTION. The Latest Stunt of the A. T. & T. Co.'s Engineers is a Secret Transmitting and Receiving System From Which Only an Unintelligible Noise Can be Picked up by Outside Stations.

Referring to our diagram, the *hybrid coil* consists essentially of a transformer with three suitable windings. These windings are arranged around an iron ring in the form of a toroid and are so carefully wound that their electrical characteristics balance one another with extreme accuracy. The *balancing network* is composed of resistances, inductances and capacities so arranged that the electric impedance of this network is as nearly as possible the same as the impedance of the telephone circuit joined to the other end of the hybrid coil.

To those of our readers who are familiar with the action of the Wheatstone bridge which is used for measuring resistances, capacities, etc., the action of the hybrid coil will now be apparent. Let us consider the case in which the ship is talking to shore. Voice currents are generated at the Elberon receiving station and pass out over the two-wire circuit to the associated winding of the hybrid coil. Now the electrical impedance between the points C and B is exactly equal to the impedance between C and D; also the impedance between B and A passing around by way of the telephone instrument is equal to the impedance between D and A passing by way of the network. CB and CD and BA and BD, therefore, constitute the four balanced arms of a Wheatstone bridge. Therefore, when the voice currents flow in the winding which is connected to the Elberon station they generate similar currents in the other windings of the hybrid coil, which flow thru the balancing network and the telephone instrument. But due to the balanced relation, voice currents flow in such a way that the electric potential of the points A and C are always equal to one another and hence no current flows in the circuit running between A and C and the Deal Beach transmitting station. On the other hand, when the telephone instrument on shore is spoken into, current does flow down to the Deal Beach station, but because of the balanced relation in the hybrid coil no current flows to Elberon.

Altho the use of hybrid coils and balancing networks is relatively new in the radio art it is a matter with which telephone engineers have long been familiar, as these are pieces of apparatus which are made use of at every repeater station located at regular intervals along the long-distance lines of the country.

One interesting point in connection with the hybrid coil and balancing network remains to be mentioned. Many radio fans thruout the Eastern section of the United States who have "listened in" on the ship-to-shore tests between Deal Beach and the steamship *America*, have noticed that they could tune their sets for Deal Beach and receive the ship, altho it was transmitting on quite a different wave length. Also others with crystal detectors have recorded hearing the ship, altho several hundred miles out to sea. As a matter of fact, these observers have not heard the ship directly, but have heard its messages re-radiated from Deal Beach. This occurs in the following way. In practice it is impossible to maintain an exact balance between a telephone line and the balancing network. As a result a certain amount of the voice currents coming up from Elberon find their way thru the hybrid coil back down the other circuit to Deal Beach, where they pass in on the radio transmitter and are re-radiated. This unbalance, so long as it does not become great enough to overload the transmitting station at Deal Beach, is of no practical importance.

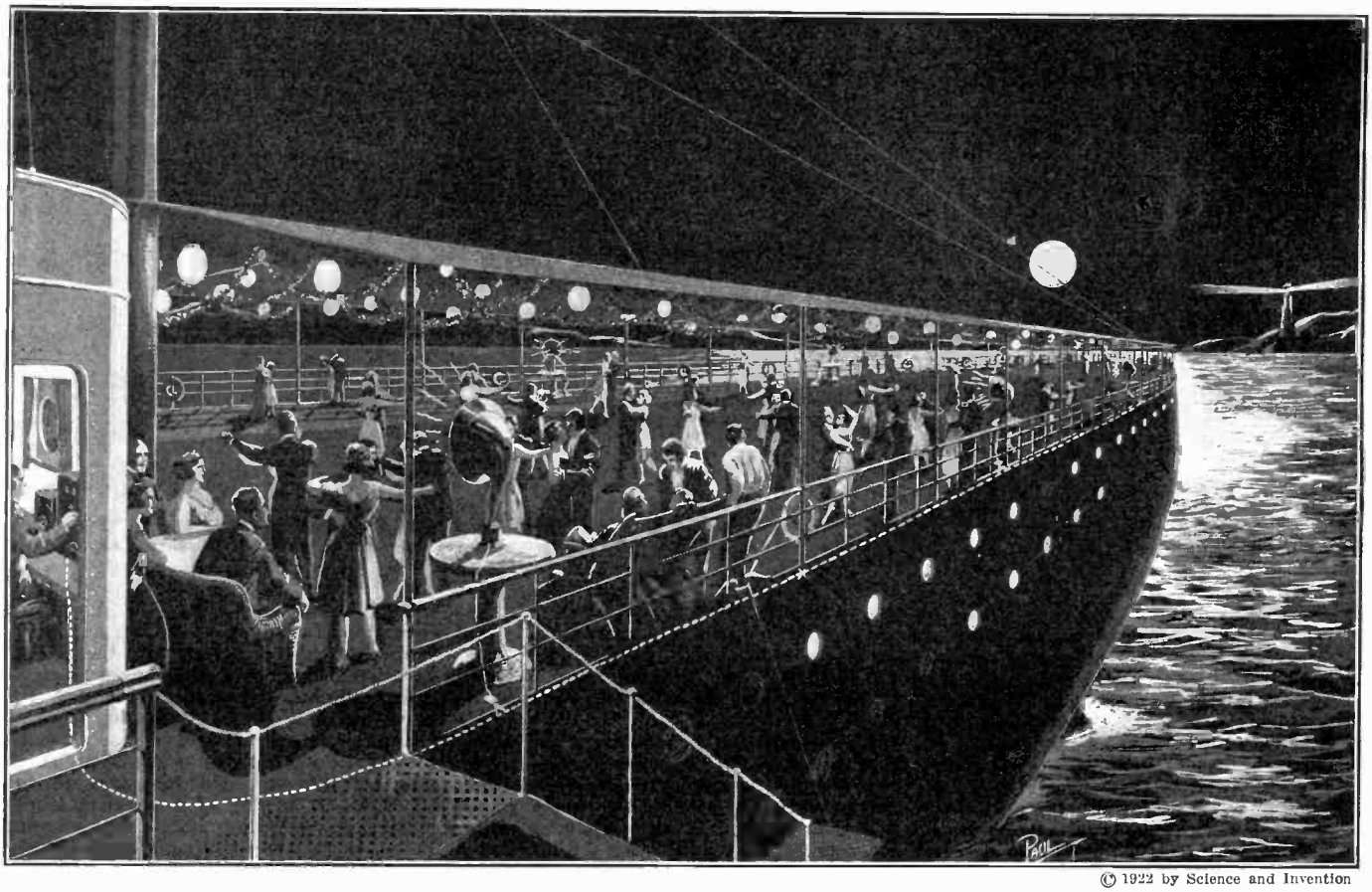
Thomas A. Edison Has Become a "Radio Fan"

THOMAS A. EDISON has followed the lead of the several hundred thousand citizens who have armed themselves with radio receiving sets, so as to snatch radiophone speeches, music, weather reports and time signals from the obliging ether, which permeates everything everywhere, so scientists tell us. This accounts for the fact that the radio waves travel right thru the brick wall of a building, as if there were no wall there at all. The radio waves pass right thru our bodies from hundreds of stations everywhere all day long, if we but knew it, but thanks to a wise Creator, our senses do not register the passing of these waves thru our body cells.

Radio is not new to Mr. Edison, for he was one of the very first to become interested in the wireless transmission of telegraph dot and dash signals way back in the 80's, when he installed an electrostatic radio telegraph scheme on a train and tried it out. There was not any great enthusiasm over this stunt, which worked all right, but did not seem to possess any great future at that time, for the few people who did travel on railroads would not bother to spend the money to talk from the moving train to a land station. The transmission was effected by induction between metal strips installed along the roofs of the train and a parallel wire carried on poles alongside the track.

Thomas A. Edison has Become a "Radio Fan" at Last, and He is Here Seen Busily Tuning to Pick up a Radio Concert Being Transmitted from "W. J. Z.," Newark, N. J. Mr. Edison Hears All the Eastern Stations, as He Has a Good Sized Aerial Connected with it. Note that Mr. Edison is Using One of His Latest Audion "B" Storage Batteries. Signals Have to be Specially Strong for Mr. Edison to Hear Them, as He is Quite Deaf.

Dancing to Radio Music on the Ocean



One of the Atlantic Coast Steamship Lines Has Equipped a Steamship Plying Between New York and Havana, Cuba, With a Series of Magnavox Radio Loud-talkers, and the Passengers Have Enjoyed Dancing to the Music Transmitted from "WJZ"—the Westinghouse Radiophone Broadcasting Station at Newark N. J.,—a Distance of About 1,200 Miles, While in Havana Harbor. The Vessel Is Wired With a Special Loud-talker Circuit, so That the Instruments Can Be Plugged in Thru Regular Marine Receptacles. This Circuit Runs to the Radio Cabin on the Ship, and One of the Radio Operators Tunes in the Music from the Broadcasting Station, While the Loud-talkers Spread About the Deck Do the Rest.

OUR illustration depicts a scene on board one of the various passenger vessels plying between New York and other Atlantic seacoast cities and Havana, Cuba, dancing being enjoyed on shipboard, thanks to radiophone music picked up out of the air from the distant broadcasting station, located at Newark, N. J., just outside New York City. This marks a phenomenal and extraordinary application of radiophone music and concerts.

As we see from the picture, several Magnavox loud-talkers are placed about the deck and the wires from each instrument are connected by means of a plug into a socket in the floor or ceiling of the deck. All of these sockets are wired to a common circuit connecting all of them, and the wires then lead to the radio cabin, as shown.

In other words, the passengers who enjoy the dancing have to thank the ship's radio operator or operators for this service, for it is up to them to pick up the broadcasting wave and keep it tuned sharp and steady thru interference and static. This performance is all the more interesting and remarkable in view of the fact that the distance is so great, in the neighborhood of 1,200 miles.

No doubt radiophone concerts, such as these, including dance music and other programs, will become quite common on ocean liners during the next few years, many ships now picking up the concerts broadcasted from Newark and other Atlantic coast stations, when far out on the Atlantic, over 1,000 miles from America. By utilizing suitable vacuum tube amplifiers, any number of loud-talkers can be supplied with current from the radio set. It is not so much of a dream after all, perhaps, to think for a moment that tomorrow, perhaps, the ocean traveler will be supplied with radiophone music whenever he may desire it right in his cabin, simply by turning a switch mounted on the base of a small horn device on the wall.

A question which many people have asked in regard to such elaborate radiophone reception and amplification, as that here illustrated and described, is as to whether or not regular radio messages from other ships, time signals, et cetera, can be received without interference with the radiophone reception. The answer to this question is that with most of the radio receiving sets this is not possible, and that either one or the other can be received at the same time without seriously interfering with the clarity and strength of the radiophone music or speech. Where it is imperative to pick up a message at the same time that radiophone music or concerts are being received, an expert operator can detune the radiophone wave sufficiently to be able to pick up simultaneously the radio telegraph and read the dot and dash signals thru the music at the same time. Of course the dots and dashes will be heard thru the loud-talkers on deck or in the cabin also, but we have often found in our own experience, that when the dot and dash signals are indeed quite strong enough to be read clearly, they will still be weak in the loud-talker so as not to interfere seriously with the music, altho it may be heard by those close to the horn. With respect to the time signals, these will be picked up invariably and relayed thru the loud-talkers for the benefit of all within hearing, as the broadcasting stations stop their concerts about eight or ten minutes before ten in the evening for this purpose.

It might be pointed out in this instance that the radio weather reports given out at 10:01 P. M. from the broadcasting stations, are much more correct than those given in the afternoon and evening editions of the newspapers, as radio fans everywhere have undoubtedly learned by this time, for the reason that the 10:01 P. M. weather report broadcasted *via radio*, has been received but a short time before by these stations from the U. S. Weather Bureau at Washington, or other official observation points, while the reports printed in the afternoon and evening editions of newspapers are those received during the morning hours of that day. It is the proud boast of the weather bureau, so one expert said recently, that they have not made a mistake in broadcasting the weather twenty-four to forty-eight hours ahead, except about once in one hundred daily forecasts. The writer of this article has been particularly impressed, by observing these radio broadcast weather reports himself, and has found this percentage to be about right it would seem. So when you hear the radio man howl out of the amplifier horn *Rain Tomorrow!* it's no use, old top—chase up your rubbers and the umbrella and lay them beside the hall rack, for you are going to need them in the morning!

Chicago Police Radio—The Coil Aerial of the Automobile Radio Station, Covers the City, Picks Up Reports from Patrolmen and Relays Them to Headquarters. Every Patrolman Carries a Pocket Receiving Set Like That Shown at Left.

Chicago Police Adopt Radiophone

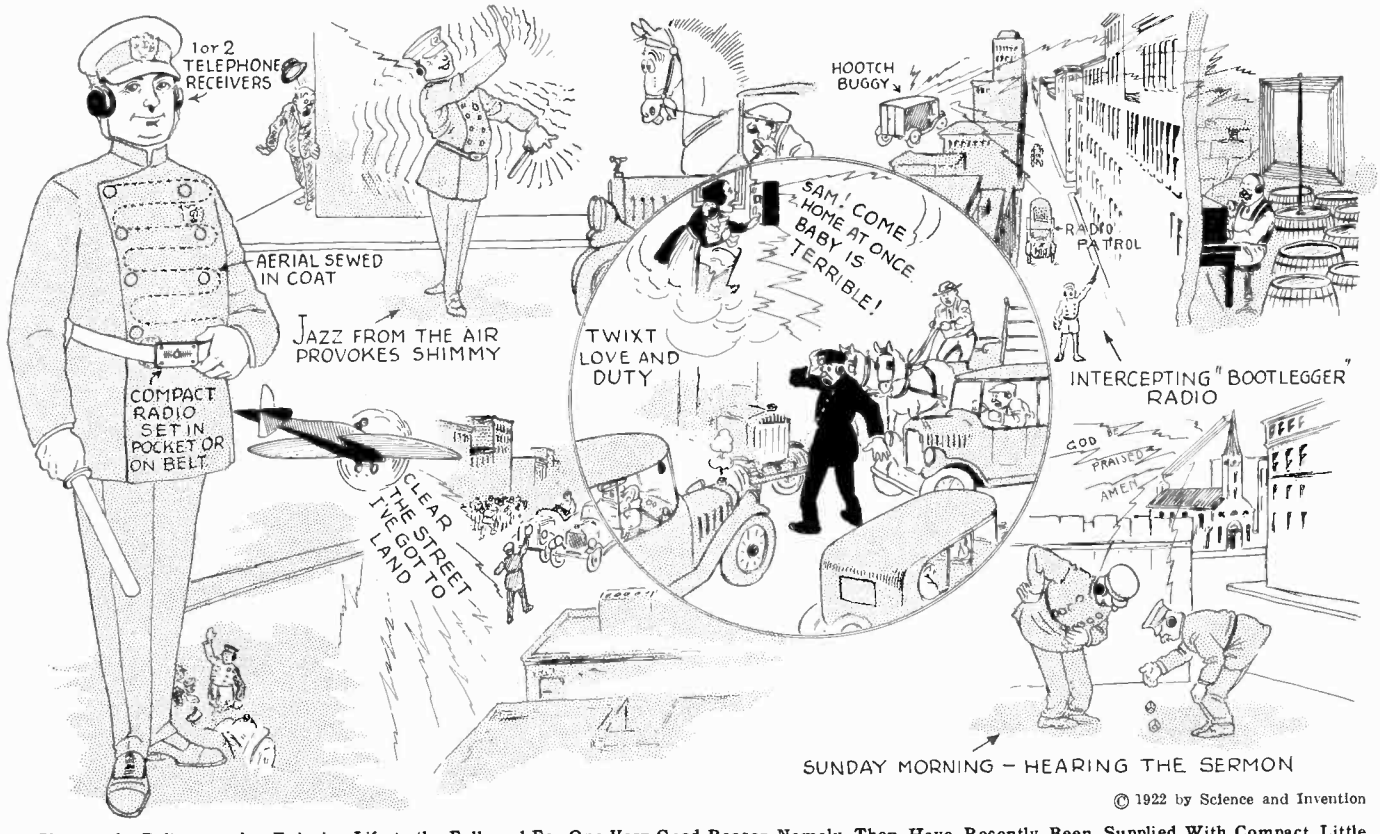
EVERY policeman patroling a beat in Chicago is to be equipt with a miniature wireless telephone, a small apparatus to be carried in the pocket, by means of which he can be in communication with headquarters every moment. The wireless telephone is not exactly an untried experiment in an everyday sense; It was employed to some extent by Secret Service men during the war, and since then great improvements have been made.

The patrolman will be able to receive a message, but he cannot send one. The instrument, which can readily be held in the hand, has a receiver, and when properly *tuned in* with headquarters permits the holder to hear his message as distinctly as from a call-box under the present system. The receiving antenna will be placed in the lining of the policeman's coat.

The signal that headquarters is calling him is given by a buzzing sound, the "radio cop" placing the receiver to his ear periodically, or else wearing a small one continually. It is possible to make the receiver very small, like the de Lange thermophone, to fit right in the ear. The adoption of this system gives police headquarters instant supervision over the entire city. Policemen may be dispatched to any spot at any time without headquarters being obliged to wait until they *report in* at their patrol boxes, as at present. A few minutes gained in this manner will be of immense value in fighting crime.

Later, with more improved instruments, a certain patrolman of a squad or group will be able to send messages to his superiors by means of a portable transmitting set weighing but a few pounds. Patrol wagons and rifle squads are already being equipt with wireless telephones, and can both send and receive from any point

(*Continued on page* 62)



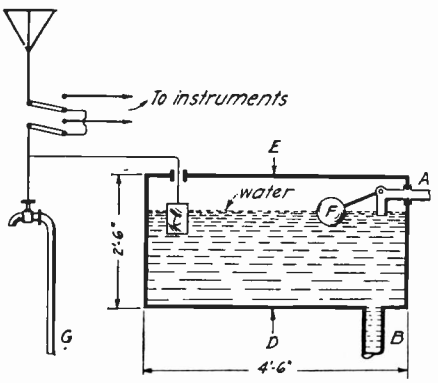
In Chicago the Policemen Are Enjoying Life to the Full, and For One Very Good Reason Namely, They Have Recently Been Supplied With Compact Little Radio Receiving Sets Which They Carry On Their Person. A Few of Our Artist's Impressions of What May Happen in the Daily Life of the Radio Equipped Cop Is Depicted in the Accompanying Illustration.

What Caused the Signals?

By JOHN G. MERNE

HEREWITH is a diagram entitled, "What Caused the Signals?" which illustrates a certain incident that happened when the writer was visiting another amateur wireless man in 1913. A large galvanized iron tank was situated in the wireless room, fitted with a wooden cover, and which tank was rectangular in shape with flat sides of about No. 10 gage metal. A copper plate about 6" x 9" was suspended from the cover by an insulated wire and hung in the water. At that time wireless was in its infancy and grounds were not considered as of much importance. The owner used this plate as a ground to water. The liquid "*water*" seemed to be the best "*ground*." This wire was thick, stranded, insulated cable and a No. 16 bare copper wire was soldered, as a supplementary ground, to a water tap in the yard. When aerial switch was connected to instruments signals were received A1, and when work was done, the switch was grounded as shown in diagram, and all retired to bed.

One night, the last of the writer's with this friend, was spent in the wireless room, receiving and experimenting—eventually all retired but the writer, and having at last finished; he grounded the aerial switch and was preparing to leave the room to go to bed, when suddenly his ear caught a wireless message, quite audible in the room. Seeking for the origin of the sound, he found it came from the tank. The first conclusion was, it's a leak or someone drawing off water somewhere from the main, and being of an inquisitive turn of mind, he waited quietly for the sounds to cease. They did for a few moments and then began again with dots and dashes continued at intervals, but evidently in code as the letters were a jumble. This led the writer to infer that it was due to other causes than wireless, but this was soon dispelled when Eiffel Tower time signals came in loud and clear from the tank. (This experiment took place in England.) All the others lay in bed, as I did not awaken them, but I told my friend what I had heard. We tried the next day to repeat the experiment, but owing to external noises and the working of the water main thruout the other houses, it was impossible to experiment. The writer had to sail for Ireland that night at 9:00 o'clock and the matter lay quiet. Then war broke out and all aerials were removed and no experimenting was allowed, and there it lies for a solution. What caused the signals?

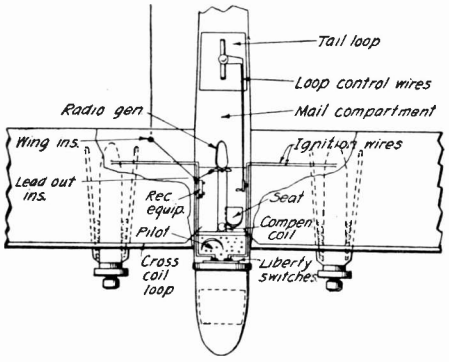


A = Water Inlet From Water Main Thru Ball Valve F.
B = Supply to Hot Water Apparatus and Lavatory.
C = Copper Plate in Water.
D = Galvanized Water Cistern 4'—6" × 3'—0" × 2'—6".
E = Wooden Cover of Tank From Which Plate Hung.
F = Ball or Valve (Water Spigot in Yard).

Radio on Aircraft

THE increasing use of flying boats and airplanes for military and commercial purposes makes it extremely important to develop methods for communicating between airplanes and between airplanes and ground stations.

The pilot of an airplane is interested in receiving radio signals, both on account of the substance of the message received and on account of his frequent need to determine the direction from which the message arrives. The problem of airplane radio reception is somewhat different in these two cases. In the former case the antenna need not be directional and so may be somewhat simpler and considerably larger.



This Diagram Shows Arrangement of Radio Outfit on a Martin Mail Plane, Including the Location of the Pilot's Seat as Well as the "Tail" Loop Aerial, the Position of the Latter Being Instantly Controlled or Changed by the Operator at Will for Obtaining Radio Compass Bearings.

In the latter case the antenna must be specially designed and carefully located in the airplane in order to give a true indication of the direction, says a writer in Aviation News, the official organ of the Canadian Flying Corps. An antenna used for airplane direction finding must necessarily be small and this limits the power which can be received and makes it necessary to use powerful amplifiers as a part of the receiving apparatus. This in turn increases the magnitude of the disturbances caused by the ignition system of the airplane. The experiments described are chiefly for use in connection with directional radio transmission and reception and when the precautions and requirements here stated are complied with, one will have little difficulty in arranging an ordinary receiving apparatus on the plane, if this should be desired.

The reception of radio signals on airplanes is necessarily handicapt by interference of two kinds: (1) Noise from the motors and the wind produced by the propellers, which makes it very difficult for the operator to hear the signals, unless his ears and telephone receivers are well protected by a helmet; (2) Electrical interference produced in the receiving apparatus by the transient currents in the wires of the ignition system of the motors. Steps which have proven to be effective in greatly reducing these two sources of difficulty are described below. Except in the case of the extremely large planes the space available for the radio apparatus is small, and therefore a compromise must sometimes be made between the apparatus most to be desired and the apparatus which would have a minimum of bulk and weight.

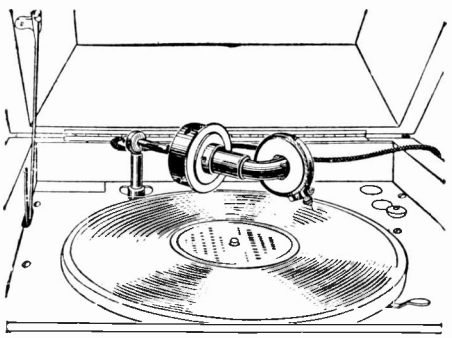
Under the present conditions it is not usually required that the signals shall be transmitted from an airplane in only one direction and therefore the problem of airplane radio transmission is not greatly different from that of transmission from a ground station. The chief elements to be considered are: (1) power supply, and (2) design of antenna, and (3) mechanical design of apparatus. The sources of power are either a generator driven by a fan which is placed in the wind stream from the propellers or batteries which may be carried on the plane if the weight is allowable. The antenna must usually be the same one which is used for receiving, unless for the latter, a coil or other directional antenna is used. On account of the limitation of size of the antenna and therefore the small maximum capacity possible, it is diffi-

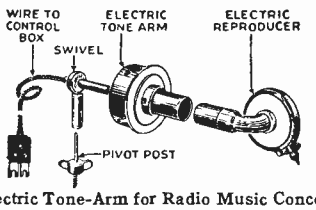
(*Continued on page 77*)

New Electric Tone-Arm

Attached to any phonograph as in the illustration, with the two wires connected to your radio transmitter as per your favorite radiofone circuit, this electric tone-arm will transmit a great deal stronger sound, than any ordinary transmitter, that you may place in front of a phonograph horn, the maker states.

There are four special low resistance, extra sensitive microphones in this arm, and the scratch of the needle or frying noise will not be transmitted. This instrument will carry four times the amount of current that any ordinary microphone can stand. This electric tone-arm is made especially for





New Electric Tone-Arm for Radio Music Concerts.

phonograph music transmission, but it can be used for transmitting speech as well, by removing the phonograph reproducer from the tube, by pulling it out, lifting the arm off the pivot post, and speaking into the electric tone-arm tube directly. The speech will also be transmitted four times stronger, because four microphones are at work.

This outfit will carry a relatively heavy current without heating. The tone-arm can be attached to any phonograph without tools in a minute. Note the pivot post in the small illustration with two wings and wood screw stud.

Religion—Via the Ether

Sermons Via the Ether Are Not New by Any Means to Radio Bugs Who Have Listened in During the Past Few Months to Such Broadcasting Stations as "WJZ" at Newark, and Many Others, But the Rev. James Lewis, of Denver, Colo., Is Particularly Ambitious and Has Installed a Radiophone Sermon Broadcasting Set of His Own, as the Photo Herewith Shows.

THE Rev. James Lewis, a Denver, Colorado, pastor, intends to make himself heard, and has arranged to install a microphone in his pulpit so that all the towns of Colorado, and within a radius of 12 miles or more, can "sit in" on his sermons. His first experiment was made several weeks ago, and more than 100 amateurs heard every word of his sermon.

The photo shows the Rev. James Lewis speaking into a microphone that is broadcasting his sermon for miles. But it is not alone the Colorado people who are able to enjoy church sermons and choir music via radio these days, for many of the wireless broadcasting stations in different parts of the country are taking up this work in earnest and are starting to put over a regular program every Sunday. The Westinghouse radiophone broadcasting station, called "WJZ," located at Newark, N. J., has a different minister give a sermon every Sunday afternoon at 3 o'clock, together with several hymns by a soloist or choir, with organ accompaniment. An attractive evening program of church music is given about 8:20, either with soloists or Edison phonograph church music, the details of these concerts being publisht in the New York, as well as Newark, N. J., daily papers, and the name of the minister and the subject of his sermon are usually given out the previous Sunday at the close of the radiophone sermon. Thousands of people within a radius of several hundred miles of the Newark broadcasting station have enjoyed these sermons, and people in other parts of the country are also enjoying sermons from their local broadcasting stations, or else will shortly when these stations get their schedules arranged to include sermons and music. One of the editors recently enjoyed a fine church service via radiophone, broadcasted from Pittsburgh, his receiving station being located at Ramsey, N. J., about 30 miles from New York City, or a distance of 320 miles from "KDKA"—Pittsburgh's call. An audion detector and three V. T. amplifiers were used, with a loud-speaker, the audience including twenty-eight people. The voice of the speaker at Pittsburgh was louder than that from "WJZ"—Newark station of the Westinghouse Company. The aerial was 125 feet long, 2 wires, 30 feet above the ground, with wires spaced 3½ feet apart.

Radio Recorder Continuous in Operation

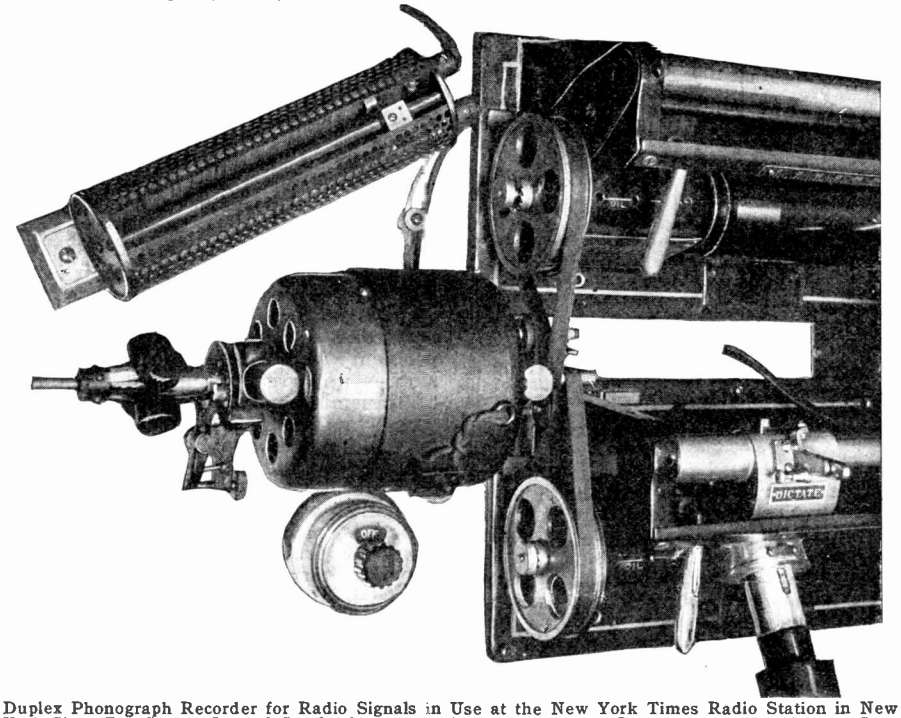
By ARTHUR H. LYNCH

A SPECIAL dictaphone recording device has been built for use in connection with the reception of radio signals from Europe, when high-speed transmission is resorted to. This device has been built especially for the New York *Times*, and it is used in that paper's radio-receiving station, for copying press dispatches.

As will be seen from the accompanying photograph, there are two recording machines, driven by the same electric motor. Each machine is fitted with a clutch which is used to carry the power from the driving motor to the drum which carries the wax records. When one machine is in operation the other is standing still, with the exception of a short period, when both machines run simultaneously, in order to make certain of continuity of the message from one cylinder to the other. This is effected in the following manner:

The recording devices of both machines are fitted with telephone receivers which operate simultaneously. Blank wax cylinders are placed on the drums of both machines and one of them is put in operation. The recording device is moved along the wax record by a worm-gear and an arm extends from it which engages a small lever shown in the photograph. Pressure on the lever causes the clutch on the first recording machine to disengage and the machine which has been idle to start. The time the two machines run together depends upon the size of the teeth on the clutches.

It will be seen that the governor of the driving motor is quite similar to those found on phonographs and any speed may be had by adjusting it. By running the records at comparatively high speed when the signals are coming in and then placing them on a reproducing machine which is run at a lower speed, it is possible for the operators to decipher messages which otherwise would be unintelligible to them, and this dual system makes certain that none of the incoming signals are lost while the records are being changed.



Duplex Phonograph Recorder for Radio Signals in Use at the New York Times Radio Station in New York City. The Second Record Can be Started While the First Is Still Rotating, so as to Obtain a Continuous record of Long Incoming Messages. Signals Can Also be Recorded on the Records at High Speed, and Afterwards Transcribed on a Low Speed Phonograph.

Simplest Radiophone Receiver

By H. L. JONES

WINNER OF $50.00 SECOND PRIZE — "THE SIMPLEST RADIO OUTFIT"

THE radio receiver shown in the accompanying drawing and photograph was designed to tune to 600 meters, using a single wire aerial about 130 feet long. This coil has an inductance of about 537,600 cms. and with an aerial having a capacity of .0003 mfd. will tune to about 750 meters. A loading coil may be used to increase the wave length if desired.

