

TK
7800
E54
V-6
NO-2-12

REG. U.S. PAT. OFF.

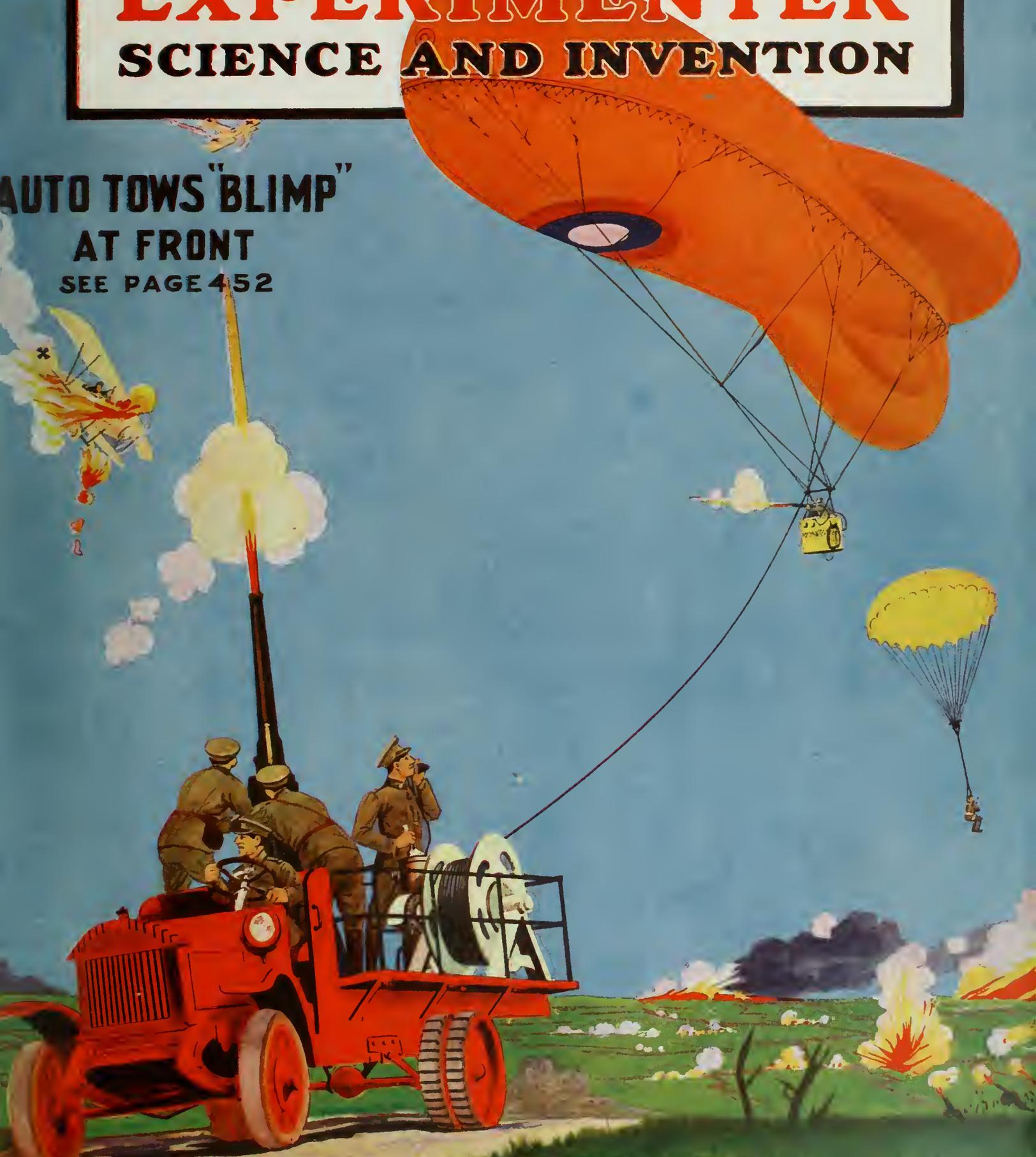
NOV.
1918
20 CTS.

OVER
175
ILLUST.

ELECTRICAL EXPERIMENTER

SCIENCE AND INVENTION

AUTO TOWS "BLIMP"
AT FRONT
SEE PAGE 452



LARGEST CIRCULATION OF ANY ELECTRICAL PUBLICATION

Learn Electricity



In the Great Shops of **COYNE**

**PRACTICAL
INSTRUCTION**

Trade and Engineering Schools
Dept. 20X, 39-51 E. Illinois St., Chicago, Ill.

**FINISH IN
3 MONTHS**

Thousands of skilled Electricians are needed. The demand is becoming more urgent every day. The Government is employing every one they can get which is causing a great scarcity throughout the country and big salaries are being paid everywhere. Right now is *your* big opportunity. Make up your mind now to prepare for one of these big jobs and then get here as quick as you can for your training.

Earn \$100.00 To \$300.00 A Month

In the Electrical business. Come here where you will be trained in these great \$100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position. We now have more positions than we can fill. Think of it.

PREPARE TO SERVE YOUR COUNTRY

**War Demands Have
Taken Thousands of Men
from this Profession. Men
Must be Trained to Fill their Places.
Prepare Now for a Big Paying Position.**

These courses are thorough, short and practical. All instruction given on the actual equipment. Each man is trained individually and stays until thoroughly trained. Start any time—day and evening classes.

Our graduates are in great demand. We are continually receiving letters, telegrams, and telephone calls from contractors, manufacturing firms, etc., seeking our graduates to fill responsible positions. We have now more positions than we can fill and the demand is steadily growing. Every comfort is given our students while here. They live in comfortable homes in the most beautiful section of Chicago—on the lake.

DRAFTED MEN READ THIS

It will only be a short time until you are called into service. This is a war of skill, brains, and machinery. Uncle Sam must win this war and must have tens of thousands of men skilled in modern trades and professions such as Electricity, Drafting, Plumbing, and Sanitation. Such men will be quickly recognized and given an opportunity to rise. It is not too late for you if you act at once.

In most cases those of our students in the draft, who have been called before completing their course, have been given an extension of time by their board sufficient to finish their course, owing to the great need of trained men in these lines in the Government Service.

LEARN DRAFTING

Skilled Draftsmen are always in demand. Our courses are thorough—short—practical, preparing a man fully to hold a position of responsibility. We have more positions than we can fill. We also have thorough practical courses in Plumbing and Heating and Motion Picture Operating.

EARN YOUR WAY

Many students earn a large part of their living expenses by doing a little work in their spare time. Our employment dept. furnishes these positions without charge.

**COYNE TRADE AND
ENGINEERING SCHOOLS**
Dept. 20X, 39-51 E. Illinois St.
Chicago, Ill.

Please send at once your big Free Book—I am interested in
 Electricity Drafting Plumbing
 Motion Picture Operating
(Check trade interested in)

Name.....
Address.....

MAIL COUPON FOR FREE BOOK

NOW!

MASTER KEY

THERE IS A

El Paso, Texas, Oct. 1, 1917.
MR. CHARLES F. HAANEL, St. Louis, Mo.
In Re "The Master Key"

My Dear Mr. Haanel: The value of an idea is determined by its application. Pragmatism has long since spread beyond the confines of Missouri. The world insists on being shown.

The last of circumstances and the logic of events are, more than ever, impelling men to think. Whether an idea be a new process for picking cabbages, or an old process (Kaiserism, for instance) for preserving kings, we are from Missouri.

A philosophy of life having as its base blind optimism; a religion that won't work seven days a week, or a proposition that isn't practical, appeals to the intelligent not at all. It is results that we want and the acid test is: will it work?