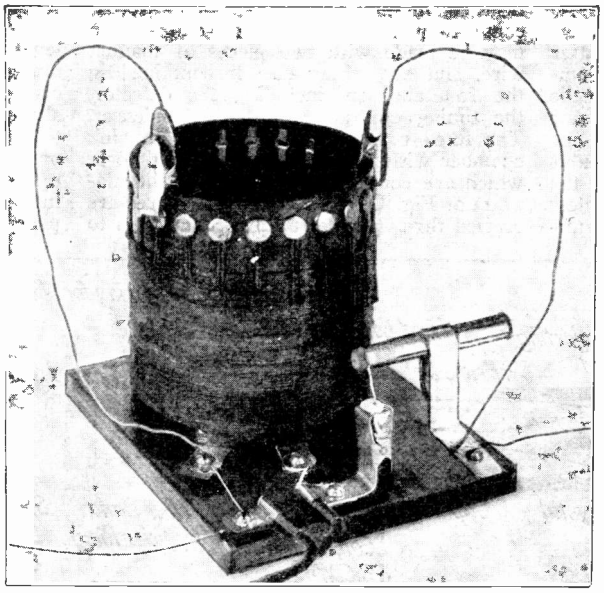
The only tools required to make this receiver are a sharp knife, a screw driver and a pair of pliers.

Aerial and Ground

A one-pound coil of No. 18 annunciator wire, obtainable at any electrical supply store, will be required for the aerial and ground. A pound of this wire will contain about 155 feet. Cut off twenty feet for the ground connection and use the rest for the aerial. The location of the station will determine how the aerial is erected. Have it as high up as possible, but it will give good results if it is only twenty feet above the earth. For insulators use porcelain cleats like those used for electric light wiring; if none of these are at hand blocks of wood boiled in paraffin will do very well. The ground lead does not require insulation. Make ground connection to a water pipe if possible. Gas pipes or steam radiators may be used but as a rule are not as good as water pipes. Be sure both pipe and wire are clean and bright when connection is made. For the best results all connections should be soldered.

Tuning Coil

Obtain a cardboard box or mailing tube about 3¼ inches diameter and cut it so that it is 3 5/16 inches long. Civil engineers and architects get their tracing cloth in thick walled mailing tubes that make ideal coil winding forms. If you don't happen to have a round cardboard box of this size about the house visit your city engineer Mark a line around the tube 5/16 of an inch from one end. With the small blade of a penknife make 19 holes on this line spaced 7/16" apart. these holes are for the contact points which are the common paper fasteners. Insert paper fasteners in holes but do not spread points.

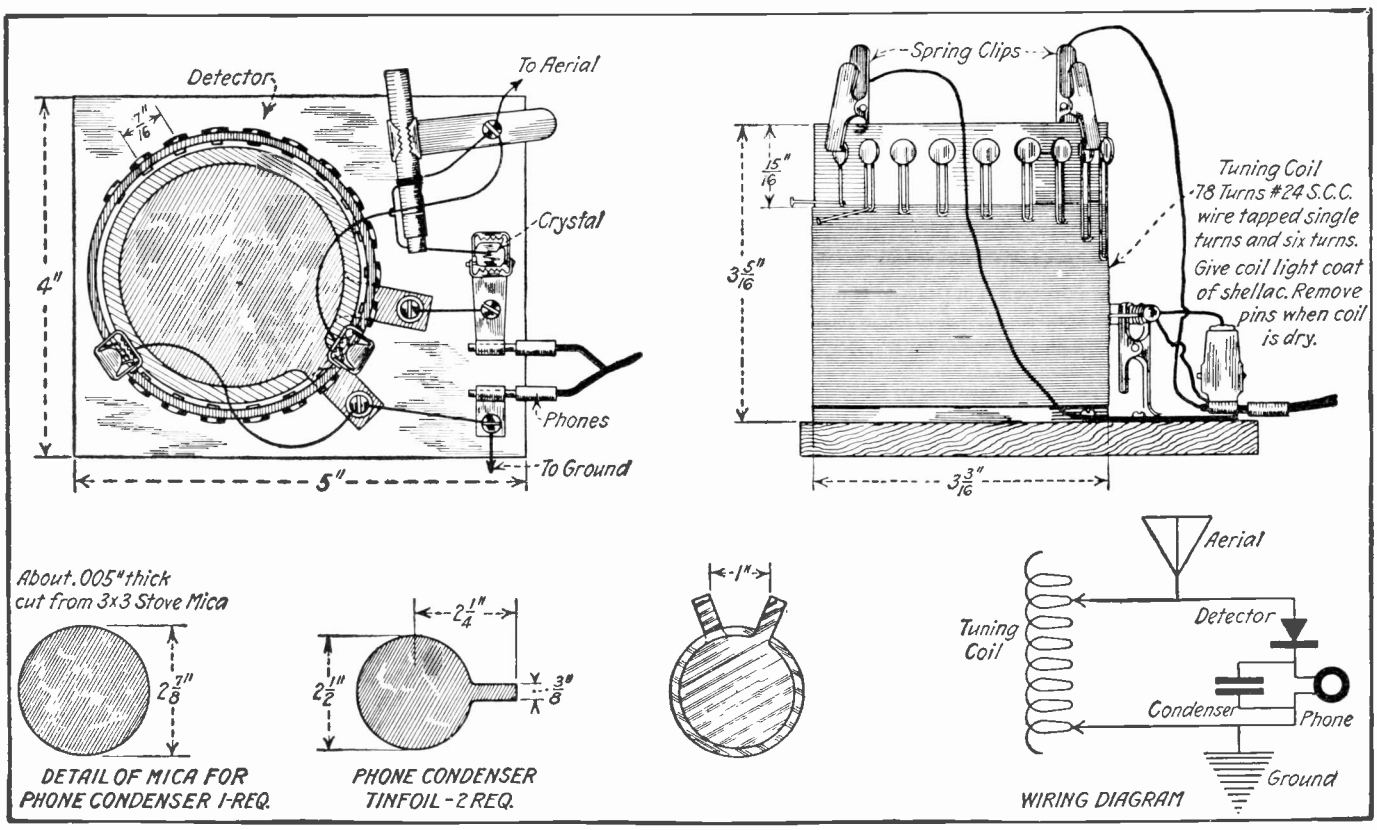


Here Is the Simple Radiophone Receiving Set Which Won the Second Prize of $50.00 in the $300.00 Prize Contest Recently Conducted by SCIENCE AND INVENTION The First Prize Winner's Set Was Illustrated and Described in Detail in the April Number, and the Other Prize Winners' Outfits Will Be Described in Succeeding Numbers

The coil is wound with No. 24 single cotton covered magnet wire and ⅛ lb. will be required. To wind the coil fasten one end of the wire to the first paper fastener. In doing this scrape the end of the wire, also the under part of the fastener, so that when the points are spread and the fastener pinched with the pliers a good contact will be made. Directly under the first fastener and 15/16" from end of tube insert a pin. Bring the wire down from the first fastener, around the pin and make one turn around the tube. Insert another pin under the second fastener, bend the wire around the second pin, up around the second fastener, back around the pin and complete another turn around the tube. Repeat this for the first six fasteners. After passing wire around the sixth fastener and pin wind six turns and take off another tap; continue in this manner to end of coil taking off tap every sixth turn. When completed the coil should have 12 six turn taps and 6 one turn taps, or 78 turns in all.

It is not necessary to scrape the wire where it passes around the contact points until the coil is wound After completing the winding wind a cord around the top of the coil to hold taps in place. remove fasteners one at a time and scrape wire and fastener, replace and pinch with pliers. Remove cord and give winding light coat of shellac After shellac is dry remove pins and winding is complete. It is best to keep shellac away from the contact points as it is apt to cause a poor contact between point and wire. If the maker has a soldering outfit by all means solder wire

(*Continued on page 78*)



These Drawings Show How Mr. H. L. Jones, Second Prize Winner in the Simplest Radiophone Receiving Set Contest, Built His Instrument.

Complete Radio Receiver in Fountain Pen

SPEAKING of real nifty and compact radio receiving sets, especially those of the vest-pocket variety which we hear of now and then, what's the matter with this *fountain pen receiver*, which comprises all of the essential parts, even to the telephone receiver itself? Mr. H. W. Secor first thought of a set built like this one several years ago, and under the stimulus of the many ideas brought out in the *cheapest radiophone receiving set* contest recently conducted by SCIENCE AND INVENTION, he has been prompted to write up this idea. True, this set is not one to be built in a haphazard manner, but really merits being constructed in the same way as our fine watches are built. In other words, it should be built with the same craftsmanship as a jeweler would employ, but the radio enthusiast who is handy with small tools can with a fair degree of patience construct such a set even down to the thermo-telephone type of receiver here employed.

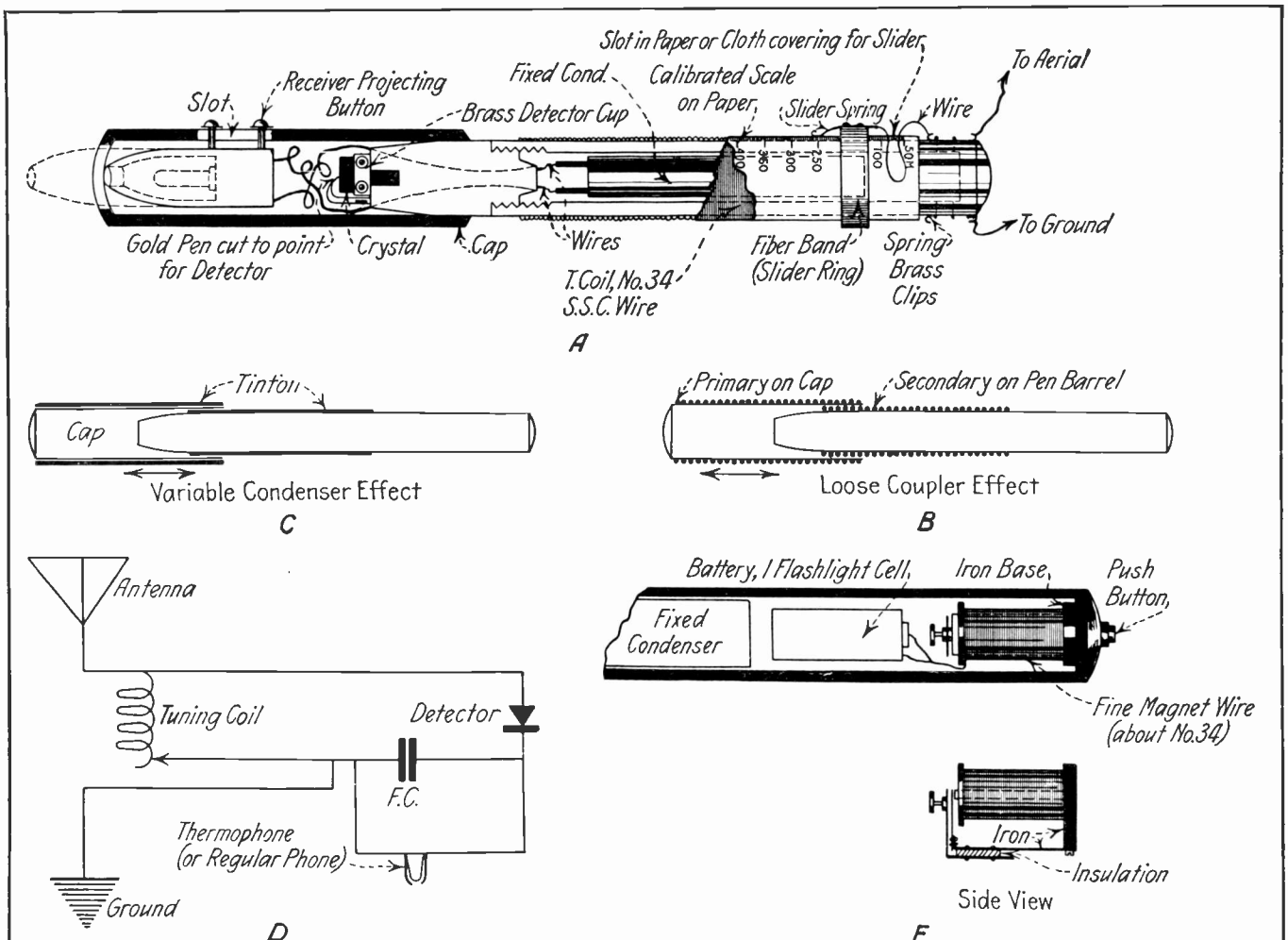
As will be seen the thermo-receiver which utilizes simply a U-shaped loop of very fine platinum (Wollaston) wire, which is heated and cooled successively by the changes in current, is placed in the fountain pen cap; the thermo-phone has a button attached to it which slides in a slot, so that it can be projected from the opening in the end of the cap, in order to be inserted in the ear. The only external connections are to aerial and ground, which may be made with two pieces of magnet wire, and everything else is contained in the fountain pen, including the detector, the tuning coil and the fixed condenser. The fixed condenser is placed in the ink chamber with suitable wires attached to it, which are connected according to the diagram at Fig. D. The connecting wires are carried thru the ink feeding channel up to the pen point, and the gold pen is cut or filed so as to have a long thin projection left, which will act as a delicately poised cat-whisker contact for the detector crystal. The crystal, galena or iron pyrites, is held in a brass cup fitted with small clamping screws, as shown in the drawing. This cup is held in position by a stud turned integral with it, drilled especially for it in the heart of the pen feed stem.

The tuning coil is composed of a layer of No. 34 or a little heavier single silk covered magnet wire, wound in an even layer along the pen barrel as indicated; this winding after being shellacked and dried, is then covered with a layer of paper or very fine silk cloth, leaving a strip about one-eighth inch wide along the length of the coil, in which the slider spring passes to make contact with the successive turns of wire, which have their insulation scraped off along the slider path. Suitable figures, fractions of an inch or else wave length in meters, if the set can be calibrated with a borrowed wave meter or else computed, may be placed along the slider path.

The slider itself is simply a hard rubber, or better still a fibre ring, which will just move nicely over the paper covered tuning coil and has a light spring brass or phosphor bronze spring riveted to it. A piece of flexible insulated wire is soldered to the slider spring and also to the spring brass clip at the end of the pen; the aerial and ground wires are snapped under the spring clips and pulled out again when thru. This fountain pen receiver set is suitable for picking up radio-telegraph as well as radio-telephone messages and if the builder does not care to purchase the thermo-phone receiver or to experiment and build one, he may simply do away with this feature by placing two spring clip phone terminals on the pen barrel or on the cap; a regular radio receiver of 1,000 ohms or more resistance can then be used, following the same hook-up scheme as shown at Fig. D.

The possibilities of the fountain pen receiving set, it seems, have been overlooked

(*Continued on page* 68)



Did You Ever Dream of a Complete Radio Receiving Set the Size of a Fountain Pen to Fit Your Vest Pocket? Here It Is and the Radio Enthusiast Can Make a Receiving Outfit Suitable for Picking Up Radio Telegraph, as Well as Radiophone Messages, With a Little Care and Ingenuity. The Thermo-phone Receiver Here Suggested, in Order to Make the Set a True "Fountain Pen" Outfit Complete, Is Not as Sensitive to Radio Currents as the Usual 1,000 or 1,500 Ohm Watch Case Receiver, But for Short Distances It Will Serve the Purpose Very Well. Most Radio Bugs, No Doubt, Will Be Satisfied to Have Either a Tuning Coil or Loose Coupler Complete in the Fountain Pen, Together With Fixed Condenser and Mineral Detector, and Perhaps the Buzzer Test, If They Get That Far With It. They Will Then Want to Use, No Doubt, a Regular Watch Case Radio Receiver Connected to the Wires Shown Leading to the Thermo-phone.

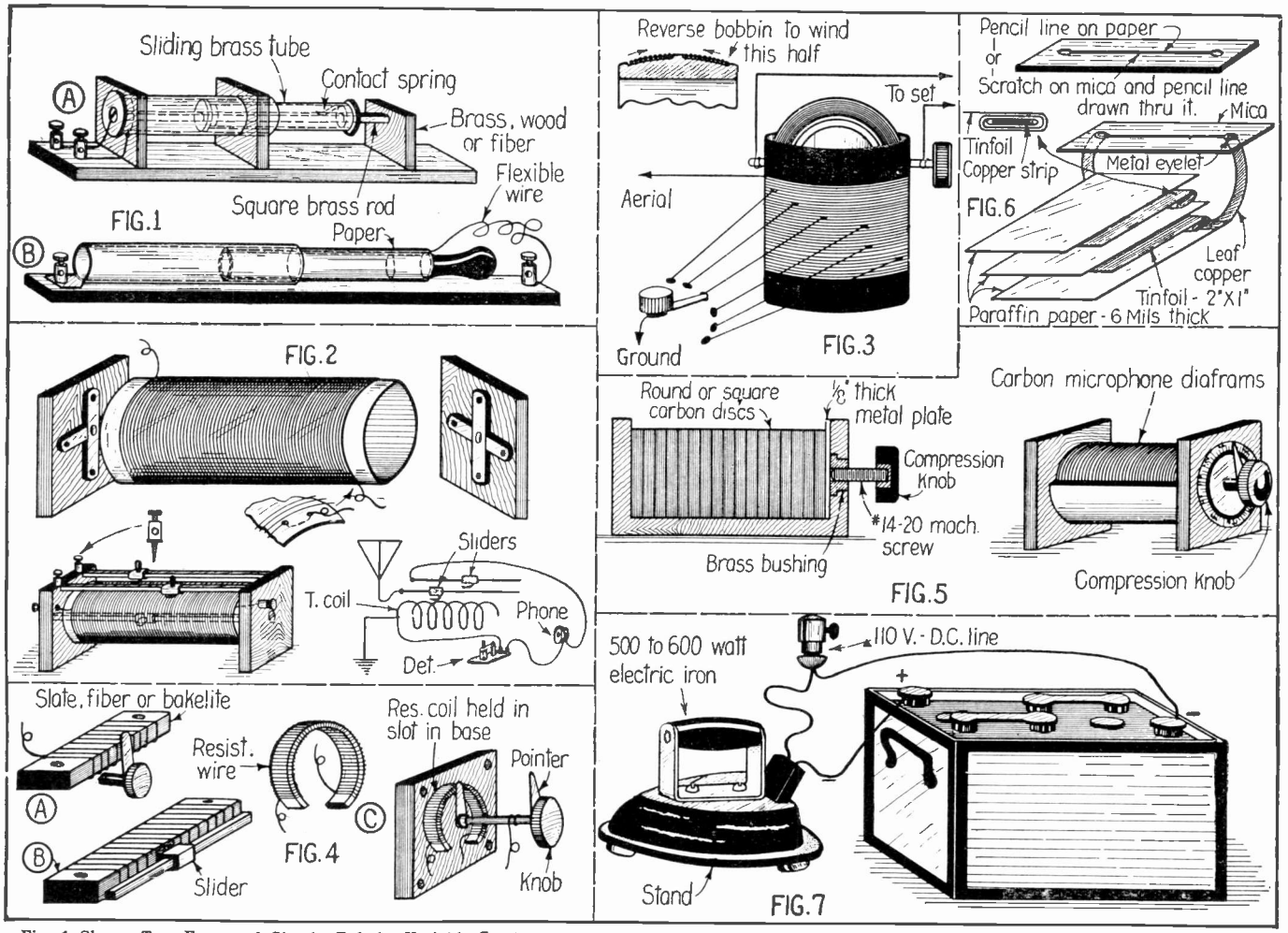


Fig. 1 Shows Two Forms of Simple Tubular Variable Condensers; Fig. 2, Hook Up and Construction Ideas for Building Efficient Tuning Coil; Fig. 3 Shows How Primary and Secondary Bobbin of a Vario-coupler Are Wound; Fig. 4 Illustrates Several Forms of Home-made Audion Rheostats; Fig. 5 Shows Rheostats of the Carbon Plate Compression Type; Fig. 6 Shows How Grid Leak and Condenser Can Be Made; Fig. 7 Shows "A" Storage Battery Being Charged With Electric Sad Iron in Series for Several Hours.

Radio Constructor Hints

By H. WINFIELD SECOR

WITH the great boom in radio occasioned by the opening of the large number of broadcasting stations thruout the country, interest in constructing one's own instruments for receiving these radio concerts, news items and agricultural reports has risen to a high degree. A few practical "How to Make It" wrinkles and ideas are given herewith, for the benefit of the layman who is just getting interested in the radio game. Among other cardinal points to remember in building radio apparatus of no matter what type, is the fact that among all its features, insulation is perhaps the foremost. In other words, instead of using ordinary wood, excepting when it is very dry or, better still, boiled in paraffin or bees' wax, you will always find that it pays to use a better insulation, such as vulcanized fibre stock, hard rubber or bakelite. In passing, it is interesting to note that the bakelite and fibre manufacturers have recently brought out new ideas in this material so extensively used for switchboards and panels on radio cabinets; one of the new materials is a fibre sheet faced on either surface with a thin veneer of bakelite; a second innovation is a bakelite sheet having a fine copper screen molded into it. This forms a protective shield, especially when connected to a ground wire, so that capacity effects caused by the proximity of the hand or the body to audion amplifiers, especially those of the two- and three-stage type, will be eliminated. When switch and condenser shafts are passed thru holes in this form of panel material, the holes should be drilled considerably larger than the shafts, and then bushed with a fibre or other insulating tube.

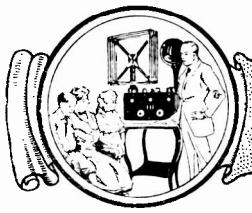
Variable Condensers

The illustration in Fig. 1 shows two forms of easily made variable condensers which those building their own apparatus can construct with very little trouble and expense. The two opposite condenser plates or surfaces are formed of two pieces of brass or other metal tube (the kind of material having nothing to do with the electrical capacity), the inner sliding tube being preferably about 1/16" smaller in outside diameter than the inside diameter of the stationary or larger tube. These tubes can be of any thickness without changing the electrical capacity, the only requisite being that the tube should be thick enough to hold its shape firmly, in order that the two tubes shall not touch when one is slid within the other.

The variable condenser shown at Fig. 1, A, has been manufactured for a great many years by several radio companies. It is not quite as handy as the rotary variable condenser, as the hand has to move a little farther back and forth in tuning with it, but it is by far the simplest to build and possesses a good degree of accuracy once it has been assembled. The inner tube can be prevented from touching the outer tube and thus short-circuiting the instrument, by placing an end washer of fibre, bakelite or wood at the inner end of the movable tube, the outside diameter of this washer or disk being a shade less than the inside diameter of the stationary tube. In some cases, a piece of paper or oiled linen, silk, etc., is shellacked around the inner tube to serve the purpose of preventing the two from touching. This is the case in the design of the extremely simple variable condenser shown at Fig. 1, B. The inner tube is fitted with a wood or other handle, and is then covered with two or three layers of paper glued or shellacked in place, so that the tube will slide nicely in and out of the stationary tube. One end of the stationary, brass or other metal tube is cut as shown, then flattened, so that a binding post can be passed thru it and into a wooden base. A second binding post terminal connects with a piece of flexible wire, such as lamp cord, the free end of which is soldered to the movable metal tube.

The writer has used a condenser of the type shown at Fig. 1, A, very successfully across the tickler winding in an audion receiving circuit, where the capacity specified was .0005 M. F. The size of the brass tubes and the spacing between them in this case was as follows: The outside tube had an inner diameter of 2", while the outer diameter of the moving tube was slightly more than 1¾". The length of each tube was 6". The moving tube may slide along a round, or

(*Continued on page 69*)



RADIO BROADCAST

WITH this issue, we are presenting a broadcast map which is a little different than the usual types of broadcasting maps, due to the fact that we would like every reader to keep this one, mounting it upon a piece of cardboard and hanging it up over his radio set. Furthermore, it can be kept up to date indefinitely.

Bordering the map itself are listed the names of towns, states, broadcasting stations, and their respective call letters. Only phone stations, or those which transmit radio telephonic messages or music are to be found. Following each of the names is a code marking such as D-15. In order to find the location of D-15 we look in the horizontal column for the letter "D" and follow this space until it is crossed by the vertical column enumerated 15 on the map. This gives us the location of the town.

Thus, as the new calls come in, and as the list of the stations increases, new towns may be recorded which do not appear on the map. Every month we will publish the names of new stations and their location with regard to the particular square they are in. In this manner, the radio enthusiasts will find it a comparatively simple matter to enlarge the list and keep his map strictly up-to-date.

A brief summary of the station and the nature of these broadcasts as well as the time the station is broadcasting will be given.

In this work, we would appreciate the assistance of our numerous readers in plotting the new phone stations. Please bear in mind that we desire phone stations only, either amateur or commercially licensed broadcasting stations. So it is up to our readers to get busy now, and make this list complete. We cannot do so without their cooperation. If all the amateurs will secure the names of the transmitting stations, as well as their respective calls, and send them to Broadcast, care of Science and Invention, this map should be completed in a very few issues.

The wave lengths as well as the maximum distances stations have been heard are absolutely authentic in this list and have been extracted from letters sent to the broadcasting stations from the various amateurs "listening in." Of course, exceptional ranges although tried for, are not within the usual experimenter's pocketbook, and such results as those obtained in Scotland, where American amateurs were heard, are possible only with large groups of vacuum tube amplifiers or during favorable atmospheric conditions.

The Government can only furnish those stations commercially licensed for broadcasting work, but there are many other radio phone stations not so licensed which send an occasional record through the ether, or otherwise pleasantly disturb the air. Have them all listed on your map. After the map has been mounted and placed near your receiving set, listen carefully. Then as you hear the various stations, stick a pin into each location so that you will have a permanent record for yourself. You can then quickly point out to friends the location of the broadcasting stations "heard."

Address all communications to "Broadcast," care of SCIENCE AND INVENTION.

Akron, Ohio. Radioart Store Station. 8 UX. 190-200 meters. Temporarily discontinued on account of recent ruling forbidding broadcasts on 200 meters.

Anacostia, D. C. NOF and NSF. 350 meters. Former call letters for broadcasts; latter for government work.

Austin, Texas. State University. 5 XU. 360 meters. Not yet broadcasting. Call will probably change.

Berlin, N. H. Y. M. C. A. 1 BKP. 200 meters. Range about 50 miles; local broadcasts. Impromptu program.

Charlotte, N. C. Southern Radio Corp. WBT. 360 meters. Located at 905 Realty Bldg.; 250 watt tube station, consistent range 200 miles daylight, 500 miles night. Broadcasts music, news of general interest daily, and church services on Sunday.

Chicago, Ill. Westinghouse Station. KYW. 360 meters. 2,000-mile radius. 9.30 A. M. to 9.15 P. M. every day except Sunday. Sunday (Chapel Service), 3.00-4.30 P. M. General broadcasts, 9.30 A. M. to 1.15 P. M. Market reports, 2.15, 4.15, and 6.30 P. M. News reports after market reports. Special speakers, 7.00 P. M. Children's bed-time story, 7.30 P. M. Music, 8.00 to 9.00 P. M. News, 9.00 to 9.15 P. M.

Cincinnati, O. Precision Equipment Co. WMH. 360 meters for concerts; 485 for news. 11.00 A. M. to 4.00 P. M., news and weather reports on week days. 8.15 P. M., concerts on Monday, Wednesday and Saturday. One of the first stations to adopt regular schedule. 1,000 miles maximum distance heard.

Cleveland, O. Cox Mfg. Co. 8 ACS. 200 meters. Station shut down because of government order prohibiting 200 meter broadcast.

Cleveland, O. W. R. Cox. WHK. 360 meters. 300 miles radius. 1.30 P. M. to 2.00 P. M., 3.30 P. M. to 4.00 P. M. and 8.00 P. M. to 9.30 P. M. every day.

Columbus, O. Ohio State University. 8 YO. 275 meters. Time signals, market reports and other useful information. 700 miles.

Dallas, Texas. Police Dept. WRR. 450 meters. 7.00 P. M., news; 8.30 P. M., music on week days, 11.00 A. M. and 7.45 P. M. Church services on Sunday. Range, 1,500 miles.

Davenport, Iowa. Palmer School of Chiropractic. WOC. 360 meters. Concert daily except Sunday, 5.45 to 6.00 P. M. and 7.00 to 8.00 P. M. Sunday, 8.00 to 8.15, business review. Chimes Sunday, 9.00 to 10.00 A. M. and 5.30 to 6.00 P. M. 1 K.W. two tube set. Station formerly located at Rock Island. 600 miles.

Dayton, O. McCook Army Station. WFO. No information as to range or broadcast yet.

Deal Beach, N. J. American Tel. & Tel. Co. 2 XJ. Varying wave lengths, working with KDOW, test station.

Denver, Colo. Fitzsimmons Gen. Hospital Station. DD 5. 325 meters. Concert, news daily, 8.15 P. M. Range 1,500 miles.

Denver, Colo. Reynolds Radio Co. 9 ZAF. 360 meters. Daily weather, 8.30 A. M. Weather and news, 7.45 P. M. Concert, 8.00 to 9.30 P. M. Range 1,500 miles.

Denver, Colo. W. D. Pyle. 9 WD. 200 meters. Saturday, 8.00 to 9.50 P. M., concert. Range 1,500 miles.

Denver, Colo. Y. M. C. A. Station. 9 YAL. 485 meters. 9.55 P. M., time signals and news. Heard 1,500 miles.

Detroit, Mich. Detroit News. WWJ. 360 meters. 4 250-watt tubes, 2 as oscillators; 2 as modulators; and 1 50-watt tube as speech amplifier. 11.30 to 11.55 A. M. phonograph music. 3.30 P. M., market and weather report on 475 meters. 7.00 to 8.15 P. M. evening program. Music, vocal and instrumental, humor, lectures, jokes and vaudeville artists. 1,500 miles.

Fairfield, Ohio. U. S. Army Station. WL 2. Experimental station.

Fort Worth, Texas. Fort Worth Record. WPA. 360 and 475 meters. News, instructions and hints on radio, special question and answer department, concerts and market reports, weather forecast, police and fire reports, 7.10 P. M. Maximum range 100 miles. New set with consistent range of 1,000 miles now in course of erection.

Hamilton, O. Doron Bros. Electrical Co. WRK. 360 meters. Heard 800 miles on crystal; maximum 1,400 miles, 8.30 to 10.30 P. M.; music Monday; 10.30, health lecture. Wednesday 8.30, music, lectures and vaudeville. Saturdays 8.30, music, health and radio lectures. Alternate Sundays, church services.

Jersey City, N. J. Hudson City Radio Club. 2 CBK. 200 meters. 2.00 to 3.00 P. M. Sunday, music; 5.00 to 6.00 P. M. week days, music. Uses Hudson City Radio Shop's Station.

Jersey City, N. J. Hudson City Radio Shop. 2 BPG. 200 meters. Saturday, 10.00 to 11.00 P. M., music. This station is used to broadcast Hudson City Radio Club material on call 2 CBK.

Jersey City, N. J. Jersey Review. 2 IA. 200 meters. Third station in the U. S. to broadcast concert, 7.00 to 8.00 P. M. week evenings. One-half hour chapel service Sunday evenings. Heard in Memphis, Tenn.; Owensboro, Ky.; S. S. Corona, 950 miles at sea; Toronto, Canada, and Calais, Me.

Jersey City, N. J. N. J. Wireless Telephone Co. WNO. 360 meters. Hourly on the half hour from 12.30 to 5.30 P. M., news of the day and music. 6.30 P. M. Monday, half hour program for children; 6.30 P. M. Tuesday, first act of local popular play; 6.30 P. M. Wednesday, Thursday, Friday, Saturday, music.

Lincoln, Neb. University of Nebraska. 9 YY. 375 meters. Heard at Hazelton, Pa. 10.10, market reports and weather forecast. 1,200 miles maximum distance heard.

Los Altos, Calif. Colin B. Kennedy Co. KLP. 360 meters. 7.30 to 8.30 P. M., news supplied by the Journal of Electricity and Western Industry, followed by music on Monday. 8.30 to 9.00 P. M., music on Thursday; 4.00 to 5.00 P. M., music on Sunday. Heard in Washington, Oregon, California, Nevada, Idaho, Utah, Arizona, Montana, Wyoming, Colorado, New Mexico, South Dakota, Nebraska, Kansas, Texas, Minnesota, Iowa, Ohio, Canada, Alaska and Hawaii.

Los Altos, Calif. Colin B. Kennedy Co. 6 XAC. 200 meters. Experimental station.

Los Angeles, Calif. C. R. Kierliff & Co. KHJ. 360 meters. Broadcasting for Los Angeles Times. Schedule not yet arranged.

Los Angeles, Calif. Leo J. Meyberg Co. KYJ. 360 meters. Operating for Hamberger Department Store. Heard 1,000 miles in North and Three Rivers, Canada by airplane, San Francisco receives easily, also Idaho, Wyoming and Washington. Music 4.00 P. M. to 5.00 P. M. Weather reports Tuesday, Thursday and Saturday, 8.00 P. M. to 9.00 P. M. Educational matters, 9.30 A. M. to 10.30 A. M. In connection with this station there is a free radio school—300 to 400 pupils. Night school for adults.

Los Angeles, Calif. Western Radio Elec. Co. KOG. Heard in Quartzburg, Idaho and Bozeman, Montana. Press notices every afternoon except Sunday, 5.00 P. M. to 5.45 P. M. Music Tuesday and Wednesday evenings, 8.00 P. M. to 9.00 P. M. Music Friday evenings, 8.15 P. M. to 9.00 P. M.

Madison, Wisconsin. University of Wisconsin. WHA. 360 and 485 meters. Range 1,000 miles. Daily press and market reports by telephone and telegraph, weather and time signals. Music, lectures, Tuesday evenings, 8.00 P. M. to 9.30 P. M. Press bulletin, music and announcement of weekly program Friday evenings, and concerts.

Mamaroneck, New York. Experimental Station. 2 BQH. 200 and 1,200 meters. Works on test work exclusively from 10.30 P. M. and after, Tuesday, Thursday and Saturday nights. This station is experimental, working continually for the benefit of the amateur, and is in charge of a competent radio engineer. Heard 1,400 miles away.

Medford Hillside, Mass. American Radio Research Co. WGI. Daily 8.00 P. M. Music and regular broadcasts. Radius 1,000 miles. Police reports in slow code, then phone. Station formerly called 1-XE.

Newark, N. J. L. Bamberger & Co. WOR. 350 meters. Music from 9.30 to 6.30 hourly on half hour. No Sunday program. Lectures and talks included. Heard at Boston.

Newark, N. J. Westinghouse Test Station. 2 SAI. No schedule.

Newark, N. J. Westinghouse Elec. Mfg. Co. WJZ. 360 meters. Program daily from 11.00 to 6.00 hourly on the hour. Regular program from 7.00 to 10.30. Music, shows, lectures, operas, artists, etc. Time and weather reports. Church services and sacred music on Sundays. 1,800 miles.

New York City, N. Y. Hudson Radio Club. 200 meters and over. 2 AYZ, 240 W. 80th St.: 2 BHY, 171 E. 70th St.; 2 KP, 345 W. 88th St.; 2 ADK, 650 West End Ave. Music and club publicity.

New York City, N. Y. Shipowners' Radio Service. WDT. 360 meters. No regular schedule at present time.

New York City, N. Y. John Wanamaker. WWZ. 360 meters. Broadcasts hourly on the 40 minutes from 11.40 to 5.40 inclusive. At 10.30 broadcasts till midnight. Program music, talks on unusually interesting matters. Heard 1,400 miles.

N. Y. Harbor, N. Y., Fort Wood, Governor's Island. WVP. 1,450 meters. Irregular program. Music. Lectures and radio questions answered via radio telephone. Heard 1,200 miles.

Oakland, Calif. Hotel Oakland. Western Radio Inst. Preston D. Allen. KZM. 360 meters. 1,900-mile radius. News on week days, 7.15 P. M. Music on Tuesdays, 7.30 to 8.15 P. M. Music on Fridays, 8.15 to 9.00 P. M. Sent out first radio sermon in the west to an audience of 30,000.

Parkersburg, Pa. H. A. Beale. 3XW. 3ZO. 200 meters. Heard in all the New England states. Range about 1,000 miles.

Pasadena, Calif. J. J. Dunn & Co. KLB. 360 meters. Heard 600 miles. Music Monday and Friday, 7.30 to 8.15 P. M. Music Sunday, 3.00 to 4.00 P. M. and 8.00 to 9.00 P. M. Power to be increased ten times in six weeks from present entry. Professional talent at least once a week.

Pawtucket, R. I. DeLancey, Felch & Co. Station of Raymond W. Farnum. 1 OJ. 200 meters. No regular program now. Music. Range 150 miles.

Pawtucket, R. I. Standard Radio & Elec. Co. 1 XAD. 290 meters. Thos. P. Giblin Station. 2 50-watt tubes, radius 400 miles. Heard at distances of 1,000 miles. Located at 463 Broadway, same city. Broadcasts three days per week, music, lectures and letters read. Now working on 290 meters. Aerial 70 feet long, 9 wires on spreader 15 feet, 11 wires on counterpoise. Ground, 11 wires 70 feet long, copper plates at end.

Philadelphia, Pa. Gimbel Bros. WIP. 360 meters. Heard 1,000 miles. Music, speeches, news items. Programs published in Philadelphia papers.

Philadelphia, Pa. T. F. Howlette. WGL. 330 meters. No schedule.

Philadelphia, Pa. Strawbridge & Clothier. WFI. 360 meters.

Philadelphia, Pa. John Wanamaker. WOO. 360 meters. Broadcasting principally a musical program, 7.00 to 10.00 P. M. Temporary installation.

Pittsburgh, Pa. Westinghouse Elec. Co. KDKA. 360 meters. 10.00 to 10.15 A. M., music; 12.30 to 1.00 P. M., music; 2.00 to 2.20 P. M., music; 4.00 to 4.20 P. M., music; 7.30 to 7.45 P. M., bed time story; 7.45 P. M., news; 8.30 to 9.00 P. M., music; 9.00 to 9.05 P. M., United Press Service News; 9.05 to 9.30 P. M., music; 9.55 to 10.00 P. M., time signals. Sundays, chapel services, 11.00 A. M., 3.00 and 7.30 P. M. Range 2,000 miles.

Portland, Ore. Willard P. Hawley. 7 XG. 200 meters. Experimental and vocal music between 8.00 and 8.45 P. M. Tuesday and Wednesday, and between 9.00 and 9.30 P. M. Thursday.

Portland, Ore. Northwestern Radio Mfg. Co. 7 XF. Broadcasts every Tuesday and Friday evening at 8.45 P. M. Public Health Service Bulletins. Sends out Industrial News every Monday evening.

Portland, Ore. The Oregonian. KSW. 360 meters. Music, talks, news bulletins daily. Maximum distance 900 miles.

Richmond, Ind. Richmond Palladium News-Paper Co. WOZ. 360 meters. Stock and market reports daily at 4.00 and 6.30 P. M. Range about 100 miles.

Ridgewood, N. Y. Broadcasting Corp. of America for Times Publishing Co. WHN. 360 meters. 100 miles radius. Every hour on the hour from 8.00 to 11.00 A. M. Every hour on the half hour, 11.00 A. M. to 9.30 P. M.

Roselle Park, N. J. Radio Corp. of America. WDY. 360 meters. Program combined with WJZ, the Westinghouse station at Newark, N. J. The Radio Corporation will open a new station in New York about June 1st.

Sacramento, Calif. J. C. Hobrecht. KVQ. 360 meters. Operating in connection with Sacramento Bee newspaper. Equipment, 5 5-watt tubes, 2 oscillators, 2 modulators, 1 speech amplifier. Heard in Alberta, Canada, Washington, Wyoming, Utah and Idaho. Every afternoon from 5.30 to 6.30, press notices and music. Wednesday and Saturday, 8.00 to 9.00 P. M., music. Range about 1,000 miles.

San Jose, Calif. Chas. D. Herrold. KQW. 360 meters. Equipment, 50 watt phone with facilities for connecting with the telephone line. 1,500-mile radius. Music and church services are transmitted by telephone to the laboratories, and then re-transmitted via radio.

Schenectady, N. Y. General Electric Co. WGY. 360 meters. Heard in Iowa, Minneapolis and Cuba. 1,600 miles. Broadcasts music, speech and topics of general interest.

Schenectady, N. Y. Union College Radio Club. WRL. 360 meters. Weekly program, Sunday 7.30 P. M. Irregular program during week. Power, 1KW.

Seattle, Wash. Excelsior Motorcycle Co. KHQ. Works on divided schedule with Northwest Radio Service. Broadcast 7.00 to 9.00 P. M. Music.

Seattle, Wash. Northern Radio Elec. Co. WJO. 360 meters. Operating in conjunction with Seattle Post Intelligencer. 100 watt vacuum tube transmitter. Heard by ship 3,600 miles at sea. News, market reports, music, etc. Seven to nine hours daily. Land range about 1,200 miles.

Seattle, Wash. Post Intelligencer. KFC. 360 meters. Operated by the Northern Radio Co. News bulletins between 12.00 and 1.00 P. M. on special occasions; at 3.30 and 5.30 P. M., news bulletins, market quotations and music. 8.30 to 10.30 P. M., cables, news, new phonograph records, concerts.

Springfield, Mass. Westinghouse Station. WBZ. 360 meters. Children's bed time story, 7.30 P. M. (every day except Sunday); prominent speaker, 7.45 P. M. (every day except Sunday); musical program, 8.00 to 9.00 P. M. (every day except Sunday); chapel service, 3.00 P. M. Sunday; church service, 8.00 P. M. Sunday. Maximum distance 1,400 miles.

Stockton, Calif. C. O. Gould. KJQ. 360 meters. 75 to 100 mile radius, operated by D. W. Horstmeyer. 5.00 to 5.30 P. M., news and music on week days. 7.00 to 8.00 P. M., music on Wednesdays and Sundays. 10.00 to 11.00 A. M., church services on Sundays.

Washington, D. C. Doubleday Hill Elec. Co. KQV. Every afternoon from 4.30 to 5.30 P. M. Thursday and Friday from 7.30 to 8.30 P. M.

Washington, D. C. White & Boyer Co. Concerts with short lectures on radio, Keith's vaudeville, music, etc. Range 1,000 miles.

There are other stations which are not yet listed on this schedule because the information regarding them has been received from various sources, and the call letters or nature of the broadcasts are not yet definitely determined. In other words, the stations here listed may not be in operation or their call letters may have been changed. Nevertheless, phone messages from each have been heard. Where possible, the name of the concern is given and, in those places where two different calls are found, some writers have reported hearing one and some the other. Telegrams have been dispatched to nearly every station here listed, but many had not replied up to the time we went to press. The list follows:

Atlanta, Ga. Garter Electric Co. 4-CD.

Chicago, Ill. WBU.

Cleveland, Ohio. Cleveland Radio Association.

Cleveland, Ohio. WHK.

Columbus, Ohio. Electrical Specialty Co. BYU. 200 meters.

Detroit, Mich. Police Department. KOP.

Gridley, Calif. KFU.

Hollywood, Calif. Elec. Lighting Co. KGC.

Indianapolis, Ind. WOH.

Indianapolis, Ind. Hamilton Mfg. Co. WLK.

Jefferson City, Mo. WOS.

Kansas City, Mo. WOQ.

Lansing, Mich. WHW.

Los Gatos, Calif. Heard by ships 2,500 miles at sea. 360 meters.

Mexico City, Mex. XDA.

Montreal, Can. Marconi Telegraph Co.

New Haven, Conn. A. C. Gilbert Co. WGJ or WCS.

New York, N. Y. Deforest Radio Co. WJX. 360 meters.

Ossining, N. Y. Deforest R. T. & T. Co. 3-ZO.

Philadelphia, Pa. WCL.

Pinebluff, Ark. WOK.

Pittsburgh, Pa. Newspaper Ptg. Co. WPB.

Pomona, Calif. KGF.

Rochester, N. Y. WHQ.

Rome, Ga. 4-BQ.

San Francisco, Calif. Fairmont Hotel. 360 meters.

San Francisco, Calif. KUO.

Stockton, Calif. Portable Wireless Tel. Co. KWG.

Sunnyvale, Calif. Radio Shop. KJJ.

Toledo, Ohio. Marshall Gerkin Co. WDZ, WHU.

Washington, D. C. Church of the Covenant. WDH.

Washington, D. C. Radio Construction Co. WDW.

Radio Reception on Aircraft

By G. H. DALY, D. S. M.

LISTENING to the terrific roar of an airplane's engine one might well be justified in supposing that the reception of wireless signals under such conditions is an utter impossibility. Yet the fact, that the aero wireless operator receives signals as efficiently as his contemporary on land or sea, is well known.

It is possible for the operator to pick out the signals thru the noise, just as an expert musician can pick out the sound of one particular instrument in a large orchestra including many other instruments.

Altho the amplifying relay has overcome the difficulty of receiving without interference by the external noise of the aircraft engine, there is another and more troublesome disturbance, which the engine creates to the detriment of the wireless receiver, namely magneto induction noises arising from the numerous high tension circuits of the modern aircraft engine.

The magneto induction noises set up by these small wireless stations are known as eddy or parasitic currents and their chief aim in life is to let themselves be heard much and often in the receiving telephones. Frequently when an aero operator is straining his utmost over a particularly weak signal of national importance he will be interrupted by a sound resembling statics gone mad. The aero-engine maker has had to take special precautions to eliminate them when constructing the engine.

A striking demonstration of this is shown in the case of the latest and most powerful aero engine yet invented, namely the thousand horse-power Napier Cub.

This engine has sixteen cylinders with two sparking plugs in each cylinder which are fed by high tension current from four magnetos. The number of revolutions which the engine can do is in the vicinity of two thousand per minute—and as there are about eight sparks per revolution, or in other words, eight parasitic wireless stations transmitting per revolution, there are roughly sixteen thousand transmissions during a minute of time.

But, as mentioned above, a way has been found by which the trouble is cured and the parasitic currents will have to toe the line. This is done by sheathing all the high tension cable in a special braided covering of an electrically conductive material and carrying the cables in aluminum brackets four inches apart secured to the top of the crank case. Thus the currents are collected in groups and earthed into the body of the engine.

But these parasites, with the pertinacity of youth on being ousted from one position, carry on in another part of the electrical circuit of the engine called the distributor.

These distributors are earthed by means of brass shields each with a length of copper wire attached to an earthing terminal on the crank case so that all the obnoxious currents exhaust themselves in the large metallic body of the engine.

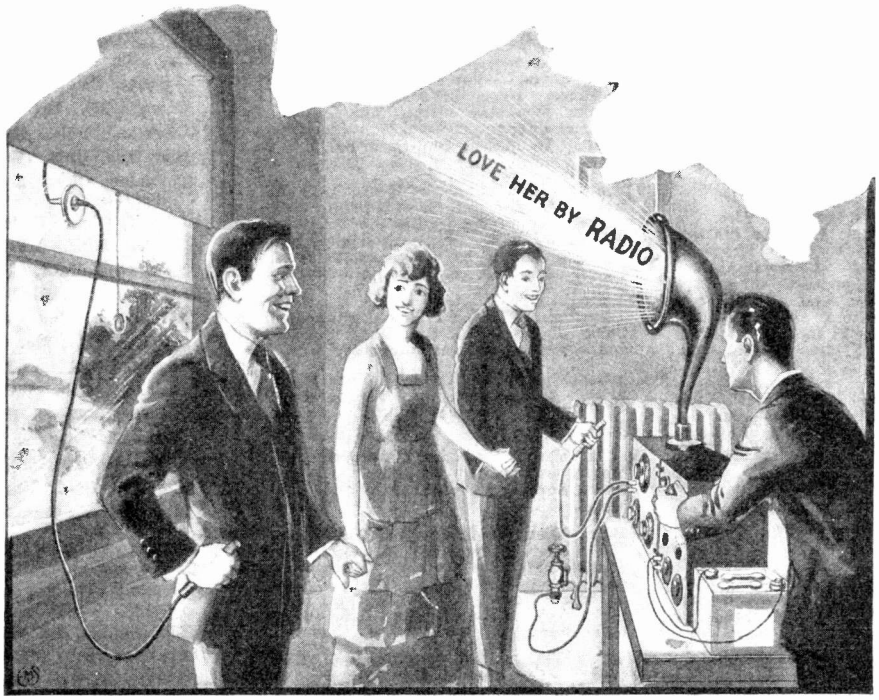
Radio for the Beginner

By ARMSTRONG PERRY

No. 3. How to Operate a Vacuum Tube Radio Receiver

JUST as I was going to start this article a well-known radio concern took the pep out of it. They installed in the National Press Club, Washington, D. C., a vacuum tube radio receiver employing eight tubes. It amplified the energy picked up by the antenna to about 8,000 times the strength it had where it went into the receiver. When I asked for a copy of the directions for operating the machine the man who set it up answered: "I think you can remember them without writing them down. They are: 'Press the button and turn the handle'."

It made me feel like the man who ordered his own tombstone, which now tells visitors to the little cemetery where he lies: "I expected this, but not so soon." The popular demand for simplified apparatus had to be met. Some receivers had been made very easy to operate. But for one of such power, I would have said before seeing this, that the number of knobs and switches for the user to learn to adjust was at least six, in the present stage of the development of radio.



To Demonstrate the Intensifying Power of Modern Vacuum Tube Receivers, It Is Interesting to Show How Several People May Be Placed in Series With the Antenna Wire and the Receiving Set, as Here Shown. The Radio Current Picked Up by the Antenna Will Pass Thru the High Resistance of the One or More Persons, and the Signals Will Be Heard in the Receiving Set Just the Same. This Experiment Was Performed Quite Early in Radio History by Dr. Marconi Himself.

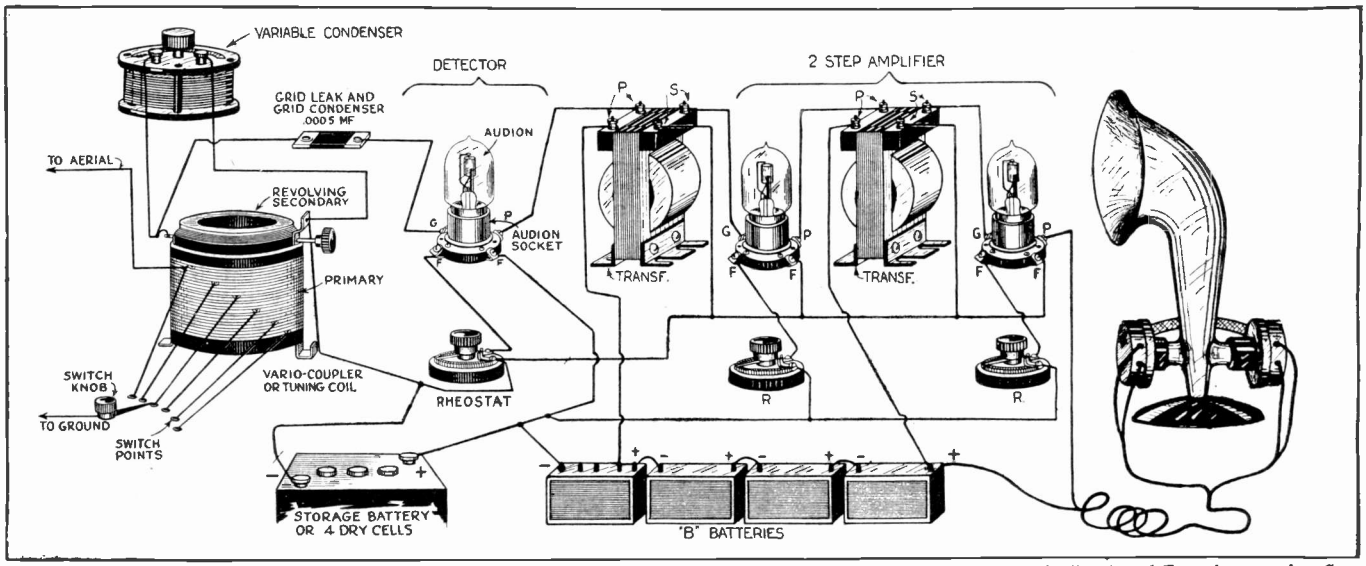
This receiver, I am told, cannot be manufactured in quantities to supply the demand for several months to come. In the meantime thousands of radio listeners will be wanting to use vacuum tubes with the present types of controls. If they can realize how simple a matter it is to operate these, many will change from the cheap mineral detector sets, to the vacuum tube types and hear concerts and lectures a thousand miles away where at present their receiving range may be only fifty miles.

There are many types of vacuum tube radio receivers. A technical amateur often has a dozen or more pieces of apparatus scattered all over a table and connected with a network of wires. The man who wants to use radio without studying it buys a cabinet instead. This cabinet will contain about the same elements but they will be arranged in a more orderly and ornate fashion, with distances and positions determined with scientific accuracy. Sometimes all the coils of wire are inside the box out of sight. In other sets two or three coils protrude from the face of the cabinet like solid truck tires hung on the wall of a garage. In the latter case they may be demountable. By pulling out one or more and substituting others it may be possible to adapt the receiver to everything from amateur messages sent on 200-meter waves to government broadcasts sent on 2,650 meters from Arlington, or on 17,000 meters and over from Annapolis. Whatever the arrangement of coils, condensers, rheostats and other elements, the heart of the receiver is the vacuum tube. It may be called by any one of a number of trade names and the operating characteristics of the different tubes may vary widely, but in principle they are similar.

The vacuum tube looks like an electric light bulb. Usually it has four prongs on the bottom and a pin sticking out from the side of its metal base. It will not fit its socket in any but the correct position. Sometimes it is pushed in against the pressure of a spring and turned slightly so it will stay. Sometimes it is pushed in and not turned. A moment's observation will show how to put it in place.

The socket into which the bulb goes is connected to four binding posts. From

(*Continued on page 66*)



A Specially Prepared Perspective Diagram Which Everyone Can Understand, Showing How the Three Vacuum Tubes (Audions) and Transformers Are Connected in a Detector and Two-Step Amplifier Receiving Set, Suitable for Radio Telegraphy or Radiophony. All of the Parts Are Pretty Well Standardized; the Variable Condenser Connected Across the Secondary of the Vario-coupler Should Have .001 M. F. Maximum Capacity; the "B" Battery Units Give 22½ Volts Each; the Storage Battery Is a 6-Volt Type Having Three Cells; the Phones Are of 2,000 to 3,000 Ohms Resistance, and Where a Single Large Horn Is Employed as a Loud-talker, It Is Preferable to Use a Single Type "C" Baldwin Amplifying Receiver; the Detector Bulb May Be a No. 200 U. V. Type, and the Amplifier Bulbs of the 201 U. V. Type.

Radio Oracle

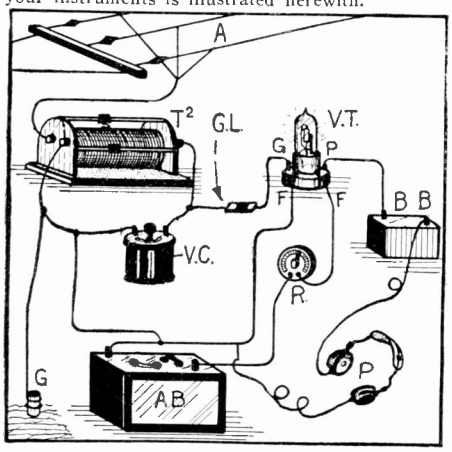
In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25c is made for all questions where a personal answer is desired.

A 2-Slide Tuner and a Vacuum Tube

(6) Martin Lusk, Atlanta, Ga., asks:

Q. 1. Can I use a two-slide tuner to tune with, in connection with an audion detector? I also have fixed and variable condensers.

A. 1. The hook-up which you may use for your instruments is illustrated herewith.



A Two Slide Tuner and Audion Circuit. "A," Aerial, "T2," Two Slide Tuner, "V. C.," Variable Condenser, "G. L.," Grid Leak and Condenser, "BB," 22½ Volt B Battery, "AB," 6 Volt Storage Battery, "R," Rheostat, "V. T.," Vacuum Tube. The Letters Around the Vacuum Tube Socket "G. P. F.," and "F," Represent the Grid, Plate and Filament Designations Found on all Such Sockets.

A Fairly Good Receiving Set

(7) G. Rudolph Thompson, Norfolk, Va., asks:

Q. 1. Please give me list of parts for a fairly good receiving set.

A. 1. For building the vacuum tube detector receiver you will need:

100 to 150 feet No. 14 7-strand copper wire, for antenna. Weather-proof insulated wire for lead-in enough to reach your set.
1 100-ampere lightning switch, or a lightning arrester, or whatever safety device may be required by your local electrical inspector. This must meet the requirements of the National Board of Fire Underwriters if you want to collect insurance on your house in case it is struck by lightning.
1 vario-coupler, to tune from 150 to 600 meters.
6 switch points and knob.
Ground wire, which may be cut from wire purchased for lead-in.
1 filament rheostat.
1 storage battery, 6 volts and as many ampere-hours capacity as you want to pay for. Smaller ones need recharging oftener.
1 "B" battery, 22½ volts.
1 pair 2,000 ohm phones.
1 audion socket.
1 audion bulb.
1 grid leak and grid condenser, .00025 microfarad capacity. Wire for connections should be insulated. Stranded wire has better conductivity. The larger it is, the less resistance, but don't get it so large and stiff that it is hard to manage. Look at a ready-made set and see how it is wired.

If you are going to build a set we suggest that you read radio advertisements, secure catalogs, compare goods and prices.

Simple Hook-up for Reception from "W. J. Z."

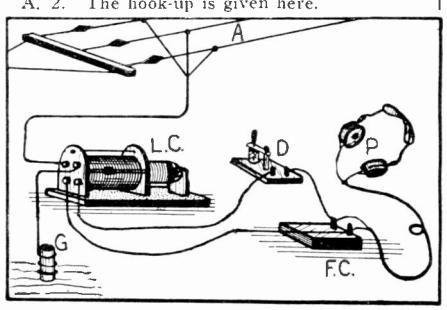
(8) Paul Novel, Long Island City, N. Y., asks:

Q. 1. With a loose coupler, fixed condenser, crystal detector and 2,000-ohm phones, can I receive music from W.J.Z.?

A. 1. Yes.

Q. 2. How shall I connect them up?

A. 2. The hook-up is given here.



The Hook-Up of a Loose Coupler With a Detector and Other Apparatus. "A," is the Aerial, "L. C.," Loose Coupler, "D," Detector, "F. C.," Fixed Condenser, "P," Phones, "G," Ground.

Ford Spark Coil for Transmission

(9) Lawrence N. Johnson, Moores Hill, Ind., asks:

Q. 1. Can a Ford spark coil be used for transmission of radio signals for distances of four or five miles?

A. 1. While it is possible to rewind a Ford spark coil so that it will operate on 110-volt A. C., the results will by no means be worth the time and trouble expended in doing so. We suggest that if you wish to use a spark transmitter you should purchase a standard make of one-inch spark coil, and operate the same from a six-volt storage battery. With this you could easily cover the distance of four or five miles. If you use this coil for transmission, be sure that you use an oscillation transformer, or helix, in order that the wave emitted will be sharp and within the law.

Radio and the Victrola

(10) W. C. Regan, Stronghurst, Ill., asks:

Q. 1. With a radio set comprising a short-wave tuner, two-stage amplifier and a Magnavox, would I be able to receive the radiophone broadcasts loud enough to use the music for entertainment?

A. 1. The apparatus which you mention will do very well for receiving the broadcast. We would suggest that you use a one wire aerial, at least 100 feet long, and as high as possible.

Q. 2. What advantages has radiophone set over a Victrola?

A Few of the Articles in June "Radio News"

Shall We Put the Brakes on Rodio? By Armstrong Perry.

A Portable Radio Receiving Set in a Suitcase. By S. R. Winters.

The Electron Theory Simplified. By Edward T. Bicak.

World's First Wireless Telephone News Service. By Maurice E. Pelgrims.

German Tests on Radio Signaling to Railroad Trains. By Dr. Alfred Gradenwitz.

A Coupled Tuner for Long Waves. By Raymond Evans.

Duplex Radio Telephone a Reality.

A. 2. The radiophone set possesses many advantages over a Victrola, inasmuch as it is not necessary to purchase new records in order to hear the latest songs and dances. Also with the radiophone it is possible to receive weather reports, market reports, general news of the day, and some remarkable operatic selections and church sermons.

Re-radiation

(11) James L. Read Macon, Miss., asks:

Q. 1. Can a large radio receiver be hooked up to a transmitting set so as to relay messages on shorter wave lengths to amateurs?

A. 1. Yes. We would suggest that you use a two- or three-step amplifier, and a good phone for receiving, and a five-watt transmitting set to re-radiate the messages. By placing the receiver and transmitter near each other you should have no difficulty in obtaining the results you desire. The distance between the transmitter and receiver can be best determined by experiment.

Types of Simple Antennae

(12) Mr. E. Kilburn, Detroit, Mich., asks:

Q. 1. Please tell me the types of antennae most easily constructed indoors and out.

A. 1. The most easily erected antennae for use inside is the one shown at the top of the first page of the article by Armstrong Perry in the March issue of this journal. If the molding is quite dry the insulated wire may be laid right on it. If not, insulators should be used to keep the wire from contact with it, as radio currents easily escape from the antenna. Another type of antennae is the loop. It looks somewhat like an old-fashioned yarn reel with about a dozen turns of insulated wire on it.

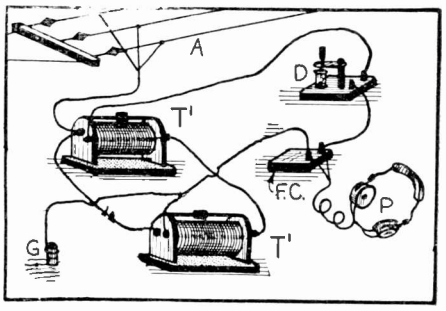
Many prefer a single-wire antennae on the roof. The higher you put it the more current it brings in from the passing waves, and that means louder music, voice or signals at the receiver.

Unique Hook-up for 2 Single Slide Coils

(13) Frank Krammer, Jersey City, N. J., asks:

Q. 1. I have two one-slide tuners of exactly the same make and size. When I use them in series I have great trouble with interference, because I cannot tune sharply. Can you give me a hook-up using these two coils, a fixed condenser, detector and phones which will work better?

A. 1. The hook-up here given will be found to produce excellent results, and is unique in that it eliminates induction and interference to a very great extent.



A Very Good Interference Preventer is Shown Above, the Two Coils T1, are Identical in Shape and Size. "A" Represents the Aerial, "G," the Ground, "D," Detector, "F. C.," Fixed Condenser, and "P," the Phones.

Radiophone Receiving Set

(14) T. M. Phillip, Lowell, Arizona, asks:

Q. 1. What is the best kind of a set to purchase for phone reception?

A. 1. In your locality we think you will need a good short-wave regenerative receiver, or one that uses radio-frequency amplification as well as audio-frequency amplification. There are so many good ones that it is hardly fair to say that one is better than the other.

We suggest that you write to concerns that advertise in this and other magazines, and to others if you care to, and send for catalogs and quotations. Study these carefully with your own requirements in mind. Also communicate with radio amateurs in your district and have them tell you about local conditions. Apparatus that works in one part of the country may not work so well in other parts. Of course, you will want to bring in the short-wave concerts, lectures and other entertainment. Sets for this purpose have a tuning range of from 150 to 600 meters. The receiving range varies with atmospheric conditions. One night you may hear a station two thousand miles away with one vacuum tube, and the next night you may not be able to get it with six stages of amplification.

United States Radio Course

(15) Roy C. Day, Ilion, N. Y., asks:

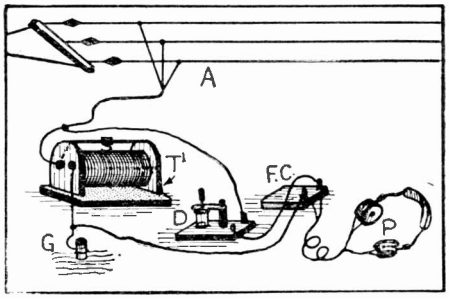
Q. 1. Where should I write in order to secure the army radio course?