The Master Key qualifies. It is the most lucidly scientific statement of "Truth" that I have seen. It reconciles rationalism and religion; illumines economic determinism and the materialistic conception of history, and is an infallible guide to understanding. It contains in condensed form the substance of an entire library on science. Its teaching, if consistently applied, will make a man healthy, wealthy and wise. Its distribution is super-missionary work in excelsis. Those who wish to think intelligently will find it invaluable.

Intelligence rules. Desire, intelligently directed, is a creative force which automatically causes its object to manifest on a material plane. It is the law. Let him that hath an ear to hear, hear.

Yours truly,
CHAS. A. HEARD.

May 15, 1918.

Dear Mr. Haanel: Ever since I have been old enough to read, I have been reading occult and metaphysical literature. I have waded ears deep through the books from all ages, all lands, all schools.

I have rejected tons of lies, oceans of misconceptions, an entire universe of false deductions.

I have found grains of truth in mines of folly, and worlds of truth in a single grain. The pursuit was interesting in itself, and I do not regret the time spent upon it. But it was a genuine surprise to read your Master Key System and find within, the essence of all that I had read, with much more added thereto.

In this extraordinary system you have sifted the true from the false; you have given in concrete form all that is worth while in many schools of philosophy.

You have placed arcane truths into the hands of the uninitiated as weapons they can learn to use without danger to themselves. I congratulate you. You are doing mankind a service.

Yours very sincerely,
CHARLES F. OURSLER.

501 Fifth Avenue, New York City, N. Y.

THE LOWE OBSERVATORY
Edgar Lucien Larkin, Director

Los Angeles, Cal., Dec. 6, 1916.

MR. CHAS. F. HAANEL, St. Louis, Mo.

Dear Sir: Your booklet, Master Key, ought to be expanded into a book. Its teachings that Mind is the all-dominating creative force is precisely in line with the wonders of the most recent psychology. All persons having desks should have this pamphlet thereon. And it would be a fitting pocket companion.

EDGAR LUCIEN LARKIN.

Detroit, Mich, May 28, 1917.

Dear Sir: The words, "Your world will change as if by magic, the moment you realize the marvelous power within your control," page 6, I have underlined. They state a fact, a real live fact; and to me this is the most wonderful, the most important fact of all—that one may put this knowledge to an immediate test, that one may, after learning of this power, proceed to apply it with a definite knowledge as to results.

W. M. HOWE.

which can throw wide the doors which seem to bar men from the Treasure House of Nature. This may seem "too good to be true," but remember that within a few years science has placed almost infinite resources at the disposal of man, is it not possible that there are other laws containing still greater possibilities? Get the Master Key and find out for yourself how the invisible forces of Faith and Desire are converted into actual, tangible, concrete facts in the objective world.

Chattanooga, Tenn., Feb. 22, 1918.

The Master Key is wonderful, it has brought about a most remarkable change in my environment, attitude toward life, mental and physical condition. I am an entirely new person and improving daily, discouragement, lack of ambition, physical ills, mental distress, and fear are things of the past.

I cannot find words that express my gratitude for all that the Master Key has done for me. With heartfelt thanks to you, I am,

Yours sincerely,
R. J. ARNOLD.

160 Claremont Avenue, New York
New York, Nov. 18, 1916.

I have made a thorough examination of the little booklet which you so appreciatively have called the Master Key, and can unhesitatingly endorse it and its teachings.

In this pamphlet of only a few pages you have led a hungry world to the threshold and placed in their hands a "key" with which the understanding ones may unlock the door and enter "The Secret Places of the Most High," and enjoy the abundance of all good to be found therein. With best wishes,

AGNES MAE GLASGOW.

HOME LIFE INSURANCE CO. OF N. Y.
James Lee Bost, General Agent
Washington, D. C., Dec. 29, 1916.

Dear Sir: Your little booklet, entitled "The Master Key," has been received and I had great pleasure in studying it carefully. It is a very clear and concise, yet forceful presentation of the big subject handled, and shows a very wide study of the absolute teachings and deep understandings of the same.

Very truly yours,
JAMES LEE BOST.

"I am able to extract from this system all that can be made known by the finite mind relative to origination, evolution, destiny and the much-mooted riddle of the Universe."

"I can hardly grasp the full significance of the facts. The vastness of this subject is so overwhelming it seems a life-time of effort could never fathom all its possibilities."

"You have given a wonderful analysis of the power that is the creative force by which the master mind controls his destiny."

"The Master Key is too modest a title for such a stupendous revelation."

"I have found the Key and with it each day am opening the store-house of wisdom and success, of which for many years I was utterly ignorant."

FREE! There is no charge for the MASTER KEY. It is FREE!

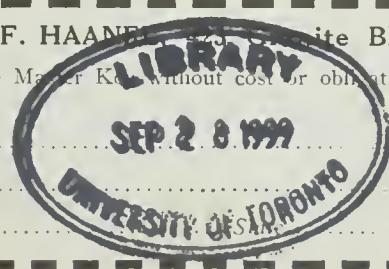
CHARLES F. HAANEL, 315 White Bldg., St. Louis, Mo.

Send me the Master Key without cost or obligation of any kind.

Name

Address

Post Office





NOTE—Tomorrow; today will be yesterday. Get your Master Key TODAY! NOW!

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

ELECTRICITY

AS EXPERTS KNOW IT

"See them First — Pay afterwards"



Learn electricity as you would in actual PRACTICE—in accordance with the methods employed by the highest paid electrical experts in America. The New McGraw-Hill Library of Practical Electricity contains the actual working facts which you need in order to succeed in the electrical field. Terrell Croft, formerly with the Westinghouse Company, makes the conquest easy for you.

A New Standard in Electrical Literature

The New Library of Practical Electricity by Terrell Croft marks a new era in electrical literature.

The great field of electrical engineering, with its limitless possibilities of earning power, is brought to you in a form that makes success easy. The Library is a creation—an achievement that is without parallel in technical literature, because it sticks to actual practice throughout its 3000 pages.



(CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY—8 VOLS.)

\$2
per
month
starts
you
to
bigger
pay

A letter that means something to YOU—

McGraw-Hill Book Company, Inc.,
239 West 39th Street,
New York, N. Y.

Gentlemen: In an attempt to express myself about CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY, I have never seen, and do not believe there was ever printed in the English language, a more comprehensive set of books. It is a library that is just as valuable to the novice as to the expert, because it is all practice.

Respectfully,

GUY H. PEIFER,
Chief, Doplan Silk Corporation,
Hazleton, Pa.

Now is the time to master Electricity—Now is the time to prepare for a high salary

Not one cent in advance—Just the coupon

Examine this new Library for ten full days without expense. Find out for yourself why it is now taking the lead in electrical book sales in America. Use the books as you see fit for ten days. Look at the hundreds of illustrations that clear up all the mysteries in electrical practice. Stick a couple of the volumes in your pockets, and refer to them during the way. Figure out in an instant the problems that have heretofore taken hours.

Then send us \$2 per month for eight months, or return the set entirely at our expense. You risk nothing by returning the attached coupon.

Old books won't do. Amateurish books won't do. Books compiled by "desk authors" or men with no practical experience will not serve your purpose.

Practical books are easiest mastered. Practical books, written by practical men, teach you accurately and rapidly. There is nothing in the Croft Library which you cannot understand. Terrell Croft tells you the secrets of success in electricity in plain words, figures and illustrations. Nothing is left to the imagination. There is no guesswork. There is no theory or higher mathematics.

Send now for these eight volumes. No matter how many books on electricity you possess, you are unfair to yourself unless you take advantage of this free examination privilege. No matter whether you are beginner or expert, these books will show you the clear road to success. Inspection will prove this.

McGraw-Hill Book Co., Inc.,
239 W. 39th St.
NEW YORK

Gentlemen:
Please send me the Library of Practical Electricity (shipping charges prepaid) for 10 days free examination. If satisfactory, I will send \$2 in ten days and \$2 per month until \$16 has been paid. If not wanted I will write you for return shipping instructions.

Name _____
Home Address _____
City and State _____
Name of Employer _____
His Address _____
Your Position _____

EXAMINATION COUPON

ACT NOW

McGraw-Hill Book Co., Inc.

239 West 39th Street, New York, N.Y.

Ex. Nov. '18

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

Electrical Experimenter

233 FULTON STREET, NEW YORK

Publishd by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer;) 233 Fulton Street, New York

Vol. VI Whole No. 67

NOVEMBER, 1918

No. 7

WHY IS A BLIMP?.....	Front Cover
.....	From a painting by George Wall
CITY OF HAM FIRED WITH ELECTRIC BOMBS.....	445
WHY AIRPLANES DONT FEAR ANTI-AIRCRAFT GUNS.....	447
HOW SUBMARINES CUT THRU NETS.....	448
CHAIN OF AERIAL LANDING FIELDS ACROSS U. S.....	449
TALKING THRU LAND AND WATER.....	450
MAGNETIC AND OTHER FOOL WAR DREAMS.....	451
WHY IS A BLIMP?.....	By the Electromagnet—Himself 452
AN X-RAY INTERVIEW WITH THE EDITOR.....	By W. Edouard Haessler 452
.....	By "Fips"—the Office Boy 454
ELECTRICITY AIDS HUN "MOVIE" SPIES.....	455
ELECTRIFIED BARRIERS STOP FISH IN STREAMS.....	456
HOW CAN WE TELL "REAL" DEATH?.....	By H. Winfield Secor 457
AUSTRIAN SEARCHLIGHTS HAVE AIRCRAFT SOUND DETECTORS.....	458
WESTINGHOUSE ENGINEERS GET NEW RESEARCH LABORATORY.....	459
A GYRO ELECTRIC "MOVIE" CAMERA FOR THE BATTLEFIELD.....	460

ELECTRIC TRUCKS AID WAR WORK.....	461
POPULAR ASTRONOMY—FIFTH PAPER—"THE SPIRAL NEBULAE AND THE ISLAND UNIVERSE THEORY.".....	By Isabel M. Lewis 462
THE GYRO ELECTRIC DESTROYER.....	By H. Gernsback 465
THE PHENOMENA OF ELECTRICAL CONDUCTION IN GASES—"MAKING IONS VISIBLE".....	By Rogers D. Rusk, M. A 466
BURN-OUT LAMP CONTEST.....	By H. Gernsback 467
RADIO DEPT.—MARCONI HEAD OF ITALY'S NEW BANKING SYSTEM.....	468
"BUNQUE"—RADIO SHORT-CIRCUITS.....	By Alan C. Rockwood 470
A SENSITIVE RADIO RECORDER.....	By Arno A. Kluge 471
THE HOW AND WHY OF RADIO APPARATUS. PART 10. "RADIO AMPLIFIERS".....	472
THE "OSCILLOGRAPH"—HOW IT WORKS.....	By Prof. Lindley Pyle 474
A THERMOSTATIC TIME SWITCH.....	By Albert H. Beiler 475
A WATER-JET VACUUM PUMP.....	By Prof. Herbert E. Metcalf 476
EXPERIMENTAL MECHANICS—"LATHE CHUCKS.".....	By Samuel D. Cohen 477
EXPERIMENTAL CHEMISTRY—THIRTIETH LESSON—IODINE, BROMINE AND FLUORINE.....	By Albert W. Wilsdon 478

EDITORIAL

COLD LIGHT

WE have pointed out on various occasions in these columns the criminal waste that daily occurs when we convert coal into electric light. We have shown that when coal is burned only one-half of 1 per cent of the actual energy stored up in the coal is converted into radiant light—the other 99½ per cent goes up in heat where no heat is actually wanted or required. The great problem of the century is heatless light, or at least an approach toward it.

All our efforts in developing incandescent lamps or arc lamps are in the wrong direction. While we have made trifling progress from the old carbon filament lamp to the up-to-date Tungsten lamp, the progress as far as wasted energy is concerned is more than trifling; it only amounts to a very small fraction of one per cent. The arc lamp which is very much more efficient, giving infinitely more light in proportion to the Tungsten lamp, can not, of course, be used in a small room, as it gives more light than wanted, and for that reason is impractical. The other electrical devices which are still more economical, such as for instance the Cooper Hewitt mercury lamp, which may be seen in every modern photographic studio, or the Moore lamp, which is a sort of Geissler tube giving a soft, pink light, are excellent for their purpose, but neither of these are flexible enough where only 30 to 50 candle-power are required.

What we need is something similar to our present-day electric light globes, but such a device must not have an incandescent filament. What this future invention, which is surely coming, will be, we do not know and the best we can do is to make a fair guess.

In Nature we find several light sources that may be termed "cold," altho in reality most of them are not. Take, for instance, the Firefly (*Luciola*), whose light at one time was thought to be of an electrical nature. Recent investigations have shown that the light is produced by the burning of the oxygen in a certain peculiar

manner inherent in the firefly's photogenic cells. While, of course, not actually cold light, it comes as close to cold illumination as is imaginable.

Then there is a certain specie of deep-sea fish—Lantern Fish—who attract their prey by giving forth a brilliant light shaft from their photophores. In this case the luminosity is known to be of a phosphorescent origin, which, strictly speaking, is not cold either, but for practical purposes comes close to it. The "Will o' the Wisp" as well as the luminous mushroom fall in the same category, their light simply being due to burning of oxygen.

Electricity at high pressures is also known to give out certain light effects, as, for instance, a highly charged Tesla coil; but this light, if anything, is more expensive than that obtained by means of an incandescent lamp. Next following, we have the high tension Tesla vacuum lamp, which gives forth a brilliant and also cold light. Due to the very high potential currents that are necessary to produce this light, it has so far not been exploited commercially, altho it deserves it.

Perhaps some inventor will devise a sort of combination Cooper Hewitt-Moore gas lamp, which, instead of a filament, will have a hundred feet of very fine glass tubing all coiled up inside of our present day lamp bulb. Then by introducing a suitable gas into this fine tubing, which, of course, must be of a fair conductivity, we may produce some sort of an economic lamp bulb, and, while this light will not be absolutely cold, it might serve for practical purposes. But perhaps the final solution will be found in some device which operates by electronic bombardment of some screen or substance, which thru this bombardment will become intensely luminous. In other words, a device working on the principle of the well-known spintharoscope.

Such a device would consume an extraordinarily small amount of current, and would constitute an ideal source of cold light.

H. GERNSBACK.

The ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is \$2.00 a year in U. S. and possessions, Canada and foreign countries, \$2.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 20 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 mis-carried or lost. A green wrapper indicates expiration. No copies sent after expiration.

All communications and contributions to this journal should be addressed to: Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contribu-

tions 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. ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered U. S. Patent Office. Copyright, 1918, by E. P. Co., Inc., New York. The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris.



'LEARN BY DOING'

The Only Way to Learn Electricity

It doesn't matter whether you are under twenty or over fifty; you can be trained in a short time to take a guiding hand in the World's most important industry.

The new Law compels men to follow only useful occupations—and every branch of electrical work is not only useful work but is most important.