A. 1. If you will write to the Signal Corps, U. S. Army, Governors Island, New York, we think you will have no difficulty in enrolling for the army correspondence course in radio. The War Department has informed us that successful students will be given an opportunity to go to an army camp in the summer for two weeks of additional training, free of charge.

There is some sort of an organization for amateurs connected with the Governors Island headquarters. It might be worth your while to look into that.

A Correction

(16) In last month's issue a circuit of a one-slide tuner, crystal detector, fixed condenser and phones was illustrated. In the diagram it appeared that the condenser was short-circuited by a piece of wire. This was, however, a font error. The wires should be connected as shown in here.



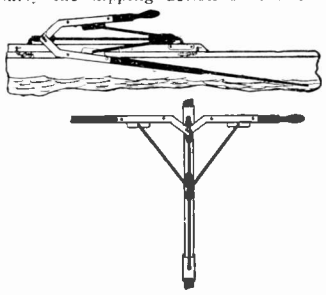
A Circuit Comprising "T1," Tuner, "D," Detector, "F. C.," Fixed Condenser, "P," Phones, "A," Aerial, "G," Ground.

LATEST PATENTS

Bow-Facing Oar

(No. 1,406,932 issued to William Henry Clay)

This invention facilitates particularly the dipping action of the oar

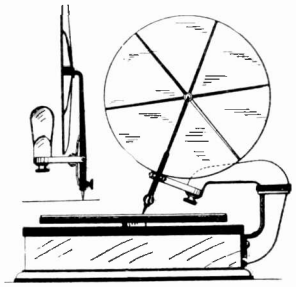


and its withdrawal from the water, and also permits the oar to be lifted over or above the gunwale with considerable ease. A guide-rail is fastened to the gunwale of the boat by means of resilient pins. The oar proper and its handle are secured to parallel clamping angular members, the latter arranged at obtuse angles to each other. These angular members are secured to the blade and handle of the oar by sleeves mounted to freely slide and turn upon the guide-rail. These are subsequently linked to the handle and blade. In this manner the blade may be lifted out of the water when desired.

Sound Reproducing Device

(No. 1,407,928 issued to Wilbur L. Chamberlain)

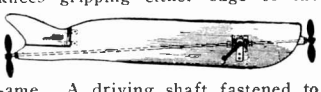
Instead of clamping the diafram of a phonographic or other reproducer at its edge, as has been the common practice, the inventor of this device provides for a member which vibrates in its entirety. A stylus carrying arm is pivotally mounted on a swinging supporting member of a phonograph, such as the tone-arm, and the vibrating device supported wholly by the stylus is so arranged that it presents a sort of grooved disc or discs upon which radiating fins have been rigidly secured.



Swimming Device

(No. 1,406,940 issued to Clarence E. Darrow)

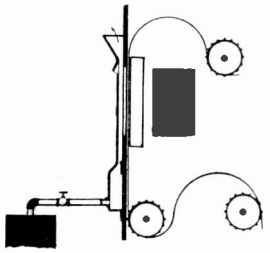
At Miami, Fla., from whence this inventor hails, such swimming devices come in very handy. The body of the device is made of a pair of boards, shaped in the form of a fish. These support the swimmer, who lies flat upon the float with his knees gripping either edge of the same. A driving shaft fastened to the propeller is operated by the swimmer thru a pair of pedals and suitable gears. A lever operated by the swimmer to control the direction of locomotion is shifted by the swimmer's feet, who thus steers the tail of the fish-like form. The relation of the parts may be changed, however.



Cooling Device for Movie Films

(No. 1,408,203 issued to Charles Francis Jenkins)

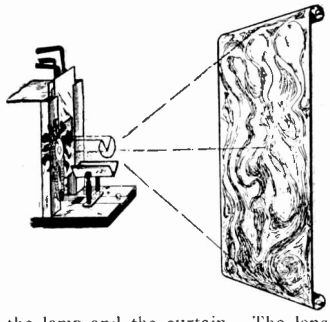
In motion picture exhibiting safeguarding against fire is of enough importance to warrant employing entirely distinct expedients in such machines, so that assurance of safety is possible under all conditions. Many methods of preventing combustion of the motion picture film have been devised. Some of these limit combustion to a single picture. Others reduce the temperature of the beam of light, etc. In the present system, however, compressed air is allowed to expand just before it reaches the film. and hence reduces the temperature. A suitable chamber for holding air is provided for, and an expansion chamber discharging by a passage across the face of the film directs a stream of air across the path of the light beam, and the air escapes from the box or passage surrounding the film thru special air exits in that box.



Color Organ

(No. 1,406,663 issued to Richard Lovstrom)

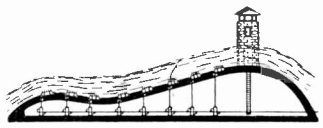
By some strange coincidence the patent issued to Lovstrom is so remarkably similar to the Wilfred machine described elsewhere in this issue that it should be made the subject of psychical study. Besides the curtain or vapor-screen which the inventor employs to project upon, a box housing his apparatus is used. An incandescent lamp in which the filament is of a three-dimensional geometric figure is used to enhance the effects. A lens having surface facets, if desired, is employed. This is arranged on the same line with the lamp and the curtain. The lens and lamp are movable with relation to each other, and the lens preferably set at a slant to the main axis. The lens movement, as well as the lamp movements, take place while the device is being operated, and one or more shiftable transparent colored glasses or screens are arranged in front of the lens, each having a distinctive color.

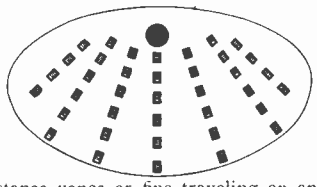


Wave Motor

(No. 1,407.885 issued to David R. Olmsted)

In this device a submersible structure adapted to receive the wave, to elevate the wave and to direct pressure or impact of the wave against the driving elements of the motor is provided for. The unusual feature of this submersible structure is that it presents the peculiar external configuration whereby it not only elevates the waves and directs its forces against the driving elements of the motor (in this instance vanes or fins traveling on an elongated track and attached thereto by a continuous belt), but the rear crest where the top wall drops, forms a rearwardly facing abutment against which the receding waves of water break and their impact insures anchorage of the structure. The fins rotating on the endless belt, drive a pumping mechanism lifting water to any height desired, which can then be used to operate turbines. All the mechanism is contained within the body of the structure and access thereto is gained by means of a suitable lighthouse.

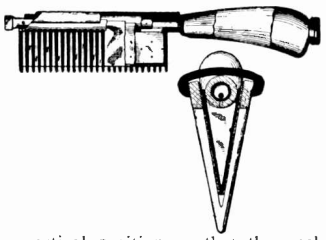




Fountain Comb

(No. 1,408,262 issued to Joseph Brueck and Norbert Salter)

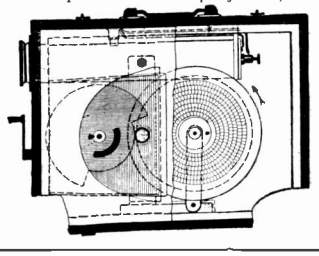
The handle in this fountain comb acts as the container for the liquid. The operator first turns the feed-holes out of registry with each other. The entire device is then turned into a vertical position so that the neck is uppermost and the screw cap subsequently removed. The liquid to be used is then poured into the handle thru the neck. In this condition none of the liquid will leak out, but when it is desired to apply some to the hair the valve cylinder is turned with relation to the thumb piece, which permits the liquid to feed into the distributing trough at the proper rate of flow. A porous material permits of the equal distribution of the liquid and its application in small quantities to the roots of the hair.



Motion Picture Apparatus

(No. 1,406,808 issued to Orazio Antonelli)

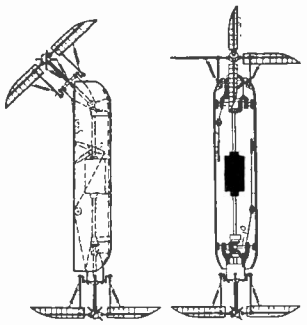
In this motion picture machine the inventor provides for a film and feeding mechanism. The film in this case is a sheet or disc clamped in position upon the outer end of a rotatably mounted shaft. The device here shown not only permits motion pictures to be projected, but acts as a camera as well, so that the average amateur may enjoy the taking of pictures and likewise their projection. The photographs are arranged upon the disc spirally, the lens being guided by suitable gears. After the pictures have been taken and a suitable positive has been made therefrom and it is desirous to project the results upon the screen, the same apparatus may be utilized.



Flying Machine

(No. 1,408.115 issued to George Matta)

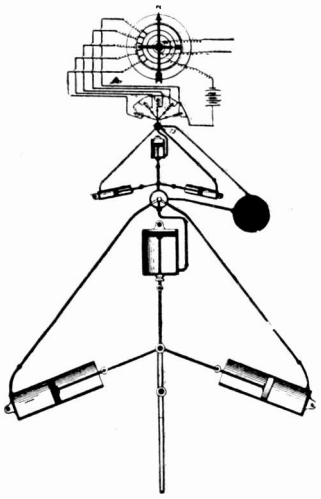
The inventor of this device utilizes what one could term new principles of aviation. He provides for two propellers, one at either end of his machine. Another object of the invention is to break off the helix of air which tends to form around the propeller when the same is driven very rapidly. The propeller blades for this purpose are mounted so that they are shifted while driven around, or, in other words, driven up and down out of the plane of normal revolution, thus breaking up the currents of air.

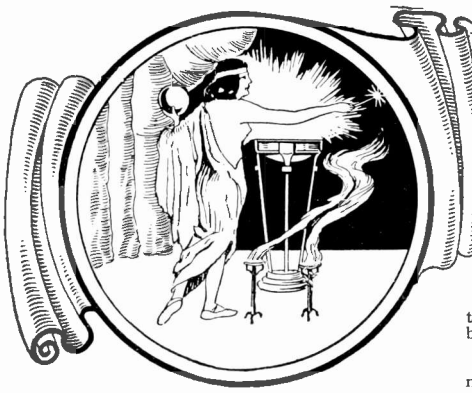


Automatic Control Mechanism

(No. 1,406,405 issued to William Harvey McGee and Reni S. Berry)

If the airplane upon which it is installed should change its course by any external cause, such as deflecting air currents, the body of the vessel will turn horizontally relative to the compass needle, which remains theoretically fixed, and cause a contact carrying cam to turn relative to the compass needle. This completes the circuit thru an electromagnet and breaks the circuit thru the central magnet. The electromagnet exerts a pull on its core and operates its respective valve, causing the rudder to move by allowing air to exhaust from one cylinder and permits the other cylinders to act upon the rudder.





THE ORACLE

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

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

Removing Stains of Printers' Ink

(1201) Dr. John A. Voorhees asks:

Q. 1. How can I remove printers' ink from paper?

A. 1. In the March, 1921, issue of SCIENCE AND INVENTION several ink eradicators were given. Stains made from printers' ink should be soaked in benzine. Wash with hard soap before the benzine evaporates and treat with one of the solutions given in the article referred to.

If the color of the ink persists after the body of the ink has been removed, we advise that you soften with oil of turpentine and weak lye. The following solution may also be used for the indelible inks:

Copper chloride is first applied and then washed with a solution of sodium thio-sulfide and afterward with water or dilute solutions of potassium permanganate and hydrochloric acid followed by hypo solution and clear water.

Coloring Aluminum

(1202) Robt. Winterhalder, Kamloope, B. C., Canada, asks:

Q. 1. How can I blacken aluminum images and figures?

A. 1. To blacken aluminum, clean thoroly with fine emery powder and wash, then immerse in the following solution:

White arsenic, 1 oz.; iron sulphate, 1 oz.; hydrochloric acid, 12 ozs.; water, 12 ozs. When the deposit is black enough, dry with fine sawdust, then lacquer.

There is another method of blackening aluminum; that is, to pour over it a thin layer of olive oil and heat slowly over an alcohol flame or in a drying oven. Repeat this operation to obtain absolute uniformity of coating.

The heat first turns the aluminum brown and then black, according to the temperature.

Human Aura

(1203) Mr. L. Saunders, Toronto, Ont., asks:

Q. 1. Are not the radiations of the human aura, alpha, beta and gamma radiations of radium?

A. 1. What the radiations of the human aura are has not as yet been definitely ascertained. Nevertheless, they are in no way similar to radium emanations, hence cannot be any of the three rays you mention. If, on the other hand, these emanations were present they could be demonstrated by a fluoroscopic, spintharoscopic or electroscopic test, which tests would give a positive indication under ordinary circumstances.

Oxygen from Air

(1204) Robert Cox, Boston, Mass., asks:

Q. 1. Can oxygen be extracted from air?

A. 1. Oxygen is produced in large quantities directly from the air by a very simple process, namely, that of liquifying the air and then allowing the nitrogen to evaporate, which, of course, evaporates first and pure liquid oxygen will be left.

This liquid oxygen is then allowed to evaporate and is placed in containers.

The Light Ray Phonograph and Inertia

(1205) L. C. W., Topeka, Kansas:

Referring to an article in the December, 1920, issue of SCIENCE AND INVENTION called "The Light Ray Phonograph," asks:

Q. 1. Since the ordinary phonographic reproducer has both needle and diaphragm, will not the inertia which the inventor is trying to eliminate while recording be present in the reproduction?

A. 1. You have undoubtedly obtained a mistaken impression of the Light Ray Phonograph. The needle of a phonograph follows in the grooves in the record, as you know, and if there are more grooves to an inch, that same needle will still follow the grooves. This might, perhaps, cause a greater wear on the surface of the record, but even tho the needle and diaphragm have a certain definite inertia, it is overcome in much the same manner as on railroads where the train follows the tracks, regardless of their tortuous curves.

Newton's Laws of Motion

(1206) Lawrence Gurgan, Finleyville, Pa., asks:

Q. 1. If the earth revolves at such a tremendous speed, why is it that a man jumping up into the air does not come down in a different place?

A. 1. We will answer your question by asking you another. If you were in the front car of a train and this train was travelling 60 miles an hour and you jumped up into the air, would you fall down in the rear car? No. You would land in the same place from which you had attempted to leap, the reason being that your body is travelling at the same rate of speed as the train, and, therefore, will tend to remain in that state of uniform motion.

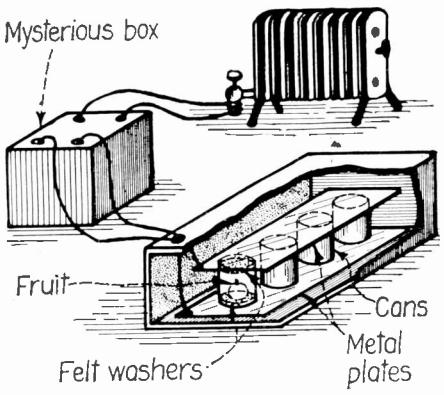
Q. 2. Could the earth be seen revolving at a high altitude?

A. 2. If you were on the planet Mars viewing the earth thru a telescope you could undoubtedly see its rotation just the same as we now observe other planets revolving, but because the envelope of atmospheric air whirls around with the earth an aviator does not see the earth revolving. He is incidently revolving with the earth in the same direction, influenced by motion previously acquired and by the atmospheric envelope indirectly. If he could ascend high enough the winds would have quite an effect on his speed, but it would be quite impossible to free himself of the earth's influences.

Fruit Preserver

(1207) Hans F. Schmid, Canyonville, Ore., asks:

Q. 1. Can you give me any information of Dr. Harry Barringer Cox's fruit preserver and its construction?



This Illustration Shows the Electrical Arrangement for Preserving Fruit, Proposed by the Late Dr. Harry Barringer Cox. Earth Currents Were Supposed to Act on the Food in the Metal Cans in Such a Way as to Preserve it.

A. 1. We were present when Dr. Harry Barringer Cox demonstrated his invention to preserve food. Candidly speaking, we hold no faith in the idea. The reason for this statement is based upon the fact that Dr. Cox employed tin cans of the ordinary molasses can type. Below and above the fruit he fastened a felt washer moistened with water. The cover was then placed upon the can and said can set upon a metallic plate, another metallic plate covered the top of the cans. Earth currents were supposed to act on the food—how, we cannot tell—in these conducting cans. What the idea of two plates is, is also beyond our very limited understanding. Two wires were then led from each of the plates thru the box to another instrument case. From this two heavy cables lead to the same steam radiator. It stands to reason that it is absolutely impossible to get a flow of current by grounding two wires to one earth connection, regardless of what is in the mysterious box, which flow of current was claimed. We would advise that you do not give this idea another thought. No article on the subject has been published in this magazine.

Steel Penetration by Straw

(1208) Miss Florence E. Siman, Rosebud, Mont., asks:

Q. 1. How is it possible for straw to be driven thru a piece of steel, after being whirled about in a cyclone?

A. 1. We do not know where the impression that straw can be driven through wood, glass and iron when whirled around in a cyclone originally came from. Nevertheless, as far as we have been able to determine, there is absolutely no scientific proof of this.

Removing Embossment on Bottles

(1209) Henry D. Gill, Randolph, Mass., asks:

Q. 1. What solution is there that will "eat" glass? I would like to remove embossment on glass bottles.

A. 1. Hydrofluoric acid, which comes in lead containers, is generally used for this purpose. Why not grind off the embossment? This will undoubtedly be cheaper in the long run.

Increasing Current

(1210) Laurence E. Genack, Springfield, Mass., asks:

Q. 1. Could I use an induction or Ford coil to step up the current from six dry batteries and still get the required amperage for making synthetic rubies?

A. 1. No, you could not use a spark coil or a Ford induction coil for stepping up the voltage and expect at the same time to step up the amperage so as to give you the required amount of heat at the arc electrodes.

Assuming that you have a current supply at 110 volts alternating or direct, you could make an arc furnace and connect it directly into the house circuit. A small resistance should be placed in series.

Home-Made Magnavox

(1211) James F. Barclay, Jr., Black Hall, Conn., asks:

Q. 1. Several queries about a home-made Magnavox.

A. 1. Would advise you as follows, concerning the loud speaker described by Mr. Secor in the October, 1920, issue of *Radio News*.

The field magnet of the instrument should be wound with about 3 lbs. of No. 17 insulated magnet wire, as you suggested, for operation on 6 volts. The two magnet coils should be connected on parallel for 6 volts, or in series for 12 volts.

Enameled magnet wire may be used for winding the field coils. An error was made in the editing and printing of the original article and the following change should be made in the winding of the moving diafram coil. This coil, if it is to be wound to have 75 ohms resistance, should contain about 72 ft. of No. 40 B. & S. gauge, single silk covered magnet wire.

With reference to the data on an audio-frequency transformer, would say that such information is given in our 25c book called, "How to Build Audio-Frequency Transformers" by E. T. Jones, available from our Book Department.

Cost of Building Small Auto

(1212) Doyle Spoonmore, Urbana, Illinois, writes:

Q. 1. What would it cost to build the small auto described by Mr. Harry Habig some time ago in this magazine?

A. 1. With regard to Harry Habig's small automobile, would say that the cost of building such a machine will vary greatly, dependent upon whether second-hand or new parts are used, and also on the kind of engine you buy.

You can build a machine like Mr. Habig's for almost any price you want to mention. If you look around motorcycle repair shops, you probably can pick up the materials necessary, including the engine for less than $100.00 easily, but if you buy new parts, particularly a new engine, the expense may run as high as $150 to $200.00.

Radio Engineering

(1213) H. Russell Stauffer, Manheim, Pa., asks:

Q. How can I start in the radio engineering line?

A. It is quite difficult to tell just how you might start in the radio line, but off-hand it would seem that one of the best moves you could make would be to connect with a radio company, even if it is but a small one, and you could then take up a radio course with one of the schools advertising in SCIENCE AND INVENTION. There are several correspondence courses being given in radio, but not very advanced ones, such as you would require, it would seem, in view of the fact that you have just graduated from an electrical engineering course given by a Washington, D. C., school.

Possibly you might be able to connect with one of the radio laboratories of the Bureau of Standards or the U. S. Navy Department, and in this way you would certainly stand a very good chance of acquainting yourself with men who are already doing practical radio engineering work and so familiarize yourself with the work quite rapidly.

Radio engineers are invariably electrical engineers in the first place anyway, and you will no doubt find it a great deal of value to you by interviewing some of the experts in the Radio Department of the Bureau of Standards, as well as in the Navy Department.

Dicyanin Dye and Human Aura

(1214) Geo. L. Barker, Cumberland, Md., writes:

Q. Being interested in your article on the "Human Aura" in the May, 1921, number of SCIENCE AND INVENTION, I will consider it a favor if you will give me some information as to where I can obtain a copy of Dr. Kilner's book on "The Human Aura," and also the name of a dealer who handles dicyanin. I suppose this dyestuff belongs to the quinoline class and is similar to cyanine, which is used as a panchromatic sensitizer.

A. Our Book Department can supply you with the book called "The Human Aura," by Dr. Kilner. The name of company supplying dicyanin will be furnished on receipt of stamped and self-addressed envelope.

You are quite right in assuming that it is used as a panchromatic sensitizer. It is a greenish-blue dye which imparts to bromide of silver an extraordinary sensitiveness to the extreme red.

The screens to be used in viewing the "human aura" must be made by yourself. Simply dissolve dicyanin in absolute alcohol, or in a very high proof alcohol which has not been medicated. This solution is then poured between two pieces of glass which have been firmly glued or fixed together. The separation between the two sheets of glass, and also the proper strength of the solution, must be determined by experiments.

¼-K.W. Step-up Transformer

(1215) David C. Baird, Eugene, Ore., says:

Q. 1. Give me data on ¼-K.W. step-up transformer.

A. 1. Herewith are instructions for building a ¼-K.W. transformer:

On an iron core 10¾ inches long, 6¾ inches wide, 1.1 inches thick, wind 663 turns of No. 15 DCC wire in six layers. This will need about 5 pounds of the wire.

The secondary is wound in 17 pies, each pie being ¼ of an inch thick and wound with 2,092 turns of No. 34 DCC, about 4 pounds being necessary. The primary is tapped for every 100 turns and the voltage ranges from a little over 39,000 for 100 turns in the primary circuit to 6,520 volts when the entire primary is being used.

Q. 2. Also data for 100-watt step-down transformer, with 2-volt taps on secondary.

A. 2. For a step-down transformer we would advise an iron core 10 inches long, 6 inches wide, 1 inch square. Wind this with 700 turns or 4½ pounds of No. 15 DCC wire in 7 layers. The secondary is wound with No. 12 DCC wire and tapped for every 3.2 turns for the 2-volt steps.

Q. 3. How can I compute the ampere-hour capacity of a storage battery?

A. 3. It will be quite impossible for you to compute the ampere-hour capacity of batteries as this will depend on a great many factors, among which are the size of the plates, their distances with reference to each other and the electrolyte. Resistance of the circuit will affect both the amperage and the voltage of the battery.

"Free Gas" Automobile

(1216) Frank O. Barth, Canton, Ohio:

Q. Can an automobile be operated from gas evolved from water decomposed by electric current generated by a dynamo driven by the engine?

A. Relative to using gas electrically evolved from water to run an automobile, we would state that the inventors of this system are still working upon it; but in our opinion the device will never be practical, or ever see a market, for the reason that more electricity is needed for electrolytically decomposing water than could possibly be produced by a generator driven by a gas motor, which gas motor would derive its power from the water so decomposed. In other words, in a 20-horsepower motor driving a generator at its maximum efficiency, the generator would not develop the full 20 horsepower because of frictional and electrical losses.

When the electrical energy from the generator is passed into water so as to decompose it there are again losses due to convection currents and heat, and therefore, in order to make an automobile of this nature operate you would constantly have to supply an additional source of power, either from storage batteries or otherwise, which would have to be charged before using the auto. There is nothing to prevent you trying this out yourself.

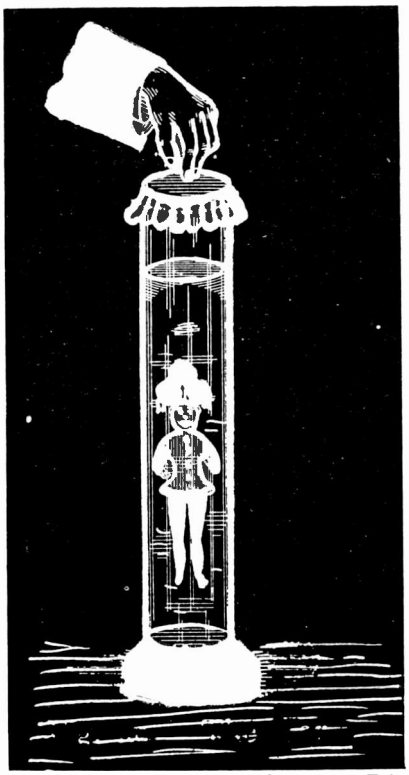
Will Ship Sink Part Way Only in Deep Water?

(1217) Virgil Waitman, Camp Lewis, Washington, writes:

Q. Will a ship sink only part way to the bottom in very deep water or will it sink to the very bottom?

A. Regardless of whether the steel ship is the size of a needle or the size of the Titanic, when that ship starts to sink it will continue to sink until it rests on the very bottom of the ocean. In other words, there is no such condition as stable buoyancy, and the vessel must either travel forward in a sinking position, but being constantly elevated by means of its elevating rudders, or sink to the bottom.

Take a submarine as an example. A submarine may be permitted to sink to the desired depth and may be maintained at that depth or near that depth by causing it to rise slightly and then shifting it into the sinking position again, so that it oscillates back and forth near the particular location desired. Should all the operators on



The Cartesian Diver—A Very Mysterious Fellow. Slight Pressure Variations Cause Him To Rise or Sink.

the submarine become incapacitated and should the machinery stop, that submarine will continue to fall to the bottom, or rise to the surface. Should a vessel like the Titanic sink to any considerable depth there would, of course, be leakage, due to the water-tight bulkheads being compressed by the terrific external force of water pressure.

Eventually this bulkhead would rupture inwardly, allowing the water to enter. In view of the fact that the weight of the water is now equal, and the force exerted is equal, in all directions, that vessel will continue down to the very bottom. Even should the bulkheads withhold the water pressure, the vessel would sink.

This may be summarized in a very few words. In liquids of fairly constant specific gravity in which the specific gravity increases only because of pressure, a sinking body will sink to the bottom. For a demonstration, build a cartesian diver. This is merely an inverted bottle placed inside of another bottle, or a small figure just afloat. The top of the larger mouthed bottle is covered with a piece of rubber, and the smaller bottle in the liquid has sufficient water in it to allow it to come just above the surface of the water. By pressure on the rubber diafram just covering the mouth of the bottle, the increase of pressure within the container will cause the diver to sink.

It is impossible, regardless of how accurately you graduate the increase in pressure, to keep the bobbing bottle positioned in or near the center without rapidly changing the pressure, permitting the diver to rise slowly or sink again.

Books on Einstein Theory

(1218) A. Burati, North Dana, Mass., writes the Oracle:

Q. Please explain briefly the Einstein Theory.

A. It will be impossible for us to explain the Einstein Theory in a few words, and even dozens of books on the subject do not explain it thoroly.

Perhaps the best books for the beginner are "Easy Lessons in Einstein," by E. E. Slosson, and the "Einstein Theory of Relativity," by Prof. H. A. Lorenz, which may be procured from our Book Department.

From Drafting to Engineering

(1219) D. R. Davis, Rochester, Pa., wants to know:

Q. Where can I take up an electrical drafting course?

A. We note that you are a qualified electrician and that you are thinking of taking up a mechanical drafting course at a correspondence school.

The writer has met and worked with many draftsmen who have taken up a correspondence course in one of the leading schools, such as those advertised in this journal, with excellent success. A thoro course in mechanical drawing will take about a year, together with mathematics, all depending upon how much time you devote to studying it each week, but not less than three to four nights should be devoted to it every week.

The editor of this column has known draftsmen who have not had much practical experience, yet who got along very well after taking one of these courses, and the best way, no doubt, is to start in as a tracer in the drafting department, or else as a detailer, with some industrial concern.

There is no special course of electrical drafting, altho some schools advertise a course under this title. In other words, a good mechanical draftsman will invariably adapt himself to making drawings of electrical machinery, circuits, etc., quite easily, and most of the drawings he will have to make will be based on the rules of projection and sectioning which the mechanical draftsman has mastered.

The best way is to send for the catalogs publisht by the various correspondence schools and study them carefully, and the very best thing to do is, of course, to endeavor to become acquainted with a few draftsmen who are taking courses in different schools if possible, and then find out by direct questioning which you think is the best. With any of these schools you will get a square deal and excellent training, if the course is followed diligently.

Finally, in closing, the writer would personally suggest very strongly that, in view of the fact that the cost of a mechanical drawing course being about one-third that of a complete engineering course usually, you might do best in the long run by taking a complete Electrical Engineering course, which includes drafting. One predominant and noticeable fact about all correspondence courses is that the students who do the best with these courses are those who correlate their theoretical studies with their practical everyday work, and after you have started to study one of the courses, therefore, it would be best to try and get a position in the particular line in which you are interested.

Dental Cement

(1220) C. F. Bowman, Chicago, Ill., wishes to know:

Q. How a cement like that used in filling teeth can be made.

A. We regret to inform you that we have no record of a hard cement resembling ivory, such as is used in filling teeth. This cement may be purchased, however, from any dental supply house and we would advise that you communicate with such concerns.

Liquid water glass with some abrasive or mixed with marble dust makes an extremely hard cement, but it is not as smooth as ivory. There are other equally hard cements which are not smooth, however, but before giving formulas we must know their applications.

110 Volts to 220 Volts A. C. Step-up Transformer

(1221) James B. Barclay, Shanghai, China, asks:

Q. What windings and core should I use for a transformer to step up 110 volts A. C. to 220 volts, for use on an electric fan? The fan in question uses ¾ amp. at 220 volts and 60 cycles. I wish to use this device on a 110-volt A. C. circuit.

A. We would advise that an iron core 11 inches long, 6½ inches wide, made in the form of the picture frame, having a side of 1.2 inches cross-sectional area, is wound with 666 turns or five pounds of No. 15 double cotton covered wire, B. & S. gauge wire, and is placed in six layers. The secondary is wound with 1,330 turns of No. 18 double cotton covered wire, B. & S. gauge.

Actual photo of one of our rebuilt Underwood Typewriters

GUARANTEED REBUILT TYPEWRITER EMPORIUM Shipman-Ward CHICAGO UNDERWOODS

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STANDARD UNDERWOOD

Rebuilt like new. Every typewriter is factory rebuilt by typewriter experts. New enamel—new nickeling—new lettering—new platen—new key rings—new parts wherever needed—making it impossible for you to tell it from a brand new Underwood. An up-to-date machine with two-color ribbon, back spacer, stencil device, automatic ribbon reverse, tabulator, etc. In addition, we furnish FREE waterproof cover and a special Touch Typewriter Instruction Book. You can learn to operate the Underwood in one day.

From Factory to You

Yes, only $3 brings you this genuine Rebuilt Standard Visible Underwood direct from our factory, and then only small monthly payments while you are using it make it yours; or, if convenient, pay cash. Either way, there is a big, very much worth-while saving, too. Genuine, new Underwood parts wherever the wear comes—genuine standard, four-row, single-shift keyboard—thoroughly tested—guaranteed for five years.

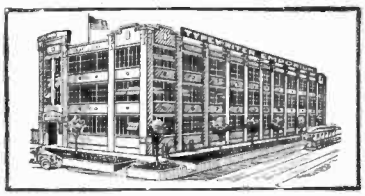
$3 Puts It in Your Home

You don't even have to scrimp and save to pay cash. Instead, you pay only a little each month in amounts so conveniently small that you will hardly notice them, while all the time you are paying you will be enjoying the use of and the profits from the machine.