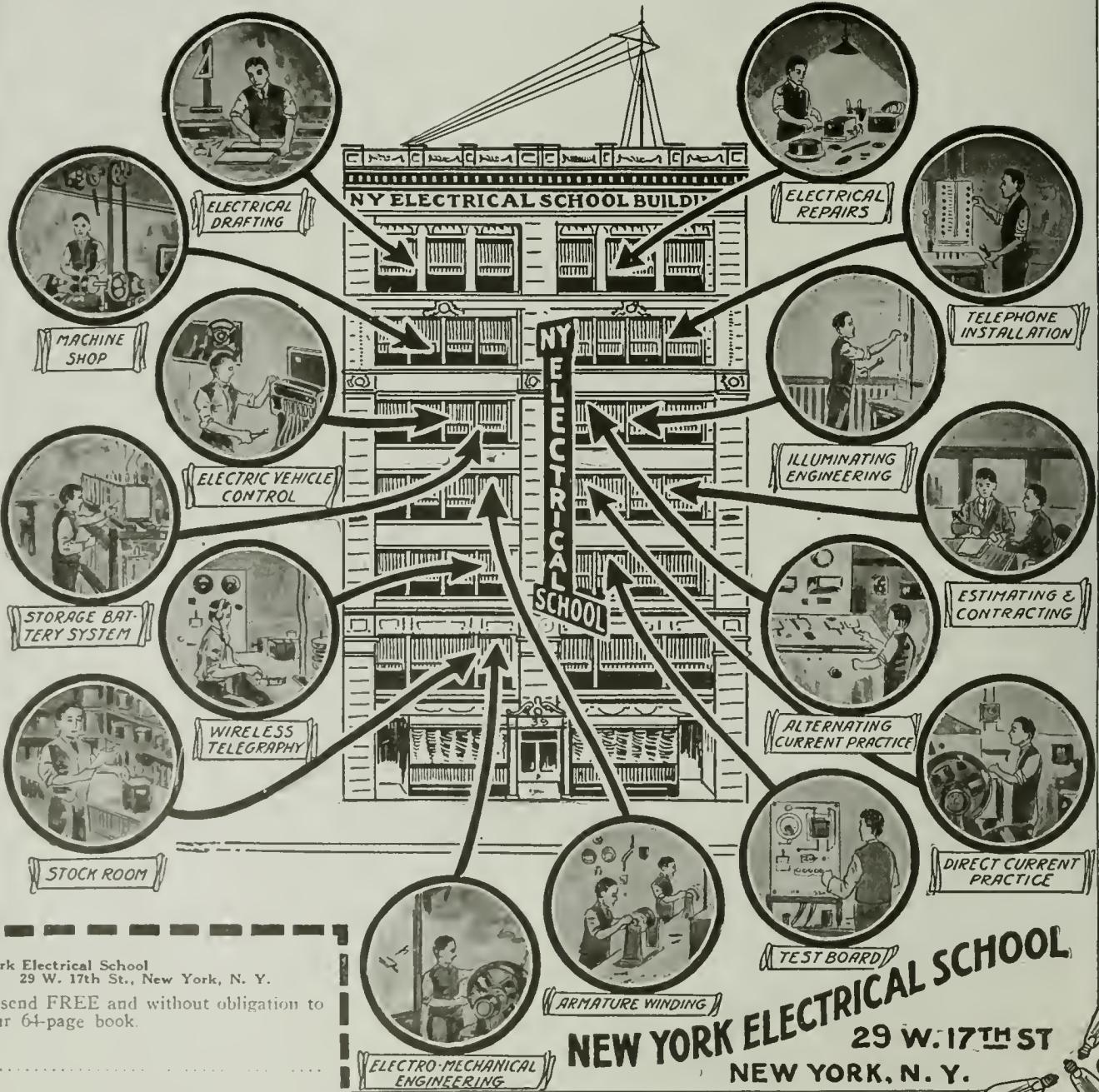
If you want to learn a line of work that is interesting as well as remunerative—a light work easily learned that pays men of ordinary ability fifty dollars and upward a week—become an electrical practitioner.

Billions of dollars' worth of electrical equipment is being made and installed as quickly as possible. Why not learn this greatest and newest business—and share in the great profits? Electrical

industry will continue to flourish when many other trades will be out of date.

If you have been following non-essential occupations, NOW IS THE TIME to learn something worth while.

Hundreds of men have made successful fresh starts in life by spending a few months at the N. Y. Electrical School. You don't have to study from books in this school; you learn the many branches of electrical trades by using TOOLS and EQUIPMENT. The course may be finished in a short time at low cost. Whatever your age or position your condition can be improved and your country served to the best advantage by taking up the profession of Applied Electricity. Visit the School any day or evening and talk over matters. On request, a 68-page illustrated catalog will be sent FREE to you.



New York Electrical School
29 W. 17th St., New York, N. Y.

Please send FREE and without obligation to me your 64-page book.

Name

Address

NEW YORK ELECTRICAL SCHOOL
29 W. 17TH ST
NEW YORK, N. Y.



Vol. VI. Whole No. 67

OCTOBER, 1918

Number 7

City of Ham Fired With Electric Bombs

HAM—the French city of that name recently recaptured from the Germans, was set on fire by an elaborate system of electric incendiary bombs, all of which were placed thruout the various buildings with proverbial Hun thoroughness, which, when the psychological moment had arrived, were

ablaze in an apparently natural manner;—just as if the Allied shell fire had done the awful work. But the trick was not pulled off so smoothly—for we have the evidence in this case of some of the populace who managed to hide in cellars and other places of shelter of just what happened to Ham, once peaceful and happy, and birth-place

direction of flow of current thru the junction. This phenomenon is called in his honor, the "Peltier Effect".

Humanity is thankful for this additional information in the already mountainous pile of evidence against the boche, to one—Walter Duranty, a New York war correspondent of the *New York Times*, who



The City of Ham Was Fired Instantaneously by the Crafty Germans After They Had Evacuated It, by Means of Electric Incendiary Bombs Ignited by an Electric Current Sent Thru a Network of Wires from a Point Several Miles Away. The Insert Diagram at the Left Shows How the Dastardly and Wanton Trick Was Accomplish't by the Throw of a Switch.

all exploded simultaneously by an enemy officer located several miles away. Perhaps the crafty boche engineers thought that by wiring up the town in this way, and by driving out the inhabitants when the troops retreated, they could set the buildings

of a well-known French electrician—Athanase Peltier—who discovered the remarkable electrical fact, that if a current is past thru a junction formed between bismuth and antimony, then the junction is either heated or cooled, depending upon the

was with the French army when they captured the still burning city. Mr. Duranty reports:

"For pure wantonness of destruction, Ham offers an example that even the Germans will find it hard to beat. It was a non-

FRENCH ALPINE TROOPS CARRY BATTERY SEARCHLIGHT.

The electric searchlight has found more extensive use in the present war than in any previous conflict, owing to the fact that it has been improved and developed so that it has become a truly invaluable adjunct to all military and naval maneuvers, both for the purpose of illumination as well as for signaling. Small but powerful electric searchlights have been used successfully by the Allied armies for signaling in broad daylight, as was described some time ago in the *ELECTRICAL EXPERIMENTER*.

The present photograph shows a group of French soldiers—*Chasseurs d'Alpine*—sending signals with a portable electric searchlight which can be carried by one man. As those who have anything to do with automobiles will at once perceive, such a searchlight does not require a very large or extremely high candle-power lamp bulb, providing the lamp itself is fitted with a high grade parabolic silvered-glass reflector. Thus it is we find, that this member of the renowned "Blue Devils" is seen carrying the battery for operating the searchlight on his back, while he holds the searchlight projector itself on his breast. By means of a simple shutter arrangement fitted on these searchlights, when they are

to be used for sending messages, it is very easy for any one familiar with the telegraph code to flash messages in the form of dots and dashes, or, in this case, by long and short flashes of light, over a distance of several miles. The signals are invariably read at the receiving end by an offi-



Photo—Kyprie Photo Service

Here We See Some of the Famous French Troops—*Chasseurs d'Alpine* or Blue Devils, Using a Portable Battery Searchlight in the Vosges for Daylight Signaling.

cer provided with a pair of field binoculars.

An old-style open street car in Boston has been equipt as a double deck ambulance for removing large numbers of patients to a hospital.

AMERICAN SPUN GLASS NOW IN ENDLESS LENGTHS.

In Venice, for many years, the art of glass spinning was fostered, until that city became known for the great beauty of the ornamental objects which it put on the market. There have always been shortcomings in the work, due to the fact that glass thread could be spun only to the length of the circumference of the wheel on which it was worked, and this was never more than eighteen feet.

This difficulty has been overcome by an American Manufacturer, who can make spun glass thread in endless lengths, and put it on spools as is done with ordinary threads. This enables a multitude of objects to be made, that could not be made before. The threads of glass can be made in all colors, giving a world of brilliancy.

Probably the largest field of use will be in the technical and engineering fields, where it already has a foothold. As absolute non-conductors, glass plates for storage batteries will give longer life than present-day plates. For insulation

of electric wires, instruments, etc., the glass thread can be used. As an example of its non-conductivity, power house workers have had their shoes bottomed with spun glass plates, to avoid shock. For the filtration of acids, glass plates are excellent.

military act of vandalism. Chauny street, leading to the market place, was piled high with the wreckage of fallen walls, and at the entrance to the square a group of poilus were risking their lives in clearing the outlet of a cellar in a house whose glowing beams still crackled into flame at each gust of wind and whose side walls were bound to fall at any minute.

"Finally I met a French woman who had lived in Ham before the Germans fired it, and who had hidden in a cellar while the conflagration raged.

"Ham," said this woman, "was destroyed methodically by fires simultaneously started in every quarter by electric devices. Nearly a month ago we noticed the boches had begun fixing up wires in all directions, and we commented on the strangeness of such installation at a time when everything else pointed to a German retreat. It did our heart good to see the streams of guns, the material, and the shattered, dispirited troops that had been pouring backward thru Ham for the last few weeks.

"As time past the boches steadily continued their preparations for departure, removing wagonloads of furniture, and, indeed, everything of any value. But the wiring parties continued their work all the more busily.

"Last Wednesday we had the key to the enigma. That morning the French guns were very near and a few shells fell close. At noon the boches issued orders to all civilians to evacuate the town. There were only about fifty inhabitants here, and perhaps twice that number of French and Belgian youths in the boche press gangs. Some fifteen of us and six boys managed to

hide in the cellars. I believe all save one or two are now safely accounted for.

"On the night from Wednesday to Thursday we heard a sudden outburst of small explosions all around. At first we thought there was grenade fighting in the street, as the noise was not loud enough for shells or airbombs. Before dawn my father stole cautiously out. The whole town was flaming above our heads, but our house did not catch fire until we were able to leave it.

"The boche wires had been connected with incendiary bombs which were fired simultaneously from a central electric control. Ham burned furiously all Thursday and Friday. On Saturday morning the fire was dangerously close, and we left the cellar, to meet French soldiers, who had advanced and taken the town, shortly afterward."

Our illustration herewith shows the scheme of carrying out such a dastardly deed. The incendiary bombs are connected up in series in circuit groups as here outlined, these groups being finally all connected to a single circuit leading to a central switch-board several miles away. At the closing of a switch the boche thus blasted out the only hope the peaceful inhabitants might have entertained of saving at least their homes and furniture.

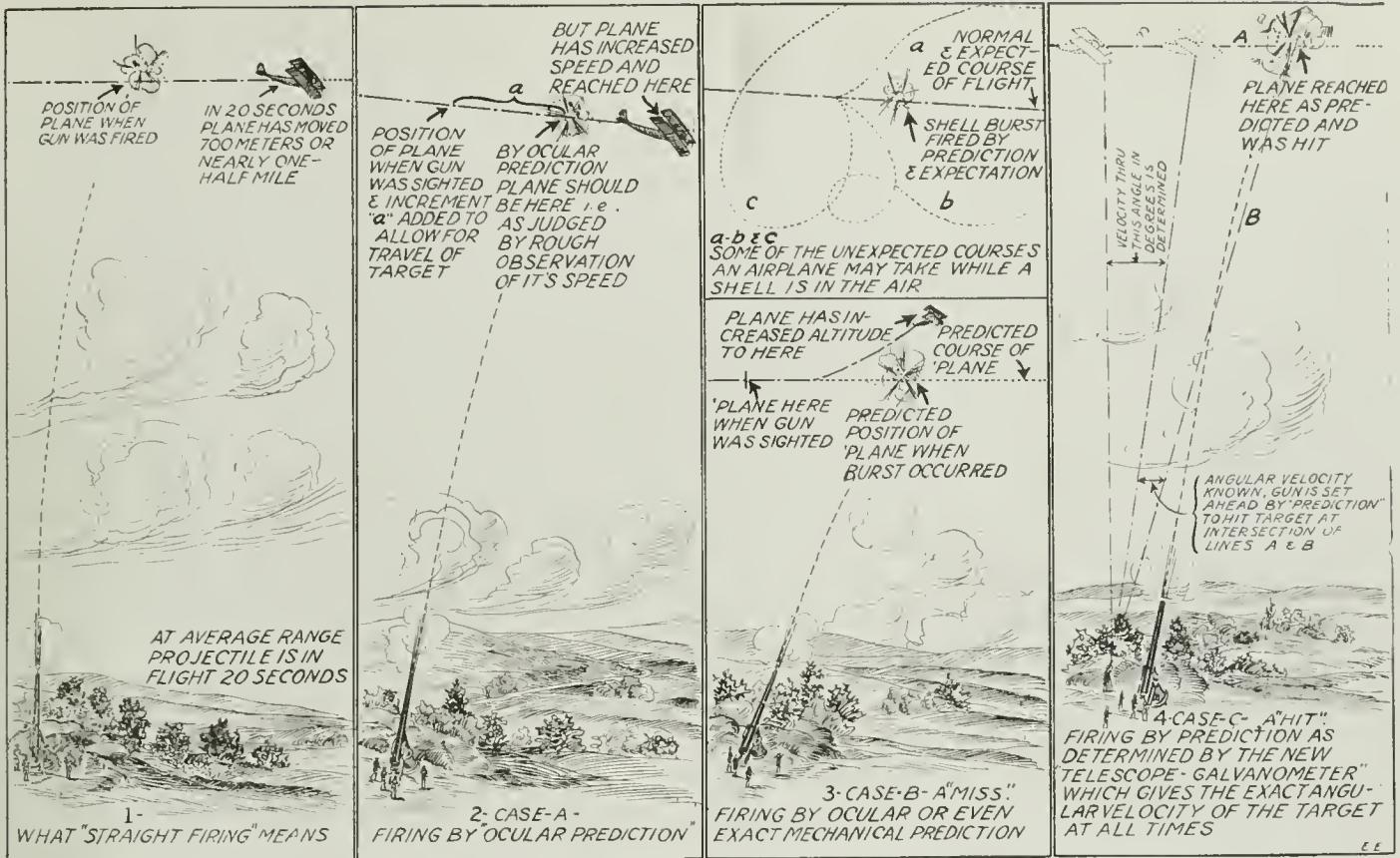
GERMANS USE NEW AIRPLANE PARACHUTES FOR AVIATORS

American Headquarters in France, Sept. 20, (Reuter.)—Patrols report having encountered an entirely new type of enemy airplane, designed especially to make it easy to maneuver. They also report that the

Germans are adopting the parachute as a means of escape from damaged planes.