10 Days' Free Trial

Remember, you don't even have to buy the machine until you get it and have used it on 10 days' free trial so that you can see for yourself how new it is and how well it writes. You must be satisfied or else the entire transaction will not cost you a single penny.

Act NOW! Mail TODAY! ☛



All shipments made direct to you from our big modern factory (shown above)—the largest typewriter rebuilding plant in the world

Now is the time when every dollar saved counts. Let us save you many dollars. Don't delay. Get this wonderful easy payment bargain offer now, so you can send for and be sure of getting your Underwood at a big saving—on our easy terms or for cash.

TYPEWRITER EMPORIUM
SHIPMAN-WARD MFG. CO.
2165 Shipman Building, Chicago, Ill.
Montrose and Ravenswood Aves.

FREE TRIAL COUPON

TYPEWRITER EMPORIUM
SHIPMAN-WARD MFG., Chicago, Ill.
2165 Shipman Bldg., Montrose and Ravenswood Aves.

Send by return mail Bargain Offer No. 2165 of a Standard Visible Writing Underwood. This is not an order and does not obligate me to buy.

Name.....

Street or R. F. D. No......

Post Office..... *State*.....

One Broadside Lifts Five Leviathans From Sea

By GRASER SCHORNSTHEIMER

(*Continued from page* 25)

Following is a comparison of these new vessels with the best in foreign navies:

Details:	*West Virginia Colorado*	*Negato Mutsu*	*Hood*
Length	600 feet	660 feet	860 feet
Beam	97 feet 3½ inches	100 feet	104 feet
Draft	30.5 feet	31 feet	28.5 feet
Displacement	32.600 tons	35,000 tons	43,000 tons
Main battery	Eight 16-inch 45 cal.	Eight 16-inch 45 cal.	Eight 15-inch 45 cal.
Secondary battery	Fourteen 5-inch	Sixteen 5.5-inch	Twelve 5.5-inch
Torpedo battery	Two 21-inch	Eight 21-inch	(?) 21-inch
Horse-power	28,900	60,000	144,000
Speed	21 knots	24 knots	31 knots
Fuel	Oil	Oil	Oil

Ten Fast Scout Cruisers

At present we have ten *scout cruisers* under construction, which we may build to completion, if Congress gives us the money. And it would seem that the wiser thing to do would be to complete them, spending a nominal sum, rather than scrap them and be forced to build them from the keels up within a very few years, as the saving entailed will be about $70,000,000 in this case. However, Congress refuses to appropriate the $20,000,000 necessary to do so, according to the present information.

If completed, and very probably at least two of them will be completed, they will be the finest scouts afloat. They will be 555.5 feet long, over all, and 550 feet long on their designed water line. The beam will be 55 feet and the draft 14¼ feet at a normal displacement of 7,500 tons. At full load they will displace over 8,100 tons.

None of these ships will have the electric drive because it weighs too much for the smaller but faster vessels. Five of them will have Parsons turbines, three Westinghouse-Parsons and the other two Curtiss turbines. All will be fitted with reduction gears, enabling them to cruise great distances with economical fuel consumption. The fuel will be oil. The turbines will be required to generate 90,000 horse-power for a speed of 33.7 knots, but it is expected that they will actually generate more than 100,000 horse-power for a speed of 35 knots.

In fact, these ships will be enlarged destroyers, ten 21-inch torpedo tubes being mounted on their decks in two triple and two twin deck mountings. The main battery will consist of twelve of the new 53-caliber 6-inch guns, which will make their first appearance in these ships. They are said to have a range close to the maximum visibility. One shot will be enough for any submarine, destroyer or flotilla leader in the world and very few fast cruisers in the class with these ships will be able to resist these shells.

The arrangement of this battery is interesting. Four guns are mounted on each beam in casemates and two are mounted both fore and aft in special shields to keep out the spray. The ships will have high freeboard and their guns may be fought in all kinds of weather, a rarity in cruisers.

Carrying both belt and deck armor, these cruisers will be able to withstand the guns of all the destroyers and flotilla leaders afloat, and also some of the smaller light cruisers. The reduced complements for these ships call for about 400 officers and men, but the war complement is around 700.

In addition to the above-mentioned battery, these ships will carry two 3-inch, 50-caliber anti-aircraft and two 3-pounder guns. Also, it is proposed that they have catapults of the type I described in SCIENCE AND INVENTION some months ago, enabling them to take planes to sea with them, which catapults will probably be installed on the quarter decks. Still another duty may be given to these ships. Mine chutes may be installed in their sterns, enabling them to act as high-speed mine layers.

The *Omaha* and *Milwaukee* were laid down in 1918 and have been launched. If Congress appropriates the little money necessary for their completion they should go into service this year, and the other eight next year. However, ten cruisers are only ten cruisers. England is retaining about fifty of the type and Japan will shortly have about two dozen, all to be retained. Are ten such vessels enough for the United States? We have none of this type at present.

Chicago Police Adopt Radiophone

(*Continued from page* 48)

in the city. The first pocket telephone will be distributed in two months, and by the end of the year, it is said in a recent report, the entire force will be supplied.

The way some of these news reports are written is all very well for the layman who does not know of the ups and downs of a radio operator's life, but the merest tyro of an amateur who has dabbled in real radio knows full well that it is no sinecure to tune in the station you desire, especially with a pocket radio set, and that it is still less of a snap to have a pocket set *talking back* to headquarters. Oh Boy! how good the reporters make it sound. Of course, these things can be done—*but!* They are not so common as they would have us infer, and when it comes to every policeman on the Chicago police force talking back to headquarters—presto! just like that, we shall see! In our more humorous moments we have concocted a few brainstorm *sidelights* on the radio cop's daily life. A glance at the accompanying illustration, recorded faithfully by artist Paul, tells the story better than words. 1—We see how the antenna is secretly sewed in the coat under the lining. 2—How even the policeman on a suburban beat may enjoy jazz dance music. 3—Imagine the excitement and chances for some good drinks by intercepting bootleggers' radio messages. 4—If an airplane has to land all of a sudden, this fact can be broadcasted via radio, and the radio cops will clear the streets—post instanter. 5—And on Sunday our beloved brethren of the nightstick may enjoy the church service and hymns while downing a glass of near beer in the original Greek "Sugar Bowl" on the corner, or mayhap he may indulge in a friendly game of craps, thus combining religion with business. 6—And imagine the feelings of the proud traffic officer on duty at a busy thorofare crossing when wifey loses control of the infant and jabs the calling button on the wireless telephone hanging on the wall!!! "Come home, Sam; little Tommy is uncontrollable!" Ach! The traffic cop will go dippy.

Fortunes are Going Begging

Photoplay producers ready to pay big sums for Scenarios but can't get them. One big corporation offers a novel test which is open to anyone without charge. Send for the Van Loan Questionnaire and test yourself in your own home.

A SHORT time ago a Utah ex-service man received a handsome check for a motion picture scenario. Six months before he had never had the remotest idea of writing for the screen. He did not seek the opportunity. It was thrust on him. He was literally hunted out by a photoplay corporation which is combing the country for men and women with story-telling ability.

This single incident gives some idea of the desperate situation of the motion picture companies. With millions of capital to work with; with magnificent mechanical equipment, the industry is in danger of complete paralysis because the public demands better stories—and the number of people who can write those stories are only a handful. It is no longer a case of inviting new writers; the motion picture industry is literally reaching out in every direction. It offers to every intelligent man and woman—to you—the home test which revealed unsuspected talent in this Utah ex-soldier. And it has a fortune to give you if you succeed.

Send for the Free Van Loan Questionnaire

H. H. Van Loan, the celebrated photoplaywright, is responsible for the invention of the novel questionnaire which has uncovered hidden photodramatists in all walks of life. With Malcolm McLean, formerly Professor of short story writing at Northwestern University, he hit upon the happy idea of adapting the tests which were used in the United States Army, and applying them to this search for story-telling ability.

The results have been phenomenal. In the recent J. Parker Read, Jr., competition all three prizes amounting to $5,000 were awarded to students of the Palmer Photoplay Corporation, which is conducting this search by means of the Van Loan Questionnaire.

The experiment has gone far enough to prove conclusively (1) that many people who do not at all suspect their ability *can* write scenarios; and that (2) this free questionnaire does prove to the man or woman who sends for it whether he or she has ability enough to warrant development.

THESE are the leaders behind the search for screen writing talent. They form the Advisory Council of the Palmer Photoplay Corporation.

Thomas H. Ince
Thomas H. Ince Studios

Frank E. Woods
Chief Supervising Director
Famous Players-Lasky Corp.

Rex Ingram
Director of "The Four Horsemen of the Apocalypse"

C. Gardner Sullivan
Author and Producer

Allan Dwan
Allan Dwan Productions

Lois Weber
Lois Weber Productions, Inc.

Rob Wagner
Author and Screen Authority

James R. Quirk
Editor and Publisher *Photoplay Magazine*

An evening with this novel device for self-examination is highly fascinating as well as useful. It is a simple test applied in your own home. Its record is held confidential by the Corporation.

The Palmer Photoplay Corporation offers you this free test because

Scores of Screen Stories are needed by producers

Scores of good stories could be sold at once, if they were available. The Palmer Photoplay Corporation exists first of all to *sell* photoplays to producers. Its Educational Department was organized for one purpose and one only—to develop screen writers whose stories it can sell.

Look over the list of leaders in the motion picture industry who form its advisory council. These leaders realize (1) that the future of the screen drama is absolutely dependent upon the discovery and training of new writers. They realize (2) that writing ability and story telling ability are two entirely different gifts. Only a few can write; many can tell a story, and, with training, can tell it in scenario form. The Palmer Photoplay Corporation is finding these story tellers in homes and offices all over the land.

You are invited to try; clip the coupon

The whole purpose of this advertisement is to invite readers of SCIENCE AND INVENTION men to take the Van Loan Questionnaire test. If you have read this page up to this point, your interest is sufficient to warrant addressing the invitation to you directly. In all sincerity, and with the interests of the motion picture industry at heart, the Palmer Photoplay Corporation extends you its cordial invitation to try. Who can tell what the reward may be in your case?

For your convenience the coupon is printed on this page. The questionnaire is free and your request for it incurs no obligation on your part.

PALMER PHOTOPLAY Corporation, Department of Education, S.I.5
124 W. 4th St., Los Angeles, Cal.

PLEASE send me, without cost or obligation on my part, your questionnaire. I will answer the questions in it and return it to you for analysis. If I pass the test, I am to receive further information about your Course and Service.

Name.....

Address.....

.....

Building Your Own Electric Fixtures

(Continued from page 40)

socket is supported as shown, by a brass strip containing a ⅛" pipe nipple, on which the socket screws. This or some similar arrangement is available from any electrical supply store or fixture shop for a few cents.

The round type of Colonial lantern is shown at Fig. 2 and this should be made preferably not less than 10" in height, and 7" or more in diameter, keeping the length about one-third longer than the diameter. The top sheet metal cover is cut out after a paper pattern has been fitted and tried, so that it will pass around the supporting pipe in the shape of a funnel, when it may be riveted or otherwise secured together. These top covers may simply rest on the lantern without being fastened.

At the present time wooden lighting fixtures are in considerable demand, and table lamps, ceiling fixtures, as well as side wall lights, may be easily constructed from square or other shaped wooden bars, as shown in Figs. 3, 4 and 5. Fig. 3 shows how a two light ceiling fixture may be made from some chestnut or other stock about 2" square or somewhat less. The upright and horizontal wooden members are secured together by two brass or iron angles thru which wood screws are secured. The holes thru which the wires are to pass are drilled by means of a long extension bit such as electricians use. Suitable canopies for such fixtures may be made or purchased. With a little ingenuity canopies having a round hole may be fitted to have a square opening instead. No. 16 R. C. fixture wire is used in wiring the chandelier. The sockets may be ⅛" and suitably ⅛" pipe nipples are procurable at fixture and electrical supply shops. These nipples can be threaded into holes somewhat smaller than themselves so as to support the socket firmly. It is better to use a nipple about 1" long or more, than it is to use too short a one which may pull out of the wood. Any style glassware can be supported on the sockets by means of brass shade holders which clamp around the sockets. Key, keyless, or chain sockets may be used as the constructor elects. Forty-watt tungsten lamps will give good results in a two-light chandelier in the average sized room. The lamps should usually be about 7 to 7½ feet above the floor. The decorative pointed wooden ends are cut out separately and fit into the holes drilled thru the horizontal bar by virtue of the dowels formed on them, as shown in the drawing. The fixture may be hung from a screw eye fitted into a beam or fixture block, in the manner indicated. The wood can be colored with dyes or stained and varnished or left dull.

A four-light wooden chandelier is shown at Fig. 4, while Fig 5 shows a side wall bracket light, many different designs of which may be worked out by those interested in wooden lighting fixtures. If you are afraid to hang these fixtures yourself, your local electrician will do this for you at small cost.

Gearless Friction Drive Car

(Continued from page 27)

to a little higher speed, you disengage the clutch a few degrees, draw the clutch, advance the speed control lever, and then release the clutch pedal. Owing to the peculiar friction action, which is fairly gradual, as regards the contact between the revolving disc and the friction wheel, there is no perceptible jar at all as the car moves forward, and owing to the great flexibility of this friction transmission, it is possible to place the speed lever well forward in the second or third position, and let in the clutch. With a gear shift car this would be liable to either strip the gears or else to stall the engine. And best of all Mr. Kelsey has provided us with a wonderful number of speeds. Not less than 50 to 60 different speeds are available, and the car is thus nearly as flexible as the famous electro-magnetic drive employed on one of the modern high priced cars.

By pushing in on the foot clutch pedal and moving it sideways, there is a locking device engaged, which retains the pedal in the *off* position, keeping the friction disc and wheel disengaged for coasting. Those who have ridden in this car say that they have never experienced such freedom in coasting as it possesses, and its inventor states that several thousand miles of driving have proved that this car will coast one mile in three, owing to the great freedom afforded thru this particularly well designed transmission and free running bearings.

The shaft on which the friction wheel is mounted contains four long keys or splines, which fit in keyways in the hub of the friction wheel; thus this wheel can be moved along the shaft to any position desired. When it is in contact with the surface of the driving disc nearest the periphery, the car moves at its highest speed; and when the friction wheel is moved toward the center, the car speed is reduced. When the sliding friction wheel is moved past the center to the other side of the disc, the direction of motion of the wheel and jack shaft, as well as of the rear car wheels is reversed. It will readily be seen that there are an infinite number of speeds available by this clever scheme of power transmission, and the main problem which had to be solved was to make this friction transmission sufficiently sturdy and reliable, and to determine the best materials from which to form the friction driving disc and the friction rim folded between the flanges of the friction wheel.

The power from the jack shaft is transmitted to the two rear wheels thru a set of two spiral gears at either side. This friction transmission unit is enclosed in a dust and water-tight compartment and several years of intensive research work and many laboratory tests have been carried out on this transmission unit in order to make sure that it would stand the test of hard road service. Just to show what this car has done in some of the tests, it might be mentioned that the inventor at the request of a committee of engineers, hauled a seven and one-half ton steam roller thru crowded city streets, which gave considerable opportunity to demonstrate the prowess of the car in handling as well as pulling ability. In another demonstration run the car was run toward the street curb at good speed, and brought to a shockless stop by throwing the friction transmission in *reverse*. Gear shift cars may be stopped in an emergency by throwing the gears into reverse position and then letting in on the clutch, but you may have a nice garage bill to pay for a new set of gears, even tho this little trick might have saved your life. Such performances, however, are an every day occurrence with the friction drive car.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page 29*)

Our inability to see surface markings on Venus is more easily explainable on the assumption that the atmosphere is dust-laden than by assuming that it is cloud-filled. If clouds did exist in the atmosphere of Venus it is likely that they would at times break away to some extent and permit us to have an occasional view of the surface beneath. The discovery of the absence of oxygen and water vapor in the atmosphere of Venus is, of course, strong evidence against the possibility of the existence of a dense canopy of clouds. It is conceivable, however, that water vapor and oxygen may lie at low levels and be entirely masked from view by upper strata of dust-filled atmosphere which would turn back as from a mirror much of the incident radiation from the sun.

Venus is at the present time a most magnificent object in the western sky for some time after sunset. It will continue to remain in a favorable position for observation thruout the summer and far into the fall. It will attain its greatest distance east of the sun, called its greatest eastern elongation, the middle of September. At that time it will resemble the moon at first quarter. After the date of elongation it will draw in rapidly toward the sun once more and will reach inferior conjunction with the sun toward the end of November after which it will be a morning star. Its greatest brilliancy will be attained on Oct. 21st, when it is in the crescent phase, at a point between eastern elongation and inferior conjunction.

It is expected that further observations of the spectrum of Venus will be made near the time of eastern elongation when the relative motion of Venus and the earth is high and the planet is in a favorable position for observation.

It has also been planned to make observations of the spectra of Mars and Jupiter by the new method when favorably placed with respect to the earth. As the atmosphere of Mars is extremely rare and certain surface markings are clearly visible there will be no question that a large percentage of the light analyzed has penetrated to the lower atmosphere and surface of the planet before being reflected to our eyes. This method, therefore, should give us some definite knowledge concerning the composition of the lower atmosphere of this mysterious planet.

WHAT GOES INTO A SHEET OF PAPER

By Wm. R. Reinicke

What is a sheet of paper?

What goes into its manufacture, and how much of each substance?

This table gives the exact amount of each of the various materials which are used in the making of 100 pounds of paper.

Wood	13.4 cu. ft.
Sulphur	12.7 lb.
Limestone	17.5 lb.
Kerosene	5.7 oz.
Bleach powder	14.3 lb.
Rosin	3 lb.
Soda	515 lb.
Alum	4.2 lb.
Color	1.8 oz.
Coal	320 lb.
Iron sulphate	.79 oz.
Copper sulphate	.19 oz.
Lime	3.17 oz.
Belt	2 sq.in.
Felts	32 sq.in.
Wire	67 cu.cm.
Lubricating oil	220 cu.cm.
Water, chemically purified and filtered	7,500 gals.

Electric Trucks Solve Freight Congestion

The electrification of the Manhattan area of the Port of New York District and the installation of an automatic electric railroad system to serve all railroads at trunk line terminals away from the waterfront was stressed as the only solution of the port problem in a recent address by Major Elihu C. Church of the Port of New York authority.

"Railroads must not clutter our waterfronts higgeldy piggeldy the way they do," declared Major Church in part. "It is essential that docking space, with efficient loading and unloading railroad facilities, be afforded all vessels entering the Port of New York. This will be brought about by a system of trunk belt lines adjacent to the port district served by an automatic electric railroad system within the immediate waterfront area."

In speaking of clearing railroad and street traffic congestion in Manhattan and the Bronx and the other boroughs of the city, Major Church praised the electric truck. He avowed that the immediate future would see the development of truck trunk line highways for the fleets of transports that have to travel in the city. "These trunk line highways," declared the speaker, "are as essential to the life of the city, its commerce and welfare, as the arteries are to human life. Trucks cannot average more than two and one-half miles a day downtown in New York. Their progress is marked by halts. They must have the right-of-way."

Mr. E. E. La Schum of the American Railway Express Company spoke on "Electric trucks in the service of the American Railway Express Company."

Referring to the remark made by Major Church that 12,000 tons of perishable foodstuffs are handled daily in New York City, Mr. La Schum stated that it was his belief that "no other agencies or methods of transportation, available at the present day, would prove more useful in reducing delays in the shipment of this material than the electric truck." He also exprest himself as of the opinion that "at least 85 per cent of all the trucking done in New York City will eventually be done by electric trucks."

Radio for the Beginner

By ARMSTRONG PERRY

(*Continued from page* 56)

these binding posts short wires lead to the knobs of switches used in controlling the flow of electricity thru the bulb. In ready-made sets these connections are all made and the user need not trace them. If he buys parts and assembles his own receiver, a pastime keenly enjoyed by persons who like to use their hands as well as their brains, he gets from the dealer a diagram and instructions telling how to put them together. The important part in making the connections is that they shall be correct, tight and strong (preferably soldered). The terminals must be marked so that when the batteries are attached the currents will flow thru the tube in the right directions.

Where the current enters, the plus sign (+) is used. Where it leaves, the minus sign (—) appears. Currents from two sources may be sent in at the same entrance or out at the same exit, like streams of patrons at a movie show, but a wrong connection operates like an attempt to send the crowd out after the first show while a long and impatient line is struggling to get in for the second.

To forestall the hopelessness that seizes the adult radio novice when some high school youth explains that the plus and minus signs on all electrical apparatus are wrong, and that the electrons whose movements make up the electric current really go into the door marked "Exit" and out of the one marked "Entrance," let it be said that the youth is quite right, but that for practical purposes it makes no difference whatever. By the time Mr. Electron and his movements were discovered several millions of electrical devices were in use, all with the plus and minus signs appearing where they had been placed on the assumption that the current flowed from the positive to the negative pole or sign. These signs were permitted to remain where they were, and millions like them were located in corresponding positions, for the same reason that we turn our clocks ahead to save daylight instead of getting up an hour earlier by the clock. It was an easier way, and it worked.

On the radio batteries the plus terminals are painted red, or else red wires lead from them, except when the plus sign can be stamped so as to be easily seen. There need be no mistake. Having connected the plus terminal of the battery to the plus terminal on the receiver where the battery's current should enter, there is only one place left on battery and receiver to attach the wire connecting the minus terminals, so that of course is the correct place. It might be possible, by looking all over the receiver, to find a wrong place to connect, but as the plus and minus terminals for any one circuit are practically always side by side there is small chance for error. The antenna, ground and 'phone connections are all plainly marked to distinguish them from battery connections and from each other.

It is possible, thru carelessness, to connect the wrong battery to the wrong terminals. There is a big, heavy (storage) battery called the "A" battery. This has a low voltage, usually from four to six volts pressure. The smaller, lighter (dry) battery, called the "B" battery, has heavier voltage. By connecting the "B" battery where the "A" battery belongs it is easy to find out the difference. It costs at least $5.00 each time this is done, and in the present scarcity of vacuum tubes there is also a delay of several weeks before a new one can be secured. The filament in the tube, which is the fine wire that lights up when you turn on the juice, will not stand for more than four volts as a rule. Some kinds will stand only 1½ volts. It is a very good investment of time to study until you are sure about the connections before you make them. For the protection of the user the proper voltage is usually marked at the terminals.

The "B" battery supplies current for the plate, which is the largest piece of metal seen inside the vacuum tube. The plate can stand a comparatively heavy charge. Usually about 22½ volts pressure is used on the plate of a receiving tube. The grid, which is between the filament and the plate, is taken care of by the wiring. There is no separate battery to be connected with it.

Having the connections all properly made, the game is to turn the current into the filament very slowly, not snap it on as you would an electric light. Light is not what is needed. Some filaments get only red hot. Some shine more brightly. An inventor tells us that we may soon be using filaments that do not get hot enough to glow at all and that they will last many times longer than hot filaments.

The juice is turned on with a knob that has a tongue which passes over what looks like a coil spring bent into the form of a circle that does not quite come together. This is the filament rheostat. The further you turn, the more current you send to the filament. At the start, turn on only enough current to produce a visible glow in the filament and stop there.

The flow of current from the "B" battery to the plate is sometimes regulated in the same way, but more often the adjustments are made on the battery itself. Some bulbs require less delicate adjustment of the plate current than others. The battery should be fitted to the requirements of the bulb used.

Both currents having been started thru the vacuum tube, the next step is to tune the receiver to the station you want to hear. The dealer usually tells the customer about where to set the knobs and switches to get the concerts, or the amateur messages, or the traffic from the government stations. Simple tuners need only the careful turning of a single handle to cover their entire range and discover every station that can be heard at the moment. On others there is a "secondary" side and a "primary" side, each with two or three control knobs. Usually the secondary side can be adjusted for the station you want to hear by following directions supplied with the tuner. If you want to hear Newark on 360 meters you can set the controls on the secondary side of the receiver so that you know you are tuned accurately on that wave length. Then by making adjustments on the primary side you can tune it to the secondary side and when they are in resonance the station will be heard if it is possible to hear it at that moment. A soft click in the phones is a sign that the primary and secondary circuits are tuned to each other.

Sometimes the light inside the bulb turns blue and the sound becomes rasping. The thing to do is to turn off the light and start over again. No damage has been done.

If sounds are heard, but are too faint to be understood, a slight increase in the filament current may make them louder. When a hissing sound is heard, like a frying pan greeting a fresh egg that has just dropped into it, it is time to stop and possibly turn back a little. Slight changes in the plate current may increase the volume of the music or voices heard. Also the finer adjustment of the inductances and condensers which are represented by the knobs on the face of the receiver may make a great difference.

If the "body capacity" effect is too strong it may be reduced by using a rubber on the end of a long pencil or piece of wood dowel pin five to six inches long, to turn the knobs. Hair-breadth adjustments are sometimes necessary, especially in long distance work.

When the results are as good as can be obtained, the position of the various knobs and switches should be written down for future reference. Altho the same station cannot always be tuned in on different days by making precisely the same adjustments, a good amateur operator, such as you will be after a few weeks of experience, will often set the knobs and switches first, then turn on the current for the vacuum tube and get the station he wants at once.

You can amuse your friends by forming them into a human antenna. There are always dots and dashes in the air—especially when you wish they were not! Disconnect the antenna from the receiver and ask one guest to hold the end while the others form a chain by holding hands, the last one placing his free hand on the antenna terminals of the receiver. The dots and dashes will come in just as well as they did over the wire alone. If they decrease in volume, drop one guest after another out of the chain until you discover who is the "dead" one retarding the flow of current.

The Power of Insects

At intervals there appear accounts setting forth the prodigious strength of insects. Their muscular force is usually compared with their size by stating, for example, that a flea can leap so many times its own length and that an ant can drag so many times its own weight. Then it is said that man, if he were strong in the same proportion, could jump so many rods or lift so many tons. These comparisons, according to the eminent French investigator Robida, are misleading, to say the least.

In his opinion, it is interesting to consider solely from a mechanical point of view these comparisons between the muscular strength of man and that of insects. Strictly from this standpoint they are by no means extraordinary, and are only one of the forms of what has been called "the conflict of squares and cubes." The law is well known — volumes decrease in more rapid ratio than surfaces.

The force that a muscle can exert depends on its section — that is, on a surface — although its capacity for doing work depends on its volume, as is logical. Here is the explanation of the astonishing strength of insects.

As an example, compare two muscles, that of a man and that of an insect, the latter 100 times shorter than the former. It is evident that the insect's muscle will be 1,000,000 times lighter than the man's, while its section, and the force it can exert, will be only 10,000 times less.

The conclusion is that since a man can lift 62 pounds, the insect will lift 10,000 times less, or 154 grains, and one gets the impressive spectacle of an insect lifting more than 100 times its weight.

But it is no longer the same if one examines the mechanical work effected. The muscle of the insect, supposed to be one-hundredth of a man's in linear dimensions, furnishes, when it contracts a force 10,000 times less than the human muscle, exerted through a space 100 times smaller.

Take the flea's jump, for instance. By its muscular contraction it gives to its mass a movement capable of raising it twelve inches. Man can raise his own weight about five feet by leaping. For equal weight the human muscle thus furnishes five times more work than that of the flea in a single contraction.

Experimental Electro-Chemistry

By RAYMOND B. WAILES

(Continued from page 35)

Ordinary potassium atoms combine violently with water and liberate hydrogen gas as shown: $K + H_2O = KOH + H$. The hydrogen gas is set free, and, being lighter than the water, or solution, rises and escapes at the surface of the liquid.

The hydroxyl ions also lose their charge of electricity and a hydrogen atom unites with the hydroxyl radical and forms water which mixes with the electrolyte. The remaining oxygen escapes at the surface.

Many other electrolytes liberate hydrogen and oxygen when electrolyzed, and many electrolytes yield metals and gases other than hydrogen and oxygen, and even molecules of matter. If a U tube (fig. 3) or the experimental cell (fig. 4) is filled with a strong solution of zinc chloride and electrolyzed with a battery, beautiful crystals of zinc will separate at the cathode or negative pole, and chlorine gas will be liberated at the anode or positive pole. This reaction occurs:

$$\overset{+}{Zn}\overset{-}{Cl_2} = Zn + 2Cl$$

The presence of chlorine gas can be detected by its bleaching action upon a strip of moistened calico, or blue litmus paper. The exit tubes facilitate the collection of any liberated gases formed during electrolysis.

If copper sulphate solution is electrolyzed, the following reactions occur:

$$1.\quad \overset{+}{Cu}\overset{-}{SO_4} = Cu + SO_4$$

$$2.\quad \overset{-}{SO_4} = SO_3 + O$$

$$3.\quad SO_3 + \overset{+}{H}\overset{-}{OH} = H_2SO_4$$

In equation 1, copper is liberated and is deposited on the cathode. Advantage is taken of this fact in electroplating. The sulphion $\overset{-}{SO_4}$ is formed at the anode, or positive electrode. This radical is unstable and splits up according to equation 2. Here, oxygen, O is formed, and it is this oxygen that escapes from the electrode, visually, during the electrolysis. The $\overset{-}{SO_3}$ radical combines with water $\overset{+}{H}\overset{-}{OH}$ (equation 3) and forms sulphuric acid, H_2SO_4.

(To be continued)

Complete Radio Receiver in Fountain Pen

(Continued from page 52)

by many of our best radio bugs. Want a loose coupler? Gaze at Fig. B and behold! We have an adjustable primary coil sliding back and forth over a secondary winding. A variable condenser? At Fig. C we see how a variable condenser can be very easily constructed by coating tinfoil over the cap and over the barrel, one slipping over the other. Of course the hard rubber cap is rather thick for this purpose and some modification of this scheme will have to be worked out, owing to the small area of tinfoil here available; the thickness of the dielectric being reduced.

As the fixed condenser in any case can be made very small, we could crowd this a bit and with a little ingenuity provide a buzzer test in the bottom part of the ink chamber, as shown at Fig. E. Here a single cell of a small flashlight battery is used, and a specially built buzzer like that shown is designed to fit within the barrel. A push button for the buzzer test, which will close this circuit when wanted, could be placed in the end of the barrel, as the diagram indicates.

Radio Constructor Hints

By H. WINFIELD SECOR

(*Continued from page 53*)

preferably a square brass rod, a spring brush serving to make positive contact between the moving tube and the slide rod. For audion circuits, however, it is preferable to have a flexible lead-in wire soldered to the moving brass tube, as all the connections in amplifier circuits should be very positive and in fact soldered, if you are to be certain that all noises are to be reduced to a minimum; it is very difficult sometimes to locate loose or microphonic contacts, which may be causing the trouble. The writer has repeatedly found them only after going over the connections several times and in the most unexpected places, especially where several wires are fastened on one binding post, the inner wire in one case being the guilty one.

Tuning Coils

A great many of the "Old Guard" Radio-bugs like a tuning coil about as much as anything, even for use with audion amplifiers having several stages of amplification. The writer has found a small two-slide coil of good design very satisfactory indeed, and prefers it by far to an excellent large-sized loose coupler which he had built for previous use with a crystal detector; the tuning coil in question is being used with a detector and three-step V. T. amplifier with a loud talker.

The drawings in Fig. 2 show all there is to a two- or three-slide tuning coil. Two wooden or bakelite ends are used, and these are held rigidly against the ends of the cardboard or other insulating tube by means of a brass tie-rod threaded for No. 8-32 nuts at either end. The size of the tube used will vary, of course, with the wave length which the instrument is to be designed for. For wave lengths up to 600 meters, where the coil will be used with an aerial about 75 feet long of one to four wires, 30 to 50 feet above the ground, the tube may measure about 8″ long and 3¼″ in diameter. The tube should preferably be given a coat of rather tacky shellac, and then should be wound with a layer of No. 22 single silk enameled, or cotton-covered copper wire. If you are familiar with lathe work or have a friend who can wind the coil in a lathe, bare copper wire may be wound on tightly and the turns spaced a slight distance apart, by using the thread-cutting gear on the lathe, feeding the wire over a grooved wheel fastened in the tool post on the traveling lathe carriage.