Did you note the full purport of that last statement? Also, do you remember reading the timely article, "Is the airplane parachute practical?" in the October issue of the *ELECTRICAL EXPERIMENTER*? Perhaps you do; at least, we hope those who should be interested in such a life-saving device digested the logic there set forth by a man who is a "flier"—and, therefore, knows whereof he speaks. Yes, the report above cited looks good. But, asks the reader, why do we not have such safety attachments provided for America's birdmen? As usual the Germans have taken this idea, which had been tried out several years ago in France and the United States, and developed it to the stage of practicability. The reports from correspondents at the front have mentioned the German aviators' use of the parachute several times of late. Also there is a gentlemen's agreement among the warring birdmen not to shoot a man down when his plane is put out of commission, or when he is parachuting earthward.

Finally, friends, listen to the clarion voice of the official bulletin on "Problems of Aeroplane Improvement," issued by the Naval Consulting Board. On airplane parachutes it says: "These, considered as a safety device, ARE NOT DESIRED as a factor in the equipment of military airplanes. No entirely satisfactory disengaging device has yet been developed. Such devices may presumably play some part in civil aeronautics and under peace conditions, but under existing military conditions they are not considered a necessary or desirable encumbrance."

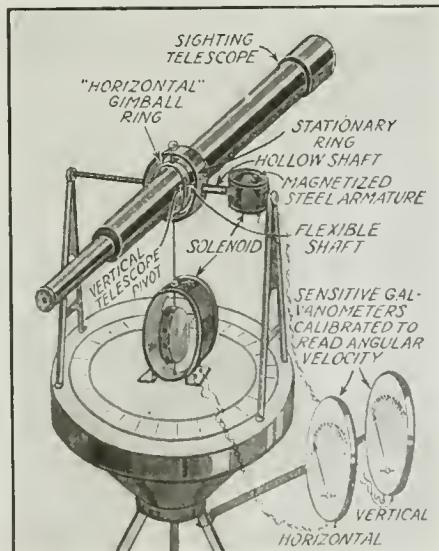


Did You Ever Stop to Ponder the Reason Why Aircraft Do Not Fear Gun-Fire from the Ground? Some of These Reasons Are Evident from the Illustration. An Aviator To-day Considers It a Disgrace to Be Brought Down by a Shot from an Anti-Aircraft Gun.

Why Airplanes Don't Fear Anti-Aircraft Guns

CONTRARY to general opinion the enemy's aircraft when they come to view, are not really to be considered as one of the arms of the enemy artillery, but rather as one of its eyes. In fighting the enemy aircraft, our guns fight the artillery of the enemy in its most vital part. When the artilleryman succeeds in landing a hit on an enemy airplane, he performs a most important service for his fellow fighting men, for not only does he bring down the 'plane which may be loaded with bombs, or else fitted with machine guns for attacking 'planes and troops at close range, but further, he is helping to render the artillery of the enemy practically useless by "blinding" it. The artillery airplane, first and last, is to a large extent, an agent of aerial observation. Without this wonderful far-seeing arm of the artillery, neither side can ever hope to accomplish any of the remarkable long range big gun hits that have been accomplished. An American army officer, recently returned from France, stated that on one occasion he saw a very remarkable long range artillery fire in which three eight-inch shells landed squarely on the target eight miles away, thanks to the range corrections transmitted via wireless, from the observation airplane. The first shot fell a little past the bridge, the second shot fell a little short of the bridge, while the third one fell squarely on the target. Such work as this is being duplicated every day on the Western Front by the remarkable means of communication and observation now mustered together by the able Allied commanders.

This gives at least a slight idea of the great importance of bringing down enemy aircraft whenever possible. One way, of course, is to send aloft other battle 'planes to destroy the enemy aircraft if possible. The problem of anti-aircraft firing has al-



The Latest Electrical Instrument Designed to Measure Constantly the Angular Velocity of an Airplane Target as It Sails Along. It is Called a "Galvanometric-Cinometer." Its Use Means More "Hits" for the Anti-Aircraft Batteries.

ways been with us, and Lieut. Colonel X. Reille of the French army recently gave an interesting discussion on this highly important problem, before the *Washington Academy of Sciences*. What a difficult job it is to hit a 'plane while in flight can best be judged by those who have tried to shoot a bird on the wing, especially when the object of your sight is a considerable distance away. Also the birdmen of today have an unkind habit of looping the loop, taking a nose dive, or executing some other rapidly changing figure in the air, just about the time you get ready to plant your second or third anti-aircraft shell squarely on them. As Colonel Reille points out—"Anti-aircraft firing does not consist merely in firing at an aerial target in motion. Moreover, this target moves with a speed which cannot be regarded as negligible with reference to the speed of the projectile designed to strike it. An observation airplane with an average wind will attain a speed of 35 meters, or 38.15 yards per second." These observation machines invariably fly at an altitude of fifteen thousand to eighteen thousand feet, and it is common for excellent photographs to be taken at this altitude also. At ordinary firing ranges, the time of flight of the projectile shooting skyward amounts to about twenty seconds. Hence, under normal conditions, the distance covered by the enemy 'plane between the moment at which the projectile is fired at it, and the moment at which it bursts in the vicinity of the target, is about seven

(Continued on page 494)

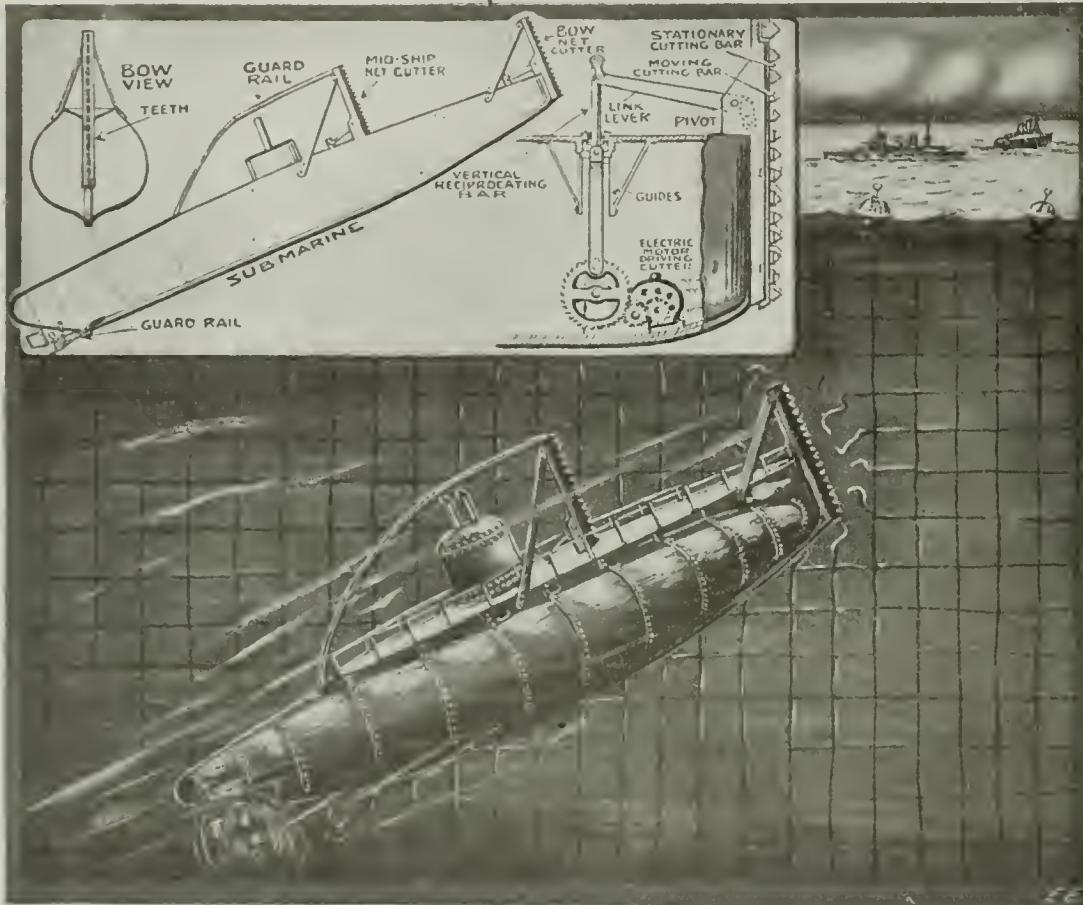
How Submarines Cut Thru Nets

WE often hear heated discussions among the pro-war enthusiasts as to how a submarine war vessel can cut its way thru one or a series of steel nets. We have had ample evidence in the past few years that it is

clever maneuvering of the sub-sea craft and by starting up the net-cutter motors, when this condition arises, the under-sea demon can shortly hack its way thru the net.

The net-cutters themselves are made on the principle of the well-known mowing ma-

blade of similar pitch slides back and forth rapidly. In the design here shown, an electric motor drives a reciprocating cutting rod thru a set of gears, this cutting rod being joined to a vertical reciprocating shaft which slides up and down in a water-tight tube. The upper end of this shaft connects thru a link with a horizontal rod as shown, which in turn connects with a second link fastened to the moving toothed blade. The stationary toothed blade is secured to the hull of the submarine. The horizontal connecting rod is pivoted on the point indicated in the diagram, so that as the motor-driven piston moves up and down, the movable teeth are caused to rapidly oscillate up and down. These teeth are made of tempered steel and of considerable thickness, and not only this, but they are driven with considerable force owing to the manner in which movement is communicated to them thru the pivoted connecting rod and motor gear.



Not Only Are We Confronted With the Important Problem of Providing Nets Thru Which Enemy Submarines May Not Pass, But Also as One of the Prime Warring Powers, We Happen to Be Interested in Devices Which Will Enable Our Submarines to Cut Thru Enemy Nets. The Motor-Driven Net Cutter Here Shown in Actual Operation, Has Recently Been Patented by a New York Inventor and Promises to Be Considerably Efficient. There Are Two Sets of Steel Teeth, One Set of Which Oscillates Back and Forth by the Other Many Times Per Minute.

possible for such an under-water craft to burrow its way thru steel nets, no matter how fine the mesh may be, or how heavy the cables of which the nets are constructed. You will hear some people argue about "submarine net-cutters," and when they are asked as to just how the "sub" manages to cut thru the net, especially when running blind, you will invariably hear a reply something like—"I do not know the exact details, but it is very easy." But is it?

Oscar A. Youngren, of New York City, has recently taken out a patent on a submarine net and cable-cutting attachment which is illustrated in action herewith. It is simple and rugged in design, and is operated by means of an electric motor placed either inside or outside of the submarine hull.

How can we locate the nets? By observations in the vicinity of such nets before totally submerging; by sinking to the bed of the harbor or channel, if it is not too deep, and liberating a diver from a special chamber provided for the purpose, who can explore the water in the vicinity of the submarine; also the proximity of nets will be made known when the submarine bumps against one, for they are usually strong enough to prevent the submarine from getting any headway once it runs into them. By

chine, which carries a long fixed toothed blade over which a second movable toothed

the tropical land of Porto Rico. Here aerial plant life insists on living on the wires.



This Remarkable Photo Was Taken in Porto Rico, Near Ponce, and Shows the Aerial Plant Life that Insists on Living on These Wires.

GROWTHS COVER PORTO RICO WIRES.

Some years ago the telephone and power companies operating down in the southwestern part of the United States and in Mexico found that they had to replace all their wooden poles by steel ones. All for the very good reason that in that part of the country there was a very busy little bird that persisted in picking the wooden poles full of holes, honeycombing them in fact. Now we have a photo of what happens to the aerial telegraph and telephone lines in

Chain of Aërial Landing Fields Across U.S.

AMERICAN birdmen will soon be able to fly across the United States, thanks to the recent announcement authorized by the War Department that a chain of landing fields for air pilots is being built across the continent. In a few states they already await the flyers, being established at intervals of 100 miles.

one at each corner of the landing field. These mark the position of the field from afar, the vertical shafts of light being visible for a distance of 40 to 50 miles or more. By using different colored marker lights for each field its name and location can at once be ascertained. Only two of the marker beams need be colored, New York City

cially needed in formation flying, where as many as 15 to 20 'planes, or more, often fly in a "V" or other formation. As the airplane heads down toward the field it is supposed, in this layout of signal lights, to light on the illuminated "Potts Arrow", then taxi along until the illuminated crescent is reached. From here the 'plane is



In the Standard Aerial Landing Field A Represents the "Markers"; B the Arrow on Which the 'Planes Land; C the Crescent Where They Stop; D, Field Limit Signal; E, Hangars, and F, the Observatory. Markers A Can be Seen 100 Miles Away Each Field Having Its Own Color

Copyright, 1918, by E. P. Co.

When completed, these well-marked, safe landing places will be to air pilots like water tanks to locomotive engineers or harbors to mariners. Besides oil and gas, the majority of the fields will supply to the pilots shelter and limited machine shop facilities, maps, charts, and barometer and thermometer ratings. New York, Pennsylvania, Ohio, Illinois, the District of Columbia, Georgia, Texas, and California already have established lines of such landing fields. Arkansas, Mississippi, Alabama, New Mexico, and Nebraska will soon be equipped.

The value of permanent landing fields, sufficiently close together to establish well-defined air routes across country, was emphasized early in the training of American flyers. Flying by compass has now become an established practise, but landing fields, like beacon lights, help the pilot to pick his course, even tho he has a compass. Most of the landings today are on army fields.

Reports to the Division of Military Aeronautics from field officers say that this movement, like that which started good roads, is rapidly gaining momentum. It is predicted that before another year an aviator with a plane of moderate power will be able to make a transcontinental flight without difficulty or inconvenience.

A typical aerial landing field of a type already successfully used in England is illustrated herewith. This layout includes four powerful electric searchlight markers,

(Mineola) having, say, two red identification beams, Philadelphia, two blue beams, etc. Another scheme would be to use a searchlight signal shutter on all the markers and to periodically blink the shafts of light on and off to give the telegraphic dots and dashes of the landing field's initials—as N. Y. for New York, etc. This could be done by automatic switching means actuated by a time-clock at periods of 5 or 10 minutes. It would also be possible in this way to signal by short and long flashes, corresponding to the dots and dashes of the telegraph code, the condition of the field,—such as dry, muddy, wet, etc. This information is of distinct importance to the aviator intending to land on the field, as the airplane is handled differently for each condition of the field. The landing dive angle varies for wet, muddy and dry fields, as does also the position of the 'plane just before it lands on the field. All army and navy birdmen have to know the telegraph and radio codes so no difficulty is encountered on this score. The electric lantern atop the Metropolitan Tower in New York City has been seen to beat the time at night at a distance of 30 miles easily, with the naked eye, and at much greater distance with binoculars or field glasses.

For night flying airplanes now carry a powerful electric headlight for use in landing, and have out-board marking lights, as well as a tail light, all of which are espe-

run off to the right or left to the hangars. A red "limit" light marks the end of the field. A meteorological observatory will be erected at certain fields. The "Potts Arrow" and other marker lights are illuminated by electric lights sunk in pits in the ground. These are covered with wired glass about two inches thick, over which the 'planes can run. The arrow is red, the crescent blue.

GERMAN "CARRY-ON MAGNET" IS TEN POUNDS OF BACON.