If bare wire is used, then all the constructor will have to do is either to make or to purchase the necessary number of sliders and square brass rods, on which the sliders move back and forth along the coil to make contact with the different turns along the winding. A two-slide coil is the one most usually employed and a simple receiving set employing a mineral detector and a 1,000 ohm radio receiver or a pair of them is shown in Fig. 2 also. The aerial wave length is adjusted by moving one slider, while the closed or local detector circuit has its wave length adjusted in syntony or tune with the aerial circuit by moving the second slider back and forth until the signals are heard at maximum strength in the radio head phones. With mineral detectors, the buzzer test described in the previous issues of SCIENCE AND INVENTION, should always be employed, as the cost is slight and it may save hours and hours of fooling around with the cat whisker wire

over the mineral, listening for signals and a sensitive spot.

A standard large-sized tuning coil suitable for wave lengths with an average aerial up to 1,000 meters and somewhat more, comprises a cardboard tube 12" long by 5" in diameter, wound with one layer of No. 22 insulated wire, or else spaced bare wire. Unless the spaced bare wire, however, is wound with the turns very close to each other, this winding will not have as great a wave length or inductance effect as when an insulated wire is used with the turns touching each other. Where insulated wire is used in building any of the tuning coils requiring sliders, a path for the brass contact spring of the slider has to be scraped along the coil with a knife or else burned off with a hot soldering iron. Paper scales can be graduated with a ruler and glued on the tuning coil tube over the wire along the slider paths so that the different settings of the sliders for certain stations will always be known.

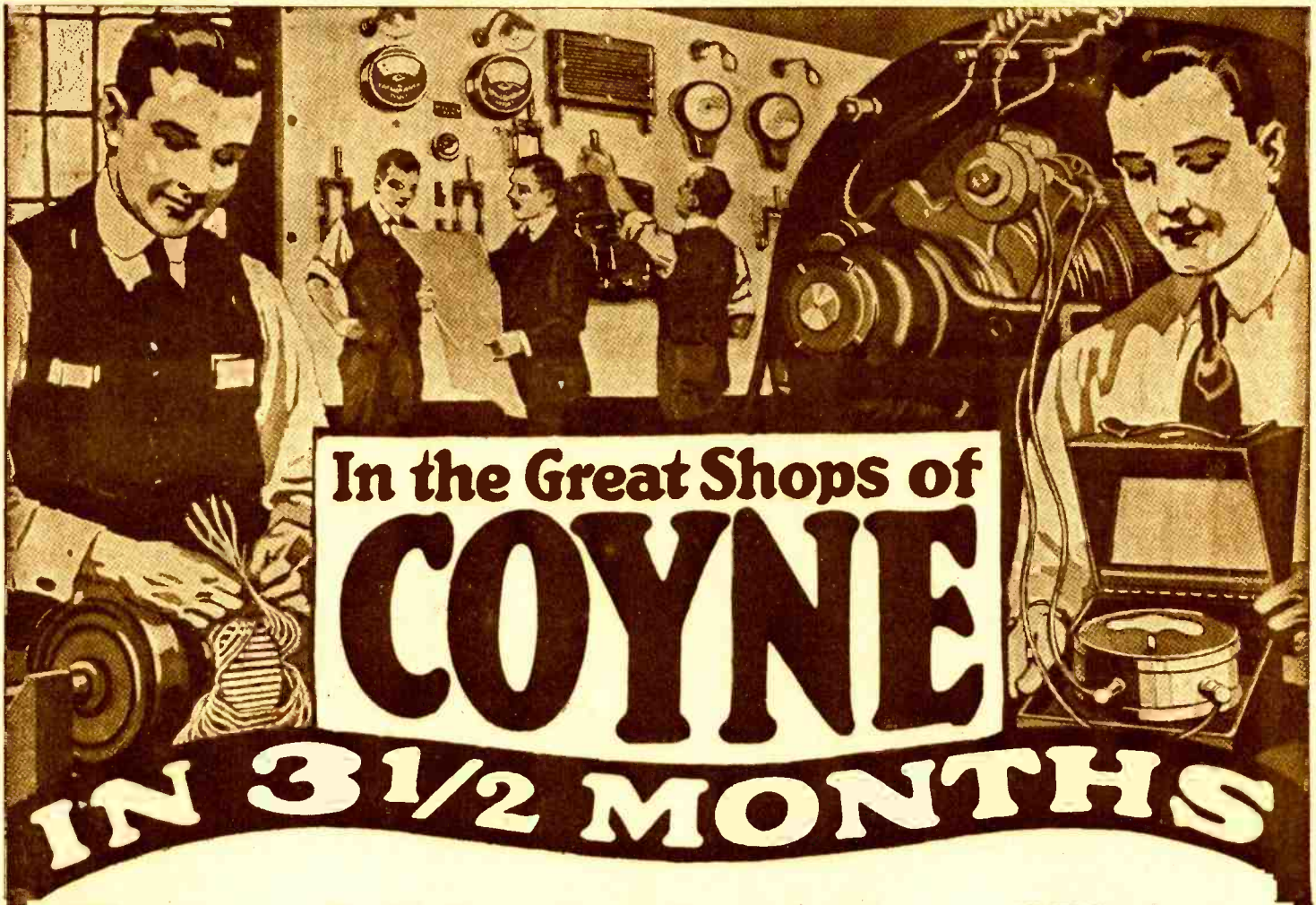
Vario-Couplers

The latest idea in tuning devices, especially those used with audion sets, is the so-called vario-coupler, shown at Fig. 3. The general dimensions for such a vario-coupler are as follows: A cardboard or, better still, micarta or bakelite primary or outside tube is employed, measuring 5½" high and 4½" in diameter. This tube is wound with one layer, 4" long, of No. 22 or similar size insulated copper wire, preferably single silk covered. This primary winding is usually divided up into sections about ½" long and a tap left by twisting the wire, as shown at Fig. 3 at these points. These taps may be made all in a row or else staggered, as here shown. Afterward a multiple point switch is connected up to the successive taps in the manner indicated in the drawing. The finer tuning of the circuit is accomplished by variable condensers, one of these being connected either in series or in parallel with the primary winding. As the wave length is changed by altering either the capacity or the inductance, or both, it is therefore seen that the intermediate finer tuning between the taps can be compensated for by adjusting the variable condenser. The tuning is also affected by changing the position of the rotary secondary coil wound on a wooden bobbin in the manner shown.

Where these bobbins are not available from your local radio supply store, they may be turned up in a lathe at small cost, or by the builder himself if convenient, and in some cases a simple piece of insulating tube of cardboard or micarta is rigidly mounted on a brass shaft and fitted with a knob, as shown. Where a bobbin of wood or of other insulating material is employed, it is best to put brass bearings or bushings thru the cardboard tube, as there is considerable wear in time at these points. Two short shafts should be used and the two detector circuit wires can then be soldered to them as indicated, while the two secondary terminals can also be soldered to these shafts inside the bobbin. The secondary winding may comprise a layer of No. 26 single silk insulated copper wire, one-half the winding being wound from the outside to the center, uphill, as the diagram shows, and then the bobbin is reversed in the lathe or winding machine, and the second half wound from the outside, up the hill toward the center. This is done so that the current will keep on traveling around the bobbin in the same direction, as otherwise one-half of the bobbin winding would buck the other and neutralize it. After the two half windings have been put on, the two inner leads are soldered together while the two

(*Continued on page 79*)

Learn Electricity



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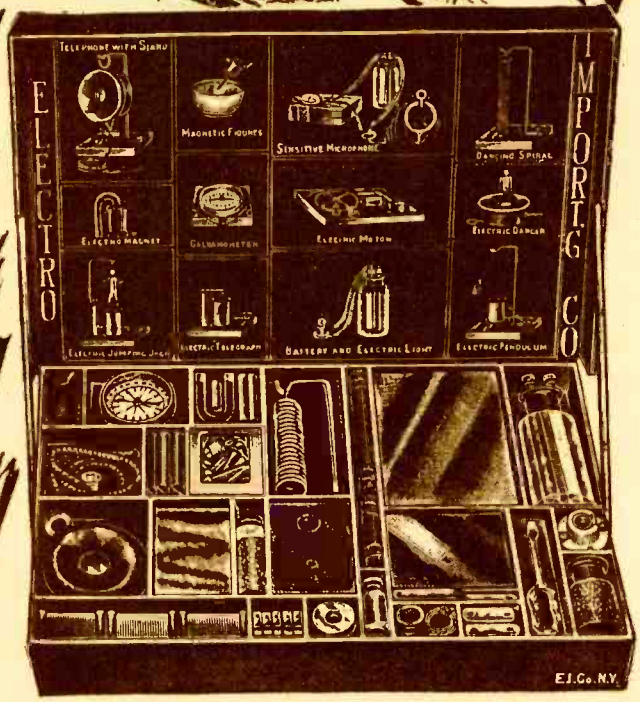

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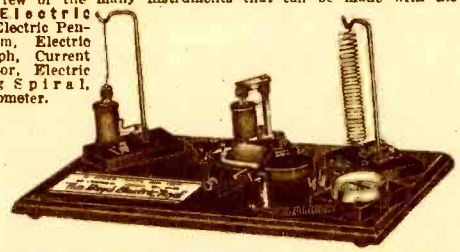

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New Theatre a Scientific Marvel

By ERIC A. DIME

(*Continued from page* 13)

ment has, however, at last been completed. It has incorporated within its unusual construction many ingenious and novel innovations as the full page cut shows.

Instead of the usual theatre with its large gaping proscenium, this theatre is provided with the regular style of stage and on either side of it there are two miniature replicas. These are the bowing platforms and the actors no longer break in upon the scene in order to step forward to acknowledge the applause of the audience, but the curtains covering the two miniature openings part and the actors pass across the opening on one side of the stage, then down a covered passageway and across the opening on the other side, so that patrons on both sides of the theatre get a good view of them. On special occasions a band may be situated on either of these bowing platforms. These platforms permit changing of scenery while gratuities are being received, thus permitting of more scenes and shorter intermissions.

Thruout the entire theatre departures are in evidence. For instance, one sees the orchestra almost on a level with and in front of the stage, the front of their platform is curved to conform with an arc and the side walls covered with marble. "Pshaw" would be one's exclamation as they noted the orchestra directly in the field of view. The lights in the theatre gradually dim and the orchestra plays its overture. Then almost imperceptibly the entire orchestra platform commences to lower itself into the pit, until finally the orchestra is "out of sight." The immense elevator upon which they are positioned weighs five tons, and is operated by a twenty horse-power electric motor, coupled to a shaft which turns four gears and raises and lowers the spiral-worm columns holding it in place.

The motor for the orchestra pit may be controlled from either the wings or from the light-controlling operator's room. This is located immediately under the stage and near the front of the platform and houses a director and operator. This operator actuates sixteen push buttons and with these controls the lights in the house thru "remote control" relays. He can, from this spot, turn out the lights in the entire building, dim individual lights, regulate the spot and flood lights, produce color variations, and in general enhance all the lighting effects. His position at the footlights is unobservable by either orchestra or balcony, as he watches the action from a sort of prompter's box. The director here can likewise watch the girls of the chorus and advise by signs and signals the execution of the various steps in dances and authorize impromptu changes. The entire stage floor is removable in this theatre, and the beams upon which it is located can likewise be displaced, leaving an immense opening in the floor into which a tank may be set; or small portions of the stage may be removed, if desired, to serve as traps for various scenic or magical effects.

Such a flooring is found extremely useful in acts like the Disappearing Elephant, one of the famous magical stunts, in which an elephant disappears from view. The floor trap arrangement is used in the show now playing at this theatre for permitting the actors to cross from one side of the stage to the other. They descend a small flight of stairs, inserted at one of these platform section openings, then journey across a wooden bridge built beneath the stage, and ascend again at the opposite end. This is particularly favorable when the scene must

take in the *horizant*, an azure sky and cloud background, which in this theatre is an immense plaster-like dome sixty feet high, upon which some clouds are painted and others projected. In such events the actors cannot cross in back of drops usually provided for that purpose, hence must use the substage passageway.

When one looks up, the gridiron, sixty feet above the floor of the stage, appears like mosquito screening. Thru this the ropes for the curtains pass and fasten to iron curtain poles. Of course, the ropes are not the usual kind, but are steel cables one-half inch in diameter and copper coated, four in number, for each drop. These ropes communicate with counterweights arranged against the wall. Here the very latest style of counterweight control is used which permits a massive drop to be raised or lowered by even a child.

In back of the asbestos curtain and just above the proscenium arch is a scaffold upon which cloud projectors, wave machines and direct spotlights are located. Two men control these devices. Rain for stage purposes is produced by sprinklers or pipes perforated with numerous holes which send out a shower of real live rain, which actually drenches the actors. Fortunately they need never catch cold for the theatre is exceptionally well heated in winter and cooled in summer. Even under the orchestra seats a stream of warm air is constantly passing. This is created by a six-foot blower located beneath the stage. The air is forced into a room criss-crossed by pipes. These are heated by steam in the winter time, and in the summer cooled by brine, so that the management can truthfully say, "The theatre is ten degrees cooler than the street." The passageway thru which hot or cool air is forced is made of concrete, and three men abreast can walk thru it. Here and there beneath the seats, openings resembling the ventilators on a ship appear, which direct the stream of air.

The actors' rooms mark radical departures in themselves. Each contains its cot, dressing table, lights and a small antichamber in which is located the bath and shower.

A *Green Room* is also provided where the old actors may sit around and talk and recall the days when they were big headliners in the theatrical circles. This room has its open hearth fireplace, writing desk, tables and smoking stands. It bears a favorable resemblance to the Green Room of the days of old, when Shakespeare was playing small parts.

Two semi-circular curtains covering the orchestra pit may be brought around on respective tracks and with slight changes, such as the building of an extra framework upon the orchestralist (for that is the name Mr. Carroll calls the orchestra elevator at the Earl Carroll theatre, where these wonders of architecture and engineering may be found), the stage could be enlarged so as to extend beyond the proscenium. Changes would have to be effected in order to do this, however, because the asbestos curtain is in back of the orchestra pit. The seats in this house are wide enough apart to permit patrons to pass in and out of the aisles without discomfort to those seated, who need not rise to permit clearance.

CORRECTION NOTICE

Thru an error the total mileage of railroad track in the United States cited in the article, "Automatic Train Control," by C. S. Corrigan, C. E., in the April number, was given as 3,100,000, whereas it should have been 100,000. This error did not mitigate against the arguments set forth by Mr. Corrigan, however, but as a matter of placing this fact correctly before our readers, we are glad to make this correction, which the author had brought to our attention.—EDITORS.

A Tropical North Pole

By C. S CORRIGAN, C.E.

(Continued from page 26)

As the glaciers grew less there was less ice to cool the air, and the winters grew warmer; common sense convinces you that the winters in New York now are much warmer than the summers were years ago, when the glaciers were here, but the sun's ability to melt the glaciers diminished as they receded toward the Poles, and altho all the snow and ice formed each winter was melted in the summer, and billions of tons of glacier ice besides, now after 30,000 years more, it is estimated there is still two million billion tons of glacial ice left on the earth. If it was near the equator it would melt in a month, but as it is near the poles, the sun only gains on it at the rate of two hundred billion tons a year, so it will be 10,000 years more in ridding the earth of all ice and snow.

Besides using the direct heat of the sun to melt glaciers, Nature keeps the entire mass of ice continually moving forward at the rate of 200 feet or more per year; in warm years the free ends often move 600 or 1,000 feet. This is the reason a warm winter and spring means a great increase in the number of icebergs at sea. This continual movement is partly on account of the glacial weight pushing down hill and partly on account of the alternate contraction and expansion as the temperature of the glacier changes, altho it can never be warmed above 32° F. It is colder at night than in the day, and colder in winter than in summer; the glacier therefore expands and contracts to some extent quite often. A glacier always has its lower end free, so every time it expands the whole movement is at the free end, since the other side is held by the ice above; then when the mass of the glacier contracts, the free end never retreats for two reasons. First—ice is not tenacious enough to pull itself up hill; second—the back pressure against the weight above being released, the whole mass flows down hill. The next time the glacier expands, its free end has to slide farther down hill, until another big piece breaks off and falls into the sea, or the free end reaches a lower and warmer climate and is entirely melted.

Natural laws keep the cold waters of the polar seas moving toward the equator, and when you see Nature continually using this force to move great mountains of ice (icebergs) to warmer climes where they are soon melted, it naturally suggests the idea that man with his inventive genius might help her rush the job a bit. To move Greenland's Icy Mountains to India's coral strand would be a big job, but if we used as much explosive as was wasted in the World War it could be finished in less than ten years.

Nature has shown man how to demolish mountains of ice. The simplest way to improve on her process would be to send armies of men to glacial regions to drill rows of wells parallel with the free sides of glaciers, in which to put enough T. N. T. to push immense mountains of ice into the sea; then tugs could be used to guide them to warm currents and warn ships of their location until they melted. It is said one glacier in the Antartic rises 300 feet above the sea for a distance of 500 miles. To slice 1,000 feet off the whole length of that glacier would rid the world of 75 billion tons of ice; the removal of so much of its free end would make the great bulk of the glacier move so much faster that the job could be repeated the next year on a much larger scale; in the meantime the army of well drillers and shooters would visit other glaciers and every week new ice mountains would be launched. To make the work interesting, prizes might be of-

fered for the biggest argosies; to make it picturesque and worth while showing in the movies, Max Sennet's bathing beauties and pretty Esquimo girls could vie with each other breaking bottles of "Shampagne" on their highest peaks, just as the T. N. T. went off and, in nautical language, knocked the blocks out from under and started them skidding towards the tropics.

Not many years ago, if a house caught fire, it had to burn up. Fire was a demonstration of Nature no man could resist. Today mere man puts out the biggest forest fires; he even builds fires as hot as the sun itself and makes them work for him; we used to let flood waters run wild and do all kinds of damage; now we build dams to hold them while we make use of their power; we used to sing, "Oh, what fun it is to ride in a one-horse open sleigh." Some pretended to prefer winter's ice and snow, no one thought of opposing winter, but now that we ride in automobiles, snow and ice are nuisances. Not satisfied with Nature's slow and sloppy methods, cities spend millions of dollars for snow and ice-fighting apparatus, and thousands of men are put to work getting rid of the nuisance at once, because cities have found that it pays to do in one day what Nature would require weeks to accomplish; after a recent snow storm in New York two million cubic yards of snow was removed from the city streets in one day; that equals a snowball 470 feet in diameter.

Would it pay to rid the whole earth of ice? Only one-third of its inhabitants, 500 million people, live where they have to provide against winter's cold. It costs each an average of $100.00 a year to provide warm houses with stoves and heating apparatus; another $100.00 a year for coal, extra clothing, bedding, etc., to keep warm; a third $100.00 is lost by food freezing and the expense of protecting the food we use; another $100.00 is lost by enforced idleness and sickness; $400.00 a year apiece. That makes a total of 200 billion dollars a year that could be saved. Then think of the immense areas that would be made available for habitation; think of the increased production and ease of transportation; think of going from here to Asia via the North Pole instead of half way around the world. The increased production and saving combined would amount to more than a thousand billion dollars a year.

Suppose we spent 100 billions a year and destroyed 100 billion tons of ice the first year while the sun destroyed 200 billion tons; not realizing man had helped, the sun would be proud of having done so much extra, and make such a mild winter that very little snow would fall, and it would be ready to start in the spring right where it left off in the fall and work so hard, that 400 billion tons of ice would melt; this would encourage the glacial army men, and they would double their efforts and destroy 200 billion tons, so encouraging each other, both would double the work done each year, so that in 12½ years all the ice would have been cleaned off both poles.

When all the polar ice was removed the sun's heat would all be used to warm the air, warm air rises, so the surface air would not increase in heat, but the warm air blanket on the Earth would increase in thickness and snow caps and glaciers on mountain tops would have to melt, then we would have sight-seeing trips to the top of Mt. Everest every day.

During the six months' polar day, the Earth at that pole would receive more heat during each 24-hour sunshine day than the equator with only twelve hours' sunshine, so all the excess heat of the day pole, as well as the excess heat at the equator would have to flow to the night pole to find air cool enough to keep up circulation so the night pole would be kept warm and temperate during the six months' night, there would be no extremes

of temperature and no rapid flow of air from the tropics to the poles or in any other direction, and no violent storms anywhere on the Earth.

When man has restored this wonder world to its pristine glory, as regards temperature and storms, he must make use of its interior heat to produce wireless electric power more subtle than fairies' magic to grant his every wish, he must use artificial lights to keep crops growing twenty-four hours a day and every day in the year to feed the multitude, the Sahara and other deserts must all be made into imperial valleys, in California more than anywhere else, poor people enjoy luxuries today, because its people have made intelligent use of Nature's willingness to improve herself; with more general help of man's intellect, Nature will perform greater wonders in the future than when she made coal and oil in the Carboniferous Age, or metals and chemicals in other prehistoric eras.

Some hold up their hands in holy horror, saying, "Would you try to improve God's handiwork?" What man does not try to improve himself? According to Genesis, God's object in forming man was to give him dominion "over all the Earth," among his first words to man were "replenish the Earth and subdue it." But man did not understand, he ate the dope apple and is just awakening from his long sleep. You see the Earth had been knocked cold by the Glacial Period and God wanted man to nurse it back to health and get its air-skin warmed up again; its time man got busy and started to obey orders, the Earth is nearly well, the Sun keeps a hot water bag on its equator, man's job is to scrape the ice off both polar feet, then the Earth will get up and put on all kinds of glad rags for man's pleasure and profit.

Radio on Aircraft

(Continued from page 49)

cult to radiate a large amount of power from an airplane transmitting station. Transmitting sets are available on the commercial market which perform fairly satisfactory service. In this connection the decision must only be made as to whether telephone or telegraph signals are desired and, in the latter case, whether undamped waves or damped waves will be most suitable. The power which can be used cannot depend so much on the distance which it is desired to cover as upon the size of the plane and the resulting capacity of the antenna which it is possible to install. Any deficiency in power must be made up by increasing the sensitiveness of the receiving set. More than usual care must be taken in the design of apparatus which will withstand the constant vibration of airplane service. For example, connecting wires should be welded or hard-soldered in place.

Airplane Height Given by Radio.

The uses to which wireless is being put on aircraft apart from ordinary communication are yearly becoming more impressive. The latest idea is to use wireless for informing the airplane pilot of his exact height above the ground. Two methods are under consideration. The first makes use of the noise of the engine, which is caught in a series of microphones on the ground, enabling the height of the machine to be ascertained and transmitted to the pilot by wireless. In the second use is made of a proximeter, which acts upon the principle that when electrical oscillations are set up in a circuit, the frequency of these oscillations depends upon the electrical capacity and inductance of the circuit.—*Lieut. G. H. Daly, D. S. M.*

Simplest Radiophone Receiver

By H. L. JONES

(*Continued from page* 51)

to points, but if both are carefully scraped a good electrical connection will be obtained.

Detector

At a stationery store purchase four window hooks. Two of these are used to make the detector and the other two with the long end cut off are used as clips to vary the inductance as shown in drawing. The drawing and photographs show the general arrangement of the detector. One window hook holds the crystal. The other holds a short end of a pencil with a rubber eraser. The cat-whisker wire is stuck thru the eraser and allowed to project about an inch. The other end of the wire is looped a few times around the pencil and fastened to the window hook. By rotating the pencil the cat-whisker wire can be made to touch the crystal. If galena is used a copper wire of about No. 30 B. & S. gauge should be used. Galena requires a very light contact. The two hooks that form the detector are fastened to the wood base with small wood screws. One end of the crystal holding hook is bent in a loop to hold the telephone wire terminals. If ordinary insulated wire is used to connect the telephone the ends may be secured under screw heads. One of the long ends cut from the hook used to vary the inductance forms the other telephone terminal. Purchase galena at a radio store.

Telephone

The telephone receiver must be of at least 1,000 ohms resistance and should be purchased from some reliable radio shop.

Telephone Condenser

A condenser shunted across the telephone is not absolutely necessary but they are easy to make and improve the working of the receiver. Purchase a mica stove window size 3x3 and cut from it a circle 2⅞" in diameter. From a piece of tinfoil cut two circles 2½" in diameter with a tongue ⅜" wide and 1" long. Hold the tinfoil pieces by the tongues and dip them in melted paraffin, be careful not to get any paraffin on the tongues. Lay one of the pieces of tinfoil on the mica circle as shown on the drawing. Warm a flat iron so it will just melt the paraffin and turn it face up. Lay the mica on flat iron with the tinfoil up and as the wax melts you must smooth the foil until it makes good contact with the mica. Fasten the other piece of foil on the other side of the mica in the same manner. Give the base a light coat of shellac and when it is still a bit tacky lay the condenser in place and smooth it down.

Operation

Connect up the apparatus as shown in the diagram taking particular care that all electrical connections are clean and bright. Place the crystal in place and rotate the pencil until the cat-whisker touches crystal. You will have to move the cat-whisker about until you find the most sensitive spot.

The usual method of testing the adjustment of crystal detectors is to connect up a buzzer and push button with one or two cells of dry battery. One binding post of the buzzer is grounded. When detector is adjusted properly you will hear the sound of buzzer in phones. If your house is equipped with an electric door bell have some member of the family push the button while you adjust the detector. Having adjusted the detector move clips about until you hear signals. It is well to avoid handling crystal with the fingers and if your crystal gets greasy from the fingers it may be washed with carbon disulphide or alcohol.

Radio Constructor Hints

By WINFIELD SECOR

(Continued from page 70)

outer leads are soldered to the short brass shafts, the ends of which should just project thru the wooden bobbin ring. The proper size of bobbin to use is determined by the primary tube and should be as large as possible, without striking the tube when mounted on its axis or shaft. The external secondary leads are of flexible cord and soldered to the two brass shafts.

The wave length of the secondary circuit is invariably tuned sharply by connecting a variable condenser across the secondary winding, and the wave length is also affected to some extent by changing the mutual induction between the primary and the secondary, resulting from rotating the secondary coil to different positions in the magnetic field within the primary tube.

Home-Made Audion Rheostats

Audion rheostats are sometimes a troublesome little item in our expense budget, and they can easily be made of various odds and ends to be found about the home workshop. The wire spring found in old shade rollers, or the spring frequently found in sleeve armlets, can be effectively used for this purpose. Fig. 4 gives an idea for two different types of rheostats which the home constructor can build. Bakelite, asbestos or slate are good materials which will stand a high temperature, and on which the wire used for the resistance can be wound. In scheme A, Fig. 4, we see how several manufacturers of radio sets build their rheostats. It comprises a small strip of slate wound with several feet of resistance wire, such as German silver or Climax, a thin spring brass or phosphor bronze switch blade being secured to a knob and shaft which can project thru the switch panel, and by turning the knob, the switch blade (behind the panel) moves over the successive turns on the resistance grid, thus varying the filament current. A similar rheostat, but provided with a slider, is shown at B, Fig. 4, while the idea illustrated at C shows how some manufacturers wind the resistance wire on a fibre, asbestos or mica strip, which is flexible enough to fit into a slot cut out of a piece of slate, fibre or bakelite, a switch blade being secured to a shaft with knob, pointer, etc., so that successive turns of wire can be cut into or out of circuit. It is useless to specify the number of feet and size of wire to use for these rheostats in most cases, as the amateur who likes to "build his own" will usually employ the wire which he happens to find at hand, and the resistance of each kind of wire varies widely of course. The standard to go by is simply to use enough wire in the rheostat and the proper size so that it will not become too hot, and also it should regulate the brilliancy of the V. T. filament from a dull red to full intensity, when the wire is all cut out by moving the slider or switch blade.

Carbon rheostats have been used a great deal in experimental work, and while the carbon grain or crushed carbon rheostat of the compression type is not advised for audion control circuits, the carbon disk or compression plate rheostat shown at Fig. 5 would seem to work out very well for the purpose. About a dozen carbon disks, either round or square, and about 2" or even less than this in diameter, are arranged in a wooden or other frame with a ⅛" metal

plate at one end, against which the compression screw turns. The knob fitted to the screw may have a pointer reading over a scale, and the resistance of the rheostat is varied by compressing the carbon disks more or less. Where a number of carbon diaframs, such as those used in microphones are available, these may be used in building the carbon rheostat, a semi-cylindrical wooden frame being constructed, as shown in Fig. 5, to hold them.

Grid Leaks and Condensers

Probably most of us will prefer to buy our grid leaks and condensers or the combined units, but a few words on this subject may not be out of place. The simplest grid leak is made by drawing a pencil line on a piece of paper and fastening the ends of the paper strip to the wood of the cabinet or instrument base with wood screws, with copper washers under the heads, to which the circuit wires can be thus attached firmly. A common size of grid condenser has a capacity of .00025 M. F. If paraffined paper six-thousandths of an inch thick is used, the paper being always somewhat larger than the tinfoil, then two tinfoil or copper leads 2"x1" will be sufficient to give this capacity. Two pieces of copper leaf or foil are cut or bound in the two ends of the condenser leaves, as shown in the detail at Fig. 6. Two other pieces of paraffined paper should be cut out, or three in all, the two copper or tin foil leaves being separated by the central paraffined paper sheet, and the three are then rolled around the mica or cardboard strip and tied in place with a piece of string. The tinfoil and paper leaves should be wound tightly around the paper strip, and preferably placed under several books until they have firmly creased and set. A pencil line may be drawn thru a scratch in the mica, or if a piece of cardboard is used, a pencil line is drawn between the two metal eyelets, as shown.

Charging "A" Storage Battery at Home

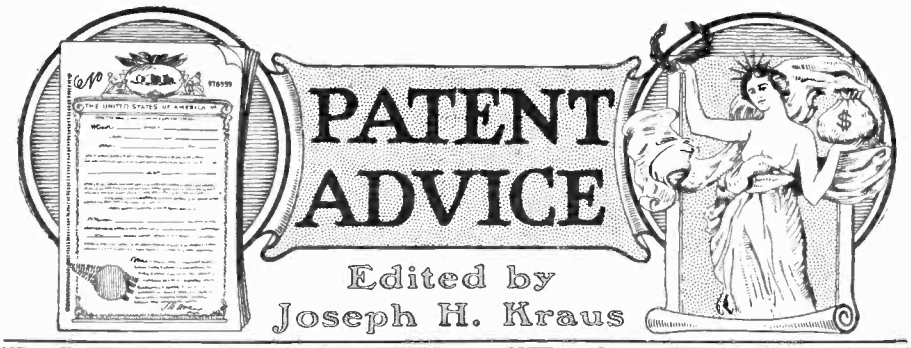
Some radio experimenters have their "A" or filament storage battery charged at their local automobile garage about once a week or once every two weeks, depending upon whether the audions are used every night or not, while others charge their battery at home. Where direct current lighting service is available at home, the battery may be given a good charge over night by simply connecting in series with it a 500 to 600-watt electric sad iron, taking care to set the iron on its ventilated metal stand or providing otherwise against any wood or other inflammable material taking fire, for the iron will get very hot after several hours in most cases. Mr. H. Gernsback, editor of this journal, charges his audion "A" battery in this way and finds it very satisfactory.

Care must be taken to connect the positive wire from the lighting circuit with the positive pole of the battery. The proper polarity may be determined either with a polarity indicator, purchasable from any electrical supply store, or by the simple expedient of sticking two wires into a glass of water containing a little sulphuric acid or salt. The wire giving off the most bubbles is the negative one, while the opposite wire is the positive.

When freshly charged and with the audions burning, the battery will usually read 6.9 to 7 volts, or about 2.3 volts per cell. When the cell volts read 1.75 with load connected on discharge, the battery should always be recharged.

ADDRESS WANTED!!

The editors desire the present address of Philip Bilisoby, who contributed articles to this journal some time ago.



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Sled Brake

(581) Harold E. Adams, Middlesbow, Kentucky, asks us for an opinion on a sled brake, furnishing us no details whatever.

A. In view of the fact that you have not described the brake, we cannot give detailed counsel. Several make-shift brakes have been devised which could be used upon sleds. Nevertheless, if your idea is good, and can be made attachable to any sled, we believe that there should be quite a favorable sale for it. One thing necessary, is that the brake must absolutely stop the sled, whether the sled be traveling on ice or snow.

Phonograph Record Idea

(582) Corbet Cooper, Beaver Dam, Ky., submits a drawing of a phonograph record, in which the last groove of the recorded voice or music communicates with a wide spiral groove terminating near the center. He claims this is more efficient because automatic phonographic stops do not have to be set with such a record. He requests our opinion.

A. We would advise that you order from your local phonograph store a new Connorized or Brunswick record.

You will find that the idea which you have advanced is already in actual practice, and has been for a great many months. Therefore, we do not believe you can secure a patent on the same.

Solenoid Generator

(583) George Anderson, Ocean, Maryland, enters a description of a solenoid generator in which a coil of wire is moved in and out of a hollow permanent magnet. He asks our advice.

A. With regard to your recent communication requesting patent advice, we would state that the idea advanced by you is not entirely new. Plunging a magnet into a coil of wire, or changing the flux across a magnet upon which has been wound quite a few turns of wire, does not give sufficient power to warrant the construction of such magneto. Reversing the process, viz., plunging a coil into a magnetic field, does not improve matters. We see absolutely no hope of a suitable market.

Flashlight

(584) J. Wilbut Boorse, Lansdale, Penn., enters a description and drawing of a battery flashlight of the lantern type. He asks our opinion.

A. Altho your idea for an electrical lamp is quite practical from a commercial standpoint, we cannot see a favorable market for the same.

There is no doubt but that you can patent the system, altho we would advise a search first. Nevertheless, we do not advise such patent upon any flashlight, unless it is of exceptional design, or construction, which exception is not found in your system.

Perpetual Motion—Again

(585) Jack E. Blake, Cincinnati, Ohio, submits a sketch of a perpetual motion machine, in which an endless chain of buckets enter a compartment of water. Valves opening at the bottom permit the buoyant buckets to enter, but prevent the escape of water.

A. This device will not function as described. A bucket rising in water must first overcome the friction of the valves at the bottom of the container, thru which it is to enter. The bucket must likewise lift a volume of water equal to a column the entire length of the container, and of an area equal to the surface of the bucket. Meanwhile, there is a tendency of the water to fall out alongside of the bucket. This tendency is compensated for by the valves acting upon the sides of the bucket, which were primarily designed to prevent the water from escaping.

If this system is so arranged that the maximum possible efficiency will be developed, it will just balance. If not, the direction of motion will be in the opposite direction to that intended by you, until all of the water has escaped from the container. Due to the valves, however, this movement will progress no further than the distance separating two adjacent air pockets. In order to secure a patent on any perpetual motion machine, a "working model" must now be submitted to the patent authorities at Washington. Do this, and they will talk to you about a possible patent.

Kewpie Lamp

(586) P. F. Czwalinski, Chicago, Ill., asks: "Can I use the usual Kewpie Doll and fit a lamp and shade to it without incurring anyone's enmity?"

A. The conventional Kewpie Doll design is fully covered by copyrights, and any attempt to use this doll in conjunction with a lamp shade and lamp would necessitate the payment of royalties to the original designer. Nevertheless, the doll could be so changed as to be different from the copyright claims and perhaps find a market just as readily.

Sanding Board Vibrator

(587) Kenneth B. Cowan, Colussa, Calif., submits a drawing of a sanding board in which 60-cycle alternating current fed to two electro-magnets acts upon a permanently magnetized armature. This armature, pivoted at its center, is coupled to a large sanding board at its far end. He asks our opinion of the device.

A. Altho the idea which you have devised is perfectly possible and feasible, relative to its principle, the drawback is that the armature (permanent magnet) will vibrate so rapidly that the sanding board will stand practically still. With this particular device the momentum of a heavily weighted sanding board would scarcely permit it to vibrate in synchronism with 60-cycle alternating current. Hence, altho theoretically possible, the system is not practical enough to warrant further action, we believe.

Radio-active Vacuum Valve

(588) Earl R. Craven, Grand Junction, Calif., asks: "Can I secure a patent on a vacuum tube in which the filament is replaced by radio-active material?"

A. No, you cannot secure a basic patent on this idea, as such a tube is already covered by patents. It has not been placed upon the market yet.

Sun Motor

(589) Kenneth R. Brooks, Cleveland, Ohio, enters a suggestion for a solar engine in which

a bulb filled with mercury communicates directly with a corrugated tube also so filled. This mercury expanding, when acted on by heat, causes the tube to extend and so develops power. He asks our opinion.

A. Altho your idea is feasible, we do not see what you can gain by such a contrivance. It is of necessity very expensive, and unless made in large proportions will develop about two or three fly-power. If made still larger, say about 18 to 20 inches in diameter, each bulb might develop 1½ mouse-power, but the additional amount of mercury in these bulbs is not by any means so small. In addition, mercury, being a metal, absorbs heat quite readily, and the result is that the contents of the bulb remain heated for quite a while. This, therefore, precludes the possibility of rapidly heating and cooling the contents of the bulbs by shielding them intermittently from the sun's rays. When night time comes on we suppose—well, we had better not make any supposition! A far better method is the thermal expansion of various metal rods.

Transmitting Key

(590) Wm. H. Christianson, San Francisco, Calif., submits a sketch of a peculiar *Key* for wireless transmission, which acts on the principle of a motor-driven typewriter. A cylinder with raised brass contacts is constantly rotated and each individual key closes the circuit when depressed thru the raised contacts. Interlocking means prevent more than one character being depressed at a time. He asks our opinion.

A. The general design and methods of starting the key at just the right spot so that the character will not be broken into as the key is depressed at any point of revolution of character cylinder is not good. We would hesitate at advising a patent.

Parachutes

(591) Robert A. Dematur, South Pasadena, Calif., asks us for authentic information on all parachutes patented in the United States.

A. Real authentic information on parachutes could be best supplied by the U. S. Patent Office, at Washington, D. C. Just ask them for the list of patents dealing with parachutes, and then purchase these at ten cents per copy. This will give you a complete record of all parachutes devices in United States which have been patented here.

Air Release for Blow Torches

(592) C. Dirksen, Dubuque, Iowa, claims that many gasoline blow torches are damaged by tightening the needle valve too much. He desires advice on a pump valve which would permit of the release of this air.

A. A needle valve, altho not absolutely essential, is a very valuable asset in all gasoline torches. If you placed an air valve upon the torch so that the air pressure within the torch could be released at will, the danger of an explosion would be quite great should you release the air while the torch is in operation, inasmuch as the air within the torch is well saturated with gasoline. This could cause a flame to strike back and light up in the vicinity of the air outlet, causing a severe burn. If, on the other hand, the air opening was considerable so that it may be released suddenly, a flame might strike back into the container and result disastrously. If your opposition to these suggestions is that the flame could first be turned off, then the torch will have no practical value, in that the same can be done with torches now on the market, with the exception that the torch must be inverted and the valve opened again. Before starting on any patent proceedings for this device we would suggest that you give it at least six months' trial.

Flue Gas Smoke Precipitators

(593) Henry Hasson, New York City, claims to have originated a device for the precipitation of chimney gases for factory use, which is very cheap and creates a forced draft at the same time. This draft can be regulated. He assures us of absolute precipitation. He asks our advice. He also wants to know whether any legislation has ever passed an ordinance making flue smoke prohibitive.

A. In Chicago such an ordinance is in effect; here smoke must be prevented and all smoking chimneys are fitted with electrical smoke precipitators. If your device does what you claim it will, and you can secure enough financial backing to warrant its exploitation, we would advise that you secure a patent upon it.

Auto Brake Lock

(594) Anthony DeToro, Bridgeport, Conn., submits a suggestion of a brake lock for automobiles in which a ratchet arrangement alongside the hand brake is pulled down to engage in a toothed rack and lock in this position. He asks for our opinion.

A. Frankly speaking, we would not advise a patent upon your automobile brake lock for the simple reason that it would be a very easy matter to bend part of the brake lever, at least enough to pull the ratchet away from the cogs or toothed arrangement upon which it depends for its safety. Such a brake lock will not entirely meet the demands of insurance and fire underwriters, because the rear wheels are locked against any movement of the machine whatever.

Radio Explorers

By ROBERT C. PARKER

(*Continued from page 20*)

never been any code invented that can't be deciphered, and besides it took a lot of time to change the message into code before sending it and to change it back again after it was received.

"Thinking about this one day I got the idea of making a wireless set to operate on so short a wave length that the enemy stations couldn't receive it. I had to design an entirely new set of instruments, and it took a lot of hard work, but I finally made an outfit that could send and receive waves from one-tenth to one-half a meter long. The outfit wasn't much good for the purpose I had made it, because it couldn't be made to send much more than a mile, but it gave some results that I hadn't expected at all."

He paused to shake the ashes from his cigar. As he talked I had changed my opinion of what he was after. As I have said, I thought at first that he was selling oil stock. Now I was convinced that he intended to manufacture some freak radio invention and wanted financial backing. Again I was mistaken.

"I didn't use a regular aerial with the instruments, simply a coil from which the waves were generated and on which they were received. For convenience I used separate coils for the sending and receiving systems. Later I found that an insulating material would cut off the waves entirely, so I placed a small plate of bakelite between the two coils and left both of them connected up all the time.

"I was surprised to find, however, that while the plate was opaque to the waves we usually used, there were certain lengths of wave that seemed to go right thru it. On further experimenting I found that the waves were really being reflected back to the receiving coil from metal objects near the instruments. I found too that just as objects reflect light of a certain color, every metal *reflects waves of a certain length.*

"I've improved the instruments a lot since I left the navy," he went on. "Now I have them so sensitive that I can detect the presence of any metal if there is a pound of it within twenty feet. If there is more of it I can tell that it's there much farther away than twenty feet."

"Henry," I said, "what you've said may all be true, but I guess I'm hard headed. I'll have to be shown."

"All right," he answered, "I can show it to you tonight."

As he said this he got up and started toward the door, I following him. We put on our hats and started out.

"I'm going to take you to my house," he said, in answer to a query from me. "I'll let you test the machine for yourself and see if it's all that I've said."

When we reached his house he took me up to his room and showed me the instruments. I couldn't see anything of the works because both the sending and receiving instruments were enclosed in cases. I was to bring into the room any metal I wanted to and he was to tell me what the metal was.

Then a difficulty presented itself. Neither of us had any metal about us except those kinds which are always found about houses. I had some silver coins and a brass belt buckle, but there was sure to be more of the same substances near enough to influence the apparatus.

However, I found a solution of the problem. There was a drug store near where I knew one of the clerks. I went there and asked him to give me samples of any rare metal he could find. He took me into the back of the store and between us we picked out cerium oxalate, barium

sulfate, strontium nitrate, and bismuth subnitrate. Then I remembered that Henry hadn't said anything about the machine being able to detect metals in the form of salts. The only thing I could do was to call up and ask.

"Sure," he answered, "it'll detect salts as well as free metals."

I took the samples back to his room and told him to do his best. I didn't really believe that he could find out what the metals were, but I was willing to let him try.

He placed the boxes containing the instruments on one side of the room and put the phones on his head. On the top of each box was a graduated dial and on the one containing the sending apparatus there was a switch. He closed the switch, remarking that it simply turned on the current, and began to turn the dial slowly. He told me that he was starting with a short wave length and increasing it gradually.

I stood on the opposite side of the room with the vials containing the salts in my pocket. He kept on turning the dial slowly. Suddenly a smile came over his face.

"Strontium," he said.

He went on turning for a second or two more and added, "Barium." Then, almost at once he said, "Cerium, too."

Again he turned for a while in silence and then added, "Bismuth."

He kept on turning until the dials had made a complete revolution.

"That is all," he said. "Am I right?"

I jumped to my feet and shook his hand excitedly.

"Old man," I exclaimed, "forgive me for doubting what you said. Why you don't realize what that machine is worth. With it you can analyze any alloy. You ought to patent it and start manufacturing them at once."

He smiled and shook his head. "No, Herbert, it's you who don't realize or you wouldn't talk of patenting it and manufacturing them. That would give the secret away."

"What do you mean?" I asked. "Why do you want to keep it a secret?"

"That's what I wanted to talk business to you about."

I had forgotten that he had come on business.

"I'm going to make you a proposition," he continued, "and whether you accept or not I'll have to ask you to keep it a secret. Will you promise not to tell a soul about it?"

"Fire away," I answered, "I think I can keep a secret; at least for an old friend."

"Herbert," he began, "I guess you know something about the Inca Indians who used to live in Peru. You've probably heard the stories about how much gold they had when the Spaniards conquered them. After I invented this apparatus I took the trouble to look into some of these stories. I hunted up all the material I could get and came to the conclusion that the stories are really true. But the question is, what became of the gold? The stories all agree that the Indians, to spite the Spaniards, hid their gold in caves in the mountains. This seems pretty probable because from time to time small collections of gold have been found.

"Of course you see that with these instruments it would be a simple matter to locate gold, but the main difficulty would be traveling over the mountains. The solution is to use an airplane. That is why I wanted you; you are the prospective pilot."

He stopped as tho he expected an answer. I thought for a minute.

"What about the plane?" I asked. "Where can we get that?"

"That's all arranged. I've saved a good deal of money and we can buy one with that."

(*Continued on page* 86)

Meeting the Demand for Radio Sets

IT is natural that broadcasting, *carrying news, music, lectures, concerts and even grand opera* into the homes of the American people, should have created a concerted and impatient demand for radio sets and apparatus—especially the popular radio receiving sets.

If the demand for radio sets and apparatus had grown normally, the well-equipped and highly-organized factories supplying the Radio Corporation of America would now be producing an excess over the market requirements.

Under the present expansion program of the Radio Corporation of America it is quite possible that there will be a surplus production within six months.

A Greatly Expanded Program

The factories manufacturing for the Radio Corporation of America are operating on a greatly expanded production program. *They are straining every nerve and muscle to meet the demand.*

It is not merely a question of men and raw materials. There are limiting factors in some of the delicate equipment parts, and even when all production is running evenly, new jigs, dies and tools must be especially designed, manufactured and installed before the production forces can be increased.

As a result of the efforts that are being made, it is expected that within the next few weeks considerable quantities of material will be shipped on orders already placed. This applies to all classes of radio sets and apparatus, and especially Radiotrons, Vacuum Tubes, etc., which are employed for reception.

The assurance can be given that every scientific, manufacturing, organizing and financial resource of the Radio Corporation of America is being used to meet the demand for radio devices.

We are working to the utmost, not merely to supply the demand, but to put into every set and every piece of equipment complete quality, and as much permanent satisfaction as a rapidly developing art will permit.

We are asking the aid of our distributors and dealers in explaining the capabilities and limitations of radio sets and apparatus, and we welcome their co-operation and indulgence, as well as that of the public itself, until the present expansion program is carried out.

A new R. C. A. Catalog, covering all the radio devices being manufactured for the Radio Corporation of America, will be ready for distribution within thirty or forty days. This catalog will contain timely and helpful information of great value to the wholesale distributor, the retail dealer, and the user of radio apparatus.

Radio WORLD WIDE WIRELESS Corporation of America

Sales Department, Suite 1805
233 Broadway, New York City

Radio Explorers

By ROBERT C PARKER

(*Continued from page* 84)

I realized that this was the turning point of my life. If I went with him I might gain untold wealth or I might lose everything, possibly my life. But I was young and eager for adventure, so it didn't take me a minute to decide.

"All right," I said, giving him my hand. "It's a bargain."

Three months later we were in Peru and had established ourselves in the little town called Puno as a center of operations. Puno is on the southwestern shore of Lake Titicaca and was the only town of any size at all near the mountains that we intended to explore.

We had spent the three months in selecting and trying out an airplane, testing the instruments to make sure that all was as it should be, and in studying the country we were to explore.

We had purchased a splendid Handley-Page plane and Henry had built the instruments into it. He had found that they were more sensitive when the sender and receiver were separated a short distance, so he had placed the wave generating apparatus in the back part of the plane and mounted the receiver in the front under the seat he was to occupy. Near the sender there was an insulating screen to keep the waves from going directly to the receiving instruments.

He had arranged the sender to alternate between the waves reflected by silver and those reflected by gold, so that if there was some of either metal near he could hear an intermittent note and if both were present he could hear a continuous note. All that he would have to do was to put on the receivers and listen. Of course he had to use a sound proof helmet, such as they used in the air service during the war, to keep out the sound of the motor.

We were quite a curiosity at Puno. Americans are scarce there and airplanes were unknown. Whenever we took the machine out for a flight the business of the town stopped while the people watched us. There was one trait of their character that helped us a great deal: the South American never asks questions about things that are none of his business, so we were never troubled by requests for information.

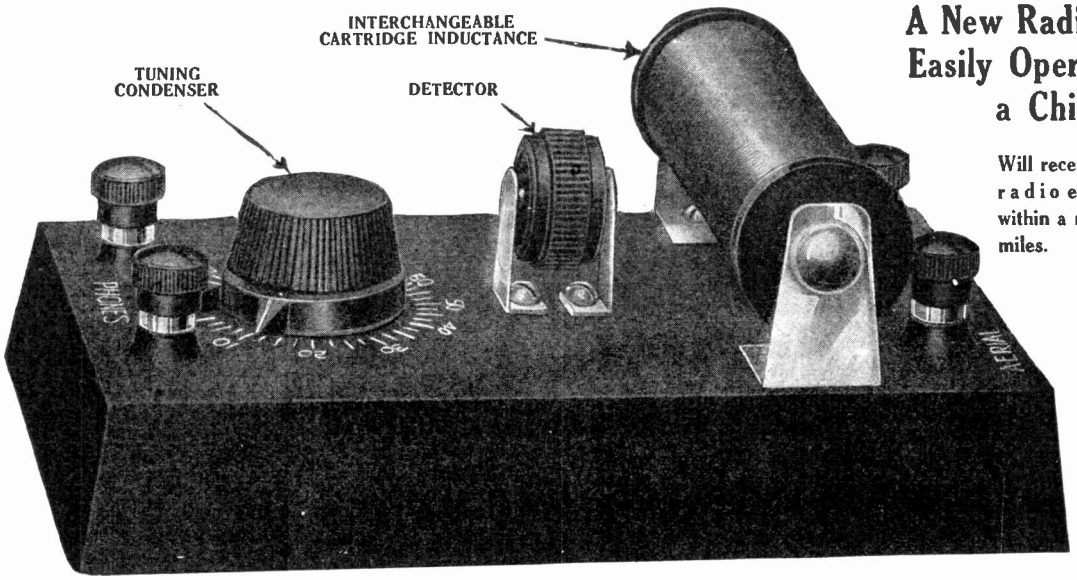
When we arrived we had taken rooms in a hotel and rented a large barn in which to keep the plane. Then we started the work of unpacking the plane and putting it together. Of course we had taken it to pieces to ship it. Altogether, it was three weeks before we had everything adjusted and ready for flight.

In order to make doubly sure that the instruments were all right we tried them out, over the city. Flying at a height of three hundred feet Henry's phones buzzed every time we came within a quarter of a mile of one of the banks of the town. We felt certain that everything was all right.

Finally the great day came when we were ready to start our exploration. We circled around the end of Lake Titicaca to the mountains on the other side and began to follow the mountain chain to the northeast. I kept the plane low; not more than two hundred feet from the ground. Henry listened intently for any sound in his phones and I kept my eyes glued to the landscape, the map, and the compass. In a strange country without many land marks, such as this was, it would have been very easy to get lost.

We had followed the range about seventy-five miles when Henry tapped me on the left shoulder. This was the prearranged signal to turn back. A tap on

(*Continued on page* 88)



A New Radiophone Easily Operated by a Child

Will receive broadcast radio entertainments within a radius of fifty miles.

PATENTS PENDING

Price $12.50

(Without Phones)

NATIONAL AIRPHONE

(MODEL G)

This set has been perfected by experts in the design of Radio Receiving Apparatus—to meet the very exacting requirements that the most recent developments in the Radio Art have made necessary.

Outstanding Points of Superiority:

1. Most Compact Radiophone Receiving Set Made: 6½" long, 4¼" wide, 2¾" high,—small enough to put in coat pocket or desk drawer.

2. Rugged construction throughout, nothing to get out of order, insuring long life in service.

3. Entire casing constructed of hard rubber composition. No wood, no warping, no losses through leakage.

4. Ultra-sensitive Foolproof Detector; entirely enclosed in composition case. Air and dust proof, no fussy minerals, no Catwhisker, no balls nor spring. To adjust for maximum sensitivity simply rotate the black disk slowly.

5. Elimination of all switches, current taps and switchpoints prevents loss of electrical energy.

6. Use of interchangeable cartridge coils gives wide range over which radiophone broadcast or radio telegraph signals can be heard. 25 miles or over for radiophone concerts; up to 1000 miles for telegraph signals depending upon coils used.

7. Two Cartridge tuners, wave length 150 to 400 meters supplied with each outfit, one takes in general broadcasting stations (360 meters), the other from 500 to 1000 meters.

8. Variable Mica Condenser used is acme of simplicity—high capacity, impossible to short-circuit.

9. Anyone without previous experience can operate a NATIONAL AIRPHONE, no delicate adjustments necessary, no fussing.

We are now ready to assign territory to Jobbers and Dealers who will appreciate the advantages of a well designed serviceable and efficient outfit.

TRADE MARK NATIONAL AIRPHONE CORPORATION REG. U.S. PAT. OFF.

16-22 Hudson St.
NEW YORK

Radio Explorers

By ROBERT C. PARKER

(Continued from page 86)

the right shoulder meant to make a landing. I turned the machine around and started back, following, as nearly as I could, a route parallel to the one by which we had come. Our plan was to fly back and forth along the range, so as to cover every part of it.

The instant that we landed I jerked off my helmet and turned to Henry. "What happened?" I asked. "Did you locate anything?"

He shook his head. "Not a thing," he answered. "Sometimes I thought I heard a very faint note, the way it would be if we passed over a very small amount of gold or silver, but it was probably only a vein of ore."

We were a little disappointed, but not discouraged. We couldn't expect success, we told ourselves, on the very first day.

The next day we went out again, following a course parallel to the one of the day before. Again we got no results, so that evening after we returned, we held a council of war. All the material we had been able to find seemed to show that the treasure we were seeking was somewhere in these mountains, but farther up the range than we had gone so far. We decided that the thing to do was to load the plane with as much gasoline as it would carry and make a two days' trip, camping in the mountains for the night.

Early the next morning we got out the machine and began to go over it. I was looking over the steering mechanism when Henry, who was examining the propeller, suddenly called, "Say, come look at this."

I came and looked where he indicated. In alighting the day before we had almost run into a bush and the propeller had struck it as the plane came to a stop. We had thought at the time that no damage had been done, but now we saw that one of the layers of wood of which the blades were made up had become unglued for about a foot at the end.

The only thing to be done was to try to make repairs and a propeller is a delicate piece of machinery. We ran hot glue into the crack, squeezed the pieces together and lashed them with tape. Then we had to wait for the glue to set. That would take a day at least and we were beside ourselves with eagerness to be moving, but it had to be done.

We spent the day looking over maps that we already knew by heart and inspecting every part of the plane. The next morning the glue was hard so we sandpapered the surface smooth and gave it a coat of varnish. Everything else had been prepared, so without waiting for the varnish to dry, we started up the motor and were off.

We were making about ninety miles an hour, so almost before we realized that we had started we were a hundred miles from Puno and on the northeastern side of the range. Then, for the first time, I noticed that the wind was rising. It was coming from the north and was blowing anywhere from thirty to fifty miles an hour. It's hard to tell when you're traveling ninety miles an hour yourself.

The wind struck us at an angle to our course, so that the plane drifted sideways. That meant that we could not depend on the compass to tell us which way we were going. I had a good map of the country, but I had been depending mostly on the compass, so that now, when I looked at the map, I had only a general idea of where we were and I couldn't find a single landmark to show our location.

I kept on trying, alternately searching the map and the landscape, and the wind

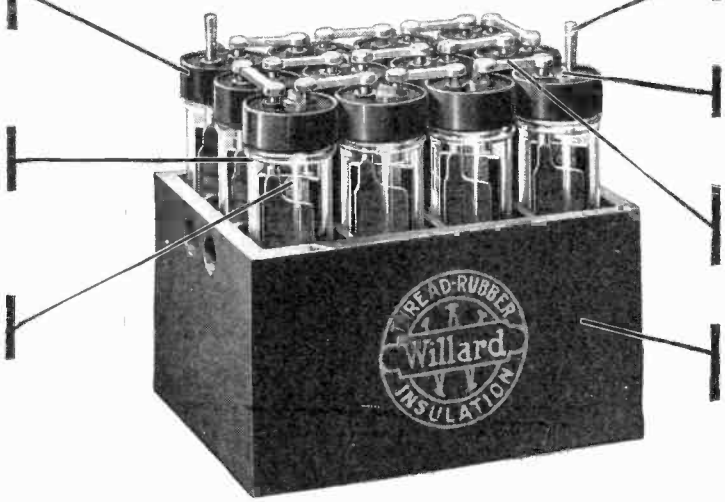
(Continued on page 91)

A Real Radio "B"
24-Volt
Storage Battery

Rubber Screw Caps seal jars tightly. No seepage between jar and cover.

Glass Jars. Leak-proof. Allow clear view of solution-level.

Threaded Rubber Insulation protects the plates.



High terminal posts permit ample room for clamps.

Rubber vent plugs—easily removable.

Connectors heavy enough to provide firm grip for clamps.

Heavy Oak Case. Coated with Acid-proof paint.

Built especially for radio reception—to bring in voice, music and signals, louder, clearer and with greatest reliability. Rechargeable—will last for years. Made up of 12 individual 2-volt cells in tubular glass jars. Separate cells are easily added to increase voltage. Threaded Rubber Insulation and leak-proof glass jars eliminate all frying and hissing noises.

Ask about the Radio "A" Battery of the special Willard All-Rubber Radio Type. Eliminates all ground noises. One piece rubber case. Threaded Rubber Insulation. Absolutely leak-proof.

WILLARD STORAGE BATTERY COMPANY, CLEVELAND, OHIO
Made in Canada by the Willard Storage Battery Company of Canada, Limited, Toronto, Ontario

THREADED RUBBER BATTERY

Willard

"RASCO HAS IT!"

THE Radio Specialty Co.—"Rasco" for short—is probably the most unique supply house in the United States, if not in the world to-day. This company makes a specialty of small orders, no order being too small to get immediate and prompt attention for the simple reason that most of our orders are small.

The reputation of this house was built upon service. Ask any of your acquaintances what they think of Rasco goods, Rasco service, Rasco promptness!. Thousands of unsolicited testimonials on file to prove that we serve the public best!

Be sure to get our great catalogue, containing several hundred different parts, which is illustrated below.

ORDER DIRECT FROM THIS PAGE. ALL GOODS SENT PREPAID IN 24 HOURS

1100

"RASCO" AUDID FREQUENCY TRANSFORMER

We have compared many of the present transformers on the market but have finally decided upon a type that is the most efficient one we have seen so far. The best amplifying transformer is that in which the impedance of its primary is equal to or exceeds the impedance of the plate-to-filament circuit of the tube in which it is connected.

We guarantee this transformer to equal any one on the market.

No. 1100 "Rasco" Audio Frequency Transformer (not assembled) each prepaid.....$2.65

ANTENNA CONNECTOR

This antenna connector is made entirely of aluminum, is light and will not rust. The only connector of its kind. The 4 antenna wires go to the upper holes; the lower hole takes the lead-in. Don't solder your aerial, don't have loose connections. Dimensions 2" high, 1¾" wide, ⅝" thick.

No. 999. Connector, each..$0.35

9-9

PANEL KNOBS

6241

838

No. 6241 is well made and has a good corrugation. Its dia. is 1", height is ½", hole 5/32". The shank is ¼" high.

No. 6241, Knob, each.....$0.06

MARCONI KNOB

Has a central hole of 5/32" and seat to hold the screw, dia. is 1¼", height ¾".

No. 838, Marconi Knob, each.....$0.15

RASCO POSTS

202 201 030 029

These are our very own patterns, from our own designs and look mighty handsome on any instrument. The top knobs are of composition, the bottom parts brass nickel plated polish.

650 651

No. 202 is nickel plated at bottom part.

"Rasco" Binding Post, 8/32 thread, each, $0.10; doz., $1.00.

No. 202, Post, each, ...$0.08

Nos. 650 and 651 made entirely in composition with a hexagonal brass nut in center.

No. 650 has 8/32 machine screw.

No. 651 has bottom wood screw.

No. 650, Post, each.....$0.08

No. 651, Post, each.....$0.08

Dozen, each style.....$0.90

BRASS NICKEL POSTS

No. 029, Binding Post, each.....$0.05

No. 030, Binding Post, each.....$0.04

RASCO SWITCH POINTS

75 1 2 3 4 5 6 7 77 76

Nickel plated and polished. The following have been found the most popular.

No. 1 ¼"x¼", 6/32 thread, ea., $0.03; doz., 35c

No. 2, 3/16" high, ¼" dia., 6/32 thread, ea., $0.03; doz., 35c.

No. 3, 3/16" x 3/16", 4-36 thread, ea., $0.03; doz., 35c.

No. 4, ¼" dia.; ⅛" thick; stem 6/32, ea., $0.03½; doz., 40c.

No. 5, ¼" dia., 3/16" thick; stem 4-36, ea., $0.03½; doz., 40c

No. 6, 3/16" dia.; 3/16" thick; stem 4-36, ea., $0.03½; doz., 40c.

No. 7, 3/16" dia.; ⅛" thick; stem 4-36, ea., $0.03½; doz., 40c.

No. 75, Switch Stop, ⅞" long, 4-36 thread, complete with nut, ea., $0.05; doz., 50c.

No. 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, ea., $0.03½; doz., 40c.

No. 77, same as above, but head is ¼" dia. x 3/16" thick, ea., $0.03½, doz., 40c.

1898

THE RASCO BABY DETECTOR

In presenting this little Detector, we feel sure that it fills a place never taken before by any small detector. It does a variety of things and does them all well and better than many $5.00 detectors. The base is solid, black composition. Mounted on same is a nickel holder and binding post which holds a flutted hard rubber knob with its sliding rod member.

The outstanding part of the Detector, is the patented nickel detector cup and binding post. The knurled cap unscrews and you place the Galena Crystal in the cup. then replace the knurled cap and the galena crystal is held secure. The circular hole in the cap exposes enough of the crystal for ordinary purposes.

No. 1898, Rasco Baby Galena Detector. Price, prepaid $0.50

No. 1899, Rasco Baby Detector with Galena and Radiocite Crystals. Price, prepaid.....$0.75

PANEL SWITCH LEVER

200

New style switch lever with lock fork. It is impossible for this lever not to make positive contact at all times. The blade radius is 1¼". Blade is nickel plated and polished. Fork is phosphor bronze. The lock fork holds the screw (in which it rotates), securely. A loose contact is impossible.

No. 200, Switch Lever, complete as illustrated..$0.30

LITZ WIRE

323

This wire is recognized as the only thing for winding coils for Radio instruments. Particularly recommended with our No. 343 Variocoupler Rotor, for vario-couplers, banked windings, etc.

No. 323, Litz Wire, 20 No. 38 strands, enameled double silk wire, per foot, $0.02; per 100 feet, $1.15

No. 890, Litz Wire, 10 strands No. 38 wire, per foot, $0.01; per 100 feet, $0.75.

No. 891, Litz Wire, 16 cables of three strands No. 38 wire, per foot, $0.03; per 100 feet, $2.25.

NOTE: This page contains only a few of our 300 specialties.

PANEL KNOB

815

This is a very distinctive knob and can be used on dials, panels, switches, condensers, etc. It is exceptional and well made. Dia. 1 1/16"; height 11/16"; comes with 8/32" bushing.

No. 815, Knob, each.....$0.18

VARIOCOUPLER ROTOR

343

This rotor is used by all up-to-date amateurs. Is accurately turned of hard wood and is used as a secondary coil. It takes any finish, either shellac or stain and can be drilled readily for any size hole. Large hole 2" dia. Width of spool is 2". Total dia. 3⅜".

No. 343 Variocoupler Rotor, each $0.75

827

"RASCO" NAME PLATES

839

Our name plates are of brass with a black background. Letters are polished nickel. Order by name and number.

	Each		Each
807 "Phones"	$0.05	810 "Ground	$0.05
809 "Aerial"	$0.05	812 "Primary"	$0.05
811 "Secondary"	$0.05	814 "Detector"	$0.05
813 "Audion"	$0.05	866 "On"	$0.05
865 "Off"	$0.05	840 "Increase Current" (Left)	$0.10
839 "Increase Current (Right)	$0.10	834 "Series"	$0.05
813 "Vacuum Tube"	$0.05	830 "Receive"	$0.05
831 "Transmit	$0.05	820 "2nd Step"	$0.05
821 "3rd Step"	$0.0	827 "Tickler"	$0.05
819 "1st Step"	$0.05	825 "Plate Variometer"	$0.05
826 "Grid Variometer"	0.05	835 "B Battery"	$0.05
823 "Secondary"	$0.05	817 "Output"	$0.05
836 "A Battery"	$0.05	824 "Primary Condenser"	$0.05
818 "Input"	$0.05	828 "Parallel"	$0.05
829 "Telephone"	$0.05	837 "+ —"	$0.05
833 "Detector Tube"	$0.0	841 "(Blank) "(takes pen or pencil writing)	$0.05
822 "Coupling"	$0.0		
808 "Load'g Coil	$0.0		

Price of all of our name plates in dozen lots, 50c, with the exception of the two "Increase Current"

BAKELITE PANELS

350-55

We list below six panels, the sizes of which have been selected after carefully checking up many dimensions of the most popular radio apparatus on the market.

Note particularly that our prices are anywhere from 25 to 50% lower than those quoted by most other concerns. The reason is that we buy these panels in very large quantities, **and we do not cut sheets to order.** Remember always that when sheets are cut to order they cost you at least 50% more than our prices, because **you must pay for the cutting and the necessary waste.**

Note also that we ship these panels prepaid. This alone amounts to a considerable saving.

No. 350	6"	x 12"	x 3/16"	thick,	each	$1.90
No. 351	6"	x 18"	x 3/16"	"	"	2.85
No. 352	9"	x 12"	x 3/16"	"	"	3.00
No. 353	12"	x 18"	x 3/16"	"	"	5.65
No. 354	6½"	x 19½"	x 3/16"	"	"	3.50
No. 355	6"	x 7½"	x 3/16"	"	"	1.20

"RASCO" LUBRICATED PANEL SWITCH

1921

A radio switch that has two nuts at the end is a monstrosity, for the reason that it will never stay put. Our patent spring fork holds the switch handle always under uniform tension, at the same time it insures the best contact possible. New wiping contact, which covers every point of the switch point. Another new improvement is the lock fork, which can assume three different positions to accommodate the switch to various thicknesses of panels.

No. 1921 "Rasco" Switch, as illustrated, each $0.50.

KNOBS

199 4451

These knobs are favorites with all experimenters The size of both is: dia. 1⅛", height ⅝". No. 4451 comes with 8/32 and 10/32 bushing.

No. 4451, Knob, each...$0.06

No. 199 (screw length ⅝") Knob, each $0.10

NAVY KEY KNOB

748

This navy key knob is now used on all standard wireless keys. It gives the right swinging mation and rests the fingers. It is a favorite with all advanced amateurs. Once used always used. The screw is 8/32 and will fit all keys.

No. 748, Key Knob, each.....$0.28

8032

THREADED BRASS ROD

We carry two styles. 6/32 and 8/32 thread. Only 6" lengths sold. No others.

No. 8032, Threaded Brass Rod 8/32 thread, per 6" length $0.08

No. 6032, Threaded Brass Rod, 6/32 thread, per 6" length $0.06

THE "RASCO" CATALOG

CONTAINS 50 VACUUM TUBE HOOK-UPS

Complete hook-ups of all important vacuum tube circuits are given in clear diagrams with complete explanation. Just to name a few. —The V.T. as a detector and one-step amplifier; regenerative circuit; De Forest ultraudion; V.T. to receive undamped and spark signals; Armstrong circuits; one step radio frequency amplifier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; V.T. radio telephone; 4-stage radio frequency amplifiers; radio and audio frequency amplifier, inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; etc., etc. The catalog contains 200 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of

15c in stamps or coin.

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This business was originated with the sole purpose to cater to the amateur who has small orders. ALL OF OUR ORDERS ARE SMALL and that is why your small order will never be sidetracked by us. A trial order will make you a life customer. Order from the above illustrations. "We can only stick you once." Try us with a 50c order. ALL GOODS PREPAID.

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Radio Explorers

By ROBERT C. PARKER

(*Continued from page* 88)

kept rising all the time. Suddenly Henry leaned forward, tapped me on the right shoulder and pointed straight down. I understood and looked around for a place to land. We were above a gently sloping mountain side then and to the right I saw a smooth spot where I thought I could land safely.

I turned the plane in its direction, keeping a careful watch as we sped toward it, for any possible obstructions. We settled to the ground with hardly a jar, rolled for a short distance, and were about to come to a stop. Then suddenly the back tipped up and the plane shot forward and downward. There was a loud crash and something struck my head. Green spots danced before my eyes. I tried to call to Henry; then suddenly I became unconscious.

When I recovered consciousness I could not at first remember where I was. Then it began to come back to me and I knew that I had been wrecked in an airplane.

Suddenly I wondered where Henry was. I ran to the plane and, stretched against the front of the cockpit, I found his body. He had been thrown forward when the machine stopped suddenly and his head had struck against the wooden frame of the fuselage, cutting a gash in his forehead. I listened for his heart beat, but I could find no sign of life. Apparently he had been killed instantly.

He was beyond help from me, so I gave my attention to the plane. The left wing and the propeller had been smashed completely and the motor had been damaged beyond the possibility of repair.

My headache had lessened somewhat by now and I could think more clearly. I must be somewhere east of the city of Cuzco. The distance might be from fifty to a hundred and fifty miles. There was nothing to do but try to walk to that city, and the prospect of a hundred-mile walk in these mountains was not inviting.

The first thing to consider was food. We had supplied ourselves well with food for one day. Eating sparingly, it might be made to last me for five days.

I walked over to the wrecked machine to take out the package of food and as I did so my eye fell upon the radio instruments. The box which had contained them had been torn open and the instruments themselves had been smashed beyond recognition. The sight of them, however, reminded me of what we had been looking for.

Henry had signaled for me to come down and had pointed to the ground below us. That could mean but one thing; he had detected some precious metal Before we had been wrecked I would have rushed with full speed to look for it, but the death of Henry and the blow on my head combined to rob me of the enthusiasm for gold. My head began to ache more violently again and I felt hungry, since it was now about twelve o'clock. I wouldn't have hurried myself then for all the gold in South America, so I sat down and began to eat a sandwich.

By the time I had finished I felt a lot better. I got up and started to the place, about a quarter of a mile away, to which Henry had pointed. As I passed the plane I looked sadly at the mangled figure that had been Henry. What a pity it was that he should have been killed just when it seemed that his dream was about to come true!

Reaching the place Henry had indicated I stopped and looked around me. I was on a smooth, level floor of stone. There was no indication anywhere of a cave such as I had expected. It was possible,

(*Continued on page* 93)

Radio Explorers

By ROBERT C. PARKER

(*Continued from page 91*)

I thought, that Henry had had some other reason for wanting to land here. But why had he pointed to this particular spot? Then, as I walked across the stone, I noticed a hollow sound where my foot struck the rock. I hit it with my heel to make sure. Sure enough, the sound was different in one small spot from what it was over the rest of the rock.

I dropped to my knees and examined the stone carefully. At first I could see nothing. Then I made out a tiny crack and began to follow it. It made a circle about twelve inches in diameter, evidently a trap door. At the edge of the circle there was a notch about three inches long It was not such a one as would arouse suspicion; it looked like a natural crevice. I put my fingers into this and pulled upward. A slab of stone raised up easily, showing a black cavern beneath.

I had to stop for an instant to admire the intelligence shown here. Not once in a hundred years would a man pass near this spot. Unless he chanced to strike it with his foot as I had done there would be no chance for discovery. The bottom of the sea could not be a safer place in which to hide treasures.

Lying down, I looked into the hole. At first I saw nothing. Then, as my eyes became accustomed to the darkness, I made out a floor about five feet below. I looked again carefully, to make sure, then put my feet into the hole and dropped, holding to the rim with my hands.

When my feet touched the floor my head still remained above ground. I lowered it cautiously, sniffing the air for any odor of the poisonous gases that sometimes gather in mines. There was no trace of them, so I dropped to my knees and began to look around.

As I could see nothing but blackness around me, I took a match from my pocket and lighted it. I was in a narrow passage which ran downward at an angle, growing larger as it descended. While the match was burning I walked quickly down the slope. The match went out and I did not dare go on in the darkness. I felt in my pocket again and found a single match. I lighted it and went forward quickly so as to go as far as possible while it still burned.

The passage ended abruptly, it was not more than twenty feet long, and I was in a circular room about fifteen feet in diameter. And around the sides of it lay great heaps of gold!

There is much more to be told, but I dread the task, since telling it necessarily brings the experience back to my mind.

Henry's body I placed in the pit where I had found the gold and replaced the trap door. It was the only thing that could be done in such a place as that, without tools and with a very limited supply of food.

Then I began the trip to the west, taking with me a few gold ornaments such as could be easily carried. The distance was as great as I had estimated and it took six days of traveling to reach a town of any kind.

At the first town I sold the trinkets I had brought with me, getting for them enough money to take me back to the United States, and about a thousand dollars more, which I put in the bank in my home town.

I am back at the garage now and am perfectly contented. Somewhere in South America there is a cave which contains enormous quantities of gold, but for all I care the gold can stay where it it, unless some day . . .

Dr. Hackensaw's Secrets

By CLEMENT FEZANDIÉ

(*Continued from page 17*)

"Did the brute hurt you?" he asked.

"No, but only because you arrived in the nick of time. But look out! He's running off with my invisible cloak!"

It was too true. The fellow had profited by the moment when Silas was attending to the young lady, and the rogue was now invisible, having thrown the lady's cloak around him.

Silas grabbed a stick and using this as a club, beat the air all about him, following in the direction he imagined the fellow must have taken. But his stick encountered no resistance, and by the time he bethought himself to stop and listen for a crackling twig, or watch for the pressing down of the grass by the fellow's feet, it was too late. He was startled by hearing the unmistakable chug-chug of his auto, and saw it apparently going off by itself with no one at the steering-wheel.

For a moment Silas was on the point of rushing to the nearest telephone station to notify the police but a glimpse at the young lady, shivering in his linen duster, reminded him that he had a more pressing duty to attend to. So he smuggled her quietly into the hotel and borrowed the raiment necessary to get her home.

Doctor Hackensaw was staying in the hotel at the time, and to him Silas imparted a full account of the affair, giving the doctor a full description of the cloak of invisibility.

"I know all about it, Silas," observed the doctor with a smile. "In fact, that cloak is my invention, and it was I who lent it to Miss Gloria Mundy. I am sorry she lost it, not on account of the value of the cloak, because in my factories I can make them by the hundred. But what worries me is the mischief that scamp can do with it. An invisible cloak is a dangerous weapon to put into the hands of a rogue."

"Is it possible, doctor, that you are the inventor of this marvel? If I had not seen its efficacy with my own eyes, I should never have believed such a thing possible."

"Tut! Tut!" said the doctor. "You must know from your own experience, Silas, how easily a man can be fooled by a highly polished mirror. It is practically invisible. All I had to invent was a few minor details. A mirror of ordinary glass would have been too heavy and brittle for the purpose. I was obliged to use the modern unbreakable glass, and employ hundreds of small mirrors set on a rubber cloak, the glass being as thin as possible, and the mirrors arranged in such a fashion as to avoid the scintillating reflections of the sunlight that would have betrayed their presence. I was also obliged to coat the glass with a waterproof compound, as otherwise any drops of mist or water condensing on them would have made the mirrors visible. But my most difficult problem was so to arrange the reflectors that a person standing on any side would apparently see through the invisible cloak as though there were nothing at all in the way. In a word, the cloak is in reality a number of periscopes, for a man in front of the invisible person literally sees, right through him, all the objects behind him. This adds immensely to the illusion."

"Could you not make the man *intangible* as well?"

Doctor Hackensaw shook his head. "No," said he, "that is beyond my powers. Putting on the cloak merely renders him invisible, but he retains his weight, and can be felt and struck the same as if he were not invisible. You must have noticed that in Gloria Mundy's case."

"I don't see how people can avoid feeling the presence of an invisible man, especially in a room," observed the reporter.

"They do usually feel his presence. They can smell him, they can hear him move, and they can feel the draft of air as he walks from place to place. But the cloak to a great extent prevents the scent from being noticed, and if the man is careful in his motions he need not betray himself. After all, it is in our eyesight that we trust the most."

"I suppose there are many uses to which such a cloak could be put."

"A great many—unfortunately, it is better adapted for criminal than for legitimate purposes. For a thief it would be invaluable; for a smuggler likewise. A man with an invisible coat could get all the *booch* he wanted. My invention would also allow a man to live rent free in the heart of New York City. He could set up a portable house with invisible exterior in any vacant lot, and live there undetected for months; and at the first sign of danger move to some other location. Invisible policemen and detectives, and invisible watchmen for buildings would be of the greatest value, and by their aid our worst gangs of criminals could be broken up unless the latter got hold of some of the cloaks. An invisible man can travel free on the railroads and steamboats or on the running board of automobiles; and could help himself to whatever food he desired from the pantry. There are a host of other purposes, too, to which the invention might be applied."

During the following week the course of the criminal who had escaped with the invisible cloak could be easily followed in the newspapers. Great excitement was caused by the appearance of the supernatural runaway automobile, which, without any chauffeur, chugged its way over the country roads, sounding its horn like mad, to make people jump out of the way. To add to its weirdness, the appearance of the auto would change completely every once in a while; at times being a mere flivver, and at others being a high-powered motor car of the finest workmanship.

Then other and darker stories were added to these first ones. Burglaries in broad daylight—a thing unknown before—became a common occurrence. Pocket-books and jewelry left lying around mysteriously disappeared. A lady would take off her jewels for a moment and lay them on a table, and would find them gone when she turned around; yet not a soul but herself had been in the room. Hysteria Johnson, the colored servant at the millionaire's mansion on the hill, swore that she saw all the silverware in the basket rise up into the air and fly slowly out through the door. But as Hysteria was not averse to a glass of tangible spirits once in a while, little heed was paid to her tale. Stories of ghostly footsteps and mysterious sneezes also became common, with an occasional tale of a grasp by a clammy hand or commands from a bodiless voice. All the women folks lived in constant terror.

Even sedate business men were upset. Money and securities vanished in broad daylight. The banks, too, suffered. Stocks, bonds and banknotes disappeared from the tables on which they were laid during business hours, though no stranger had been seen to enter the place, and although trusted clerks were present at all times.

Finally, matters became so bad that Doctor Hackensaw resolved to put a stop to these doings.

"I am the man to blame," said he to Silas Rockett, "and it's up to me to catch this fellow. I know who he is. He's known as Plug Connors, and not long ago he was making hot love to Gloria Mundy. She was on the point of accepting him, so to undeceive her I lent her the invisible cloak so she could convince herself with her own eyes that the fellow was a scamp. Twenty-four hours were enough to show

her what an unprincipled wretch he was, and how near she had come to ruining her life. Having the cloak, she profited by it to bathe in the Mansion Lake where all bathing is forbidden: In some way Gloria must have let the fellow get an inkling of the properties of the coat, for he is the man who ran off with it. And now my job is to stop him."

"But how will you do it?"

"By the aid of my super-nose or smell-intensifier. I can easily pick up his trail at the last bank he robbed, and unless I am very much mistaken, Plug Connors will be behind prison bars in a week."

CHAPTER II

"Yes, Silas, I've caught the fellow," said Doctor Hackensaw a week later, as he sat conversing with the reporter. "I had meant to send him to jail, but I learned that he had never stolen before—it was the possibilities of the invisible cloak that tempted him. So, when he offered to restore all his plunder, I let him go. He can't do much without the cloak, and I'll keep an eye on him anyway. But enough of this. What is the latest news of the war?"

"Bad news, Doctor. The Bolsheviki's advance squadron of airplanes captured New York City by a surprise attack. And we have well-authenticated reports that they are preparing an immense fleet of airplanes as well as a naval fleet, and hope to over-run our entire country before we are ready to protect ourselves."

"So I heard," remarked Doctor Hackensaw. "In fact the authorities have commissioned me to do what I can for the defense of the country. My factories have already turned out over a thousand of the invisible cloaks. These have proved of the greatest assistance for they enable our spies to pass behind the enemy's lines at all times. We are thus enabled to procure all the information we want. We can keep constantly posted as to the exact location of the enemy's forces in New York, the emplacement of the hangars and airplane fields, and the position of guns and ammunition dumps. Moreover, our invisible men are often able to inflict much damage. A well placed bomb or fuse will often blow up an arsenal or ammunition dump; or a little gasoline and a match can set fire to a hundred airplanes or airships. Then, too, our spies can remove or conceal small but important portions of the mechanism of the cannons as well as instruments difficult to replace."

"Yes, a thousand invisible men in the enemy's camp can do no end of damage," observed Silas. "Then, too, an attack by a few invisible men enables us to capture and destroy any portion of the enemy's line that gives us trouble. A squad of our men yesterday entered their arsenal, in the heart of the city, captured the guard, blew up the building and escaped unhurt. Another time one of our invisible men came across the dead body of a Bolshevik general. One doughboy first got all the information he required for his purpose, then hid his invisible cloak, put on the general's uniform and led a regiment of the enemy into an ambush we had prepared. Unfortunately, the victory cost us dear, for the young fellow's invisible cloak was discovered, and now the enemy are manufacturing them, and will soon have their invisible spies in our camp."

"Is there no way to detect their presence?"

"Yes, there is, and that's where we shall have the advantage of them. My super-nose or smell-intensifier, as you know, magnifies any scent to many times its original strength. All our pickets will be provided with these instruments, and can thus detect at once the approach of the invisible spies of the enemy, by their odor."

"That's all very well for land warfare, but what can you do against the enemy's immense fleet and its fifty thousand air-

planes? Your invisible men will be of no avail against these."

"Well," remarked Doctor Hackensaw, "the government has placed at my disposal one hundred extra rapid airplanes, capable of going over two hundred miles an hour."

Silas Rockett leaned back and laughed. "And I suppose," said he, "that with your hundred planes you expect to capture the enemy's fifty thousand planes, to say nothing of its fleet of battleships?"

"Who knows, Rockett?" observed the doctor, enigmatically. "You remember the fable of the gnat that killed the lion!"

That same afternoon, a sight that, but for its sinister import, would have been one of rare beauty, was visible from the decks of such ships as were ploughing the ocean near the coast of New Jersey. A fleet of a thousand Bolshevik airplanes, in several squadrons, were gracefully wending their way toward New York City.

Suddenly a commotion was observed on one of the largest of the battle-planes. The watchers from below saw the propeller of the airplane shiver into a thousand fragments, and the pilot, taken unawares, had all he could do to volplane safely to the surface of the ocean. Before he reached the water the same thing happened to two more of the battle-planes, and then one after another, the propellers of the airships broke, and the machines came gliding down to the water.

Inside of ten minutes over a hundred of the enemy planes were floating helpless on the water. And still they continued falling. Of the thousand splendid airplanes in the fleet, only a few of the most rapid of the scout ships managed to reach New York to tell the tale. The Bolsheviki at once sent out airplanes from New York City to pick up the survivors, but the propellers of these machines, too, fell a prey to the epidemic prevailing.

The Bolshevik warships sailed in separate squadrons, each with its own flagship. Admiral Muchblowski, the Bolshevik admiral-in-chief, was stationed on the finest vessel of the lot. He received by wireless the news of the destruction of the flotilla of airplanes.

"H'm," said he, to the captain of the ship. "That's evidently spies' work. The propellers of our airplanes must have been tampered with in some way, or they would not all have broken like this." Then, after a moment, he added, "It's singular how sleepy I feel. I can scarcely keep my eyes open."

"I feel just the same way," replied the captain. "There is something oppressive in the air. And look, it's the same with all the men on board. I wonder——" but before he could finish the sentence his head had sunk on his breast and he fell unconscious to the deck, as did also the admiral.

"Take off your invisible cloaks, boys, and drop on board!" cried Doctor Hackensaw, as he clambered out of his invisible and noiseless airplane. "Keep your gas-masks on till you get these fellows all tied up. Here, Jim, you take the rudder while I find the signal book. With the proper signals I can lead the whole fleet anywhere I want it, and so have time to overpower each vessel in turn as we did this one, with our soporific gas! New York City will be ours again before twenty-four hours have passed!"

"You see, Silas," observed Doctor Hackensaw that evening, "I wasn't for a moment afraid of any fleet of battleships or array of airplanes that the enemy might bring against us. With my hundred extra-rapid invisibles and silent airplanes I knew I was master of the situation. We had no trouble in getting behind the enemy planes and thrusting a specially prepared steel rod into the wings of their propellers, snapping them off in a jiffy and putting the plane *hors-de-combat*. The same invisible airplanes enabled us to hover over the enemy's ships and put the crews to sleep with narcotic gas."

Anesthetics and their Action

By JOSEPH H. KRAUS

(*Continued from page 21*)

coming out of an operation. For this reason ether is almost exclusively used in the American hospitals. With ether the operation may be continued for several hours without danger. On rare occasions the patient develops pneumonia after the administration. This is probably due not to the ether itself, but to the fact that the glands in the mouth secrete an unusual amount of fluid. Chloroform, strange to say, may produce fatty degeneration of the liver, heart and kidney. The fatalities directly due to chloroform or ether are one death in every 2,480 for the former and one in every 5,623 for the latter, according to one set of statistics.

Nitrous Oxide

Nitrous oxide is also a general anesthetic, used particularly by dentists, but differs from the other anesthetics in that it produces no irritating effects. A double mask having an air valve and oxygen and nitrous oxide supply hoses is placed over the patient's nose and mouth and the nitrous oxide, for full unconsciousness, is administered undiluted. The gas has a sweetish taste and odor. In about a minute the patient loses consciousness. Outside impressions become indistinct and a feeling of warmth develops. There is an abnormally rapid flow of ideas. Perception of pain is lost even before the patient has lost consciousness. This loss of consciousness is never fully produced ordinarily. If the anesthesia is to be prolonged, nitrous oxide, to which an additional 20 per cent. of oxygen has been added, is administered at atmospheric pressure. The patient comes out of the anesthetic about one-half minute after the operator has stopped administering the gas.

Ethyl Bromide

One other substance which is used as a general anesthetic is ethyl bromide. It is a colorless fluid, and altho it has an advantage over nitrous oxide, in that it acts more rapidly, it is seldom used in any minor surgical manipulations, where the duration of the anesthesia is to be more than one and a half minutes, because respiration and reflexes are abolished simultaneously.

Local Anesthetics

These are many and divided into several classes.

Opium

Opium in itself contains many alkaloids of which about 20 have been isolated. Its action develops more slowly than one of its derivatives, morphine. Because its action in general is so similar to morphine we can apply the action of that drug to this one. Its use by addicts will be discussed later.

Morphine

This alkaloid is a constituent of opium. The latter comes from the unripened fruit of the poppy. It was formerly thought that morphine acted on the peripheral organs (nerves in skin, etc.), but investigation has proved that such is not the case, as one side of the body where the morphine has been administered is no less insensible than the corresponding part on the other side of the body. Its action, nevertheless, is very directive on pain centers of the brain, but only those registering with the parts where it has been applied.

Codeine

Codeine, another of the opium alkaloids, may be looked upon as a mildly acting morphine. It is not so good in relieving pain, but at the same time it is not such a habit-forming drug as morphine or heroin.

Scopolamine

This drug has lately come forward as being quite valuable in administering ether anesthesia. The stage of excitement found under ether anesthesia is greatly diminished when about half a milligram of scopolamine has been injected in combination with morphine. It is used to produce a state of analgesia (insensibility to pain and clouded consciousness), during which relatively major operations may be performed. This combination has been called Twilight Sleep when used for a specific purpose. Both drugs are administered in successive order, until the patient does not *remember* having seen, say for instance, a bouquet of flowers. Some investigators claim that the pain of the operation is felt, but that the patient does not remember having experienced such pain.

Other local anesthetics depend upon the fact that low temperatures depress the excitability of the nerve endings or prevent the conduction of nerve impulses thru the nerve. Pressure on the nerve may also do this. Who has not experienced the sense of his foot or his arm going to sleep? This is where pressure stops nerve impulse transmission. The loss of blood circulation in the part may likewise cause a similar effect.

One of the methods most employed is freezing of the surface by Ethyl Chloride. This is a liquid which boils at a low temperature, and hence causes an extreme cooling effect by its rapid evaporation. It is sprayed on the skin, which first becomes pale, then reddens and if permitted to act long enough the skin becomes white and hard. It is practically painless and hence of value in dental practises and lancing of boils. Chemicals will likewise produce anesthesia, for instance, a 2 per cent. solution of cocaine in alcohol, when left in contact with the skin will produce anesthesia. This solution must not be permitted to remain over the affected part long, as gangrene is likely to set in. Many substances produce local anesthesia when injected under the skin. Plain water will do this; at first it creates a sense of pain. It then renders a local insensibility which may last one-half hour. Cocaine is used more often and produces local anesthesia. It very readily penetrates into the living tissues such as the sheath around the nerves. Natives of Peru and Bolivia chew the leaves of the plant Erythroxylan from which it comes, after mixing ashes or lime with the leaves, to set the alkaloid free.

Novocaine acts similarly to cocaine, but does not produce the same disagreeable after-effects.

The great danger of the use of morphine and heroin is the fact that they are habit-producing drugs. Fatigue, hunger and discomfort and pain are relieved by morphine, while at the same time a state of euphoria or exultance results. Impressions from without are not depressed, but on the contrary favored. This accounts for the ability of the morphine habitué to do hard mental work. In morphine poisoning the tendency of the patient is to dream peacefully and quietly. Respirations become quieter and slower. Then there is a narrowing of the pupils and finally a sort of tetanus effect.

Opium when used as a drug is generally smoked in pipes. The opium is first "cooked" over an oil stove or lamp, then placed in the bowl of a pipe.

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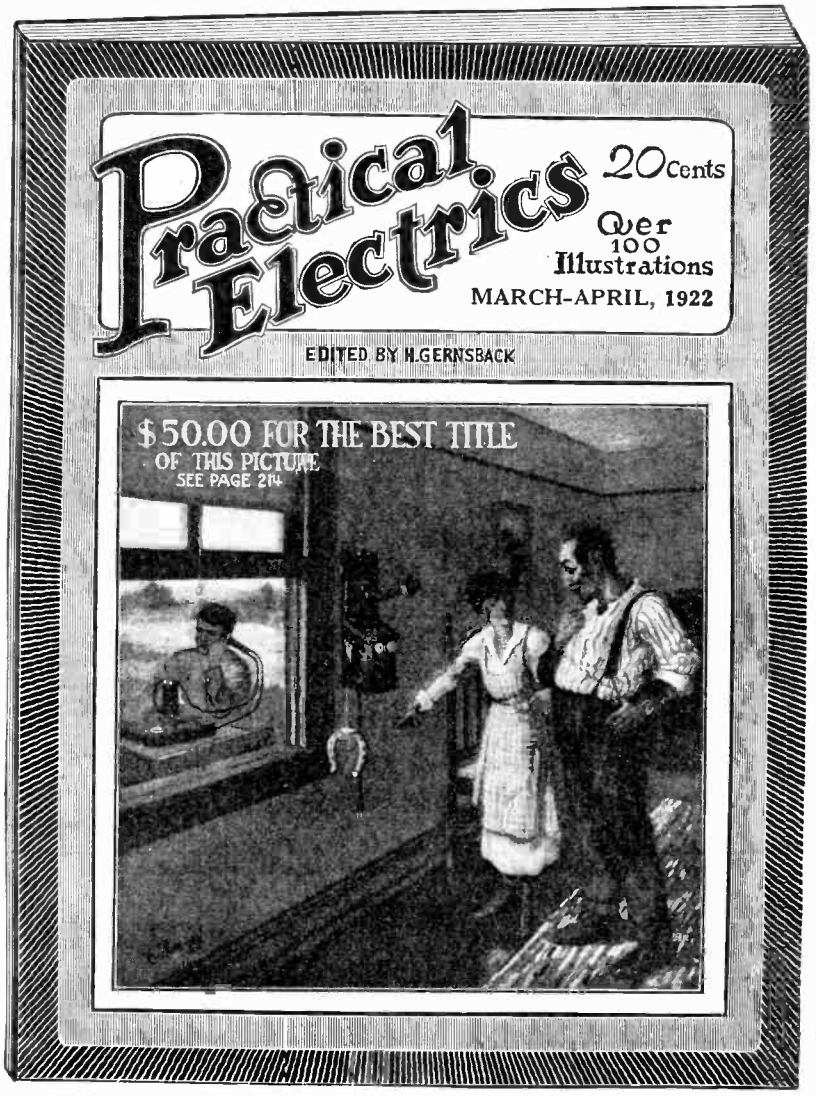

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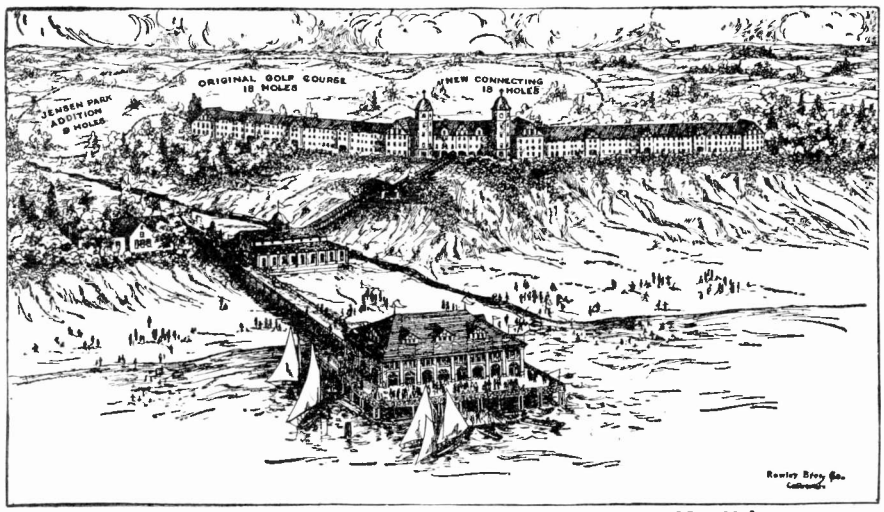

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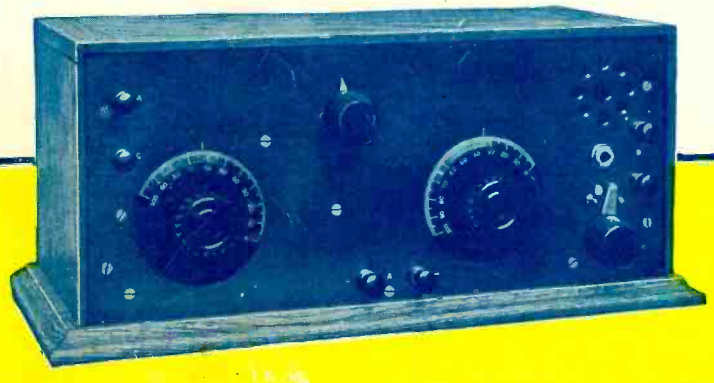

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