A "carry-on magnet, efficacy guaranteed," was advertised recently in German newspapers by its "inventor." The magnet was declared to have mystic powers enabling its possessor more easily to endure the food privations of the country.

The price was 300 marks and the buyer was privileged to inspect the magnet before paying. Those who sent in orders received a package bearing the inscription: "Contents: One Carry-On Magnet."

It is not on record that any one refused to pay for it, for the "magnet" proved to be ten pounds of Thuringian bacon. The ingenious "inventor" now is being sought by the police.

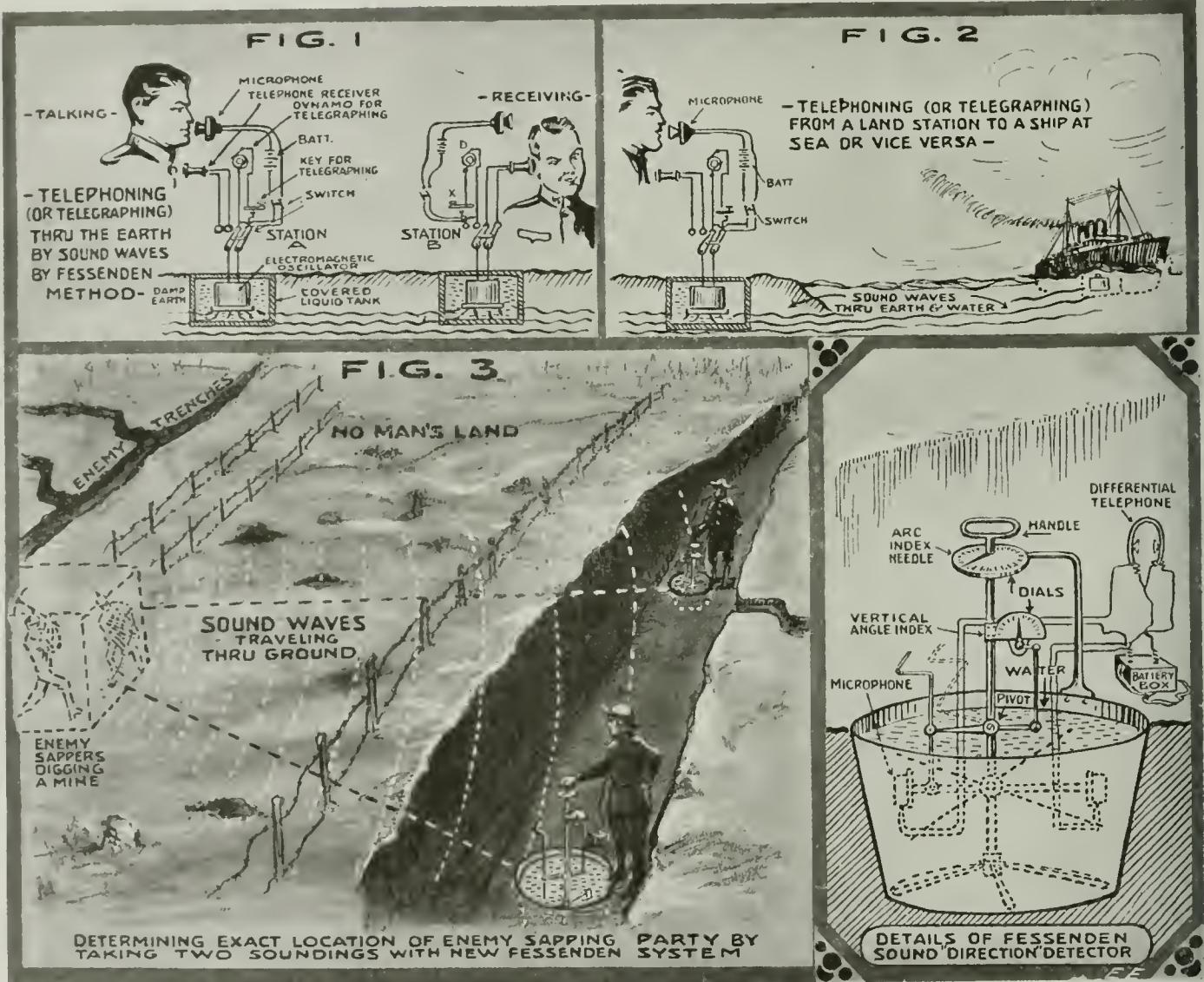
Talking Thru Land and Water

MANY years ago, when our forefathers were fighting hard to settle the country we are now living in, their enemies, the Indians, made use of many clever schemes for communicating intelligence from one tribe to another, even over considerable distances. It is said that the Indians transmitted intelligence over distances of fifteen to twenty miles when necessary, and one of the systems by which they communicated with one another when on the war-path, was to

approach of men on horseback by placing the ear to the ground and listening for the sounds of the horses' hoofs, even when many miles away.

Acting on this very idea, it has remained for an American inventor, Professor Reginald A. Fessenden, to invent a system of transmitting and receiving powerful sound waves thru the earth or water. Professor Fessenden, as generally known, is the inventor of a system of submarine telegraphy which employs sound waves for the trans-

For telegraphy, use is made of an alternating current dynamo, D, which may be switched on to the powerful vibrator or oscillator immersed in the liquid-filled tank, buried in the ground, or mounted in the hull of a ship. Whenever the telegraph key is depressed, powerful sound waves will be set up and propagated thru the intervening medium. The sound waves are picked up by means of the same oscillator, or else by a sensitive microphone, placed in a tank containing liquid, in the same way as at the



Copyright, 1918, by E. P. Co.

By Means of the New Fessenden System Here Illustrated It is Possible to Actually Talk Without Wires Thru the Earth Or Sea for Considerable Distances. Also, the New "Sound Direction Detector" Will Render the Accurate Locating of Enemy Mining or Sapping Operations a Simple and Positive Task.

employ sonorous or sound wave vibrations transmitted thru the ground, and thus we know that the ground, and also water, are good sound conductors. The Indians used to hit two rocks together, one of which was partly buried in the ground, or else hit a rock with a tomahawk or hammer, and by various other means, transmission of powerful sound waves was effected. The "code" message was picked up by another Indian located some distance away, who placed his ear close to the ground. Not only this, but the Indians, not to mention the early pioneers, were experts in detecting the

mission and reception of intelligence. This system is in use on submarines and steamships as well as war vessels at the present time, and has saved many lives.

The present invention deals with a new and novel method of mounting powerful electro-magnetic vibrators (or "oscillators," as their inventor calls them) in sunken pits which are filled with a liquid, such as water, oil, etc. The electric circuits for either telegraphing or telephoning by sound waves, thru the earth or water, will be readily understood by referring to figures 1 and 2.

transmitting station. The fluctuations of current created by the sound wave impinging on the oscillator or microphone, in turn cause the telephone receiver diaphragm to vibrate and give forth corresponding sonorous signals. In practise, the telephone receiver is invariably of the watch-case type and mounted on a head-band so as to be easily worn for long periods if necessary.

For carrying on underground or underwater telephony, the apparatus is connected up to a battery and a microphone, as shown (Continued on page 505)

Magnetic and Other Fool War Dreams

AS TOLD BY THE "ELECTROMAGNET"—HIMSELF

YES, I am the much maligned and all-powerful "Electromagnet," bone of contention among patent liars, insulting engineers, and heaven-inspired inventors of all ages, from twelve to a hundred and twelve. Recently I paid a visit to the Editorial Sanctum of the **ELECTRICAL EXPERIMENTER**, and some of the inspired contributions and ideas I saw there, reposing gracefully in the waste baskets of the editorial and consulting staff, were from my more or less uninformed Over-Lords, who would have me perform some of the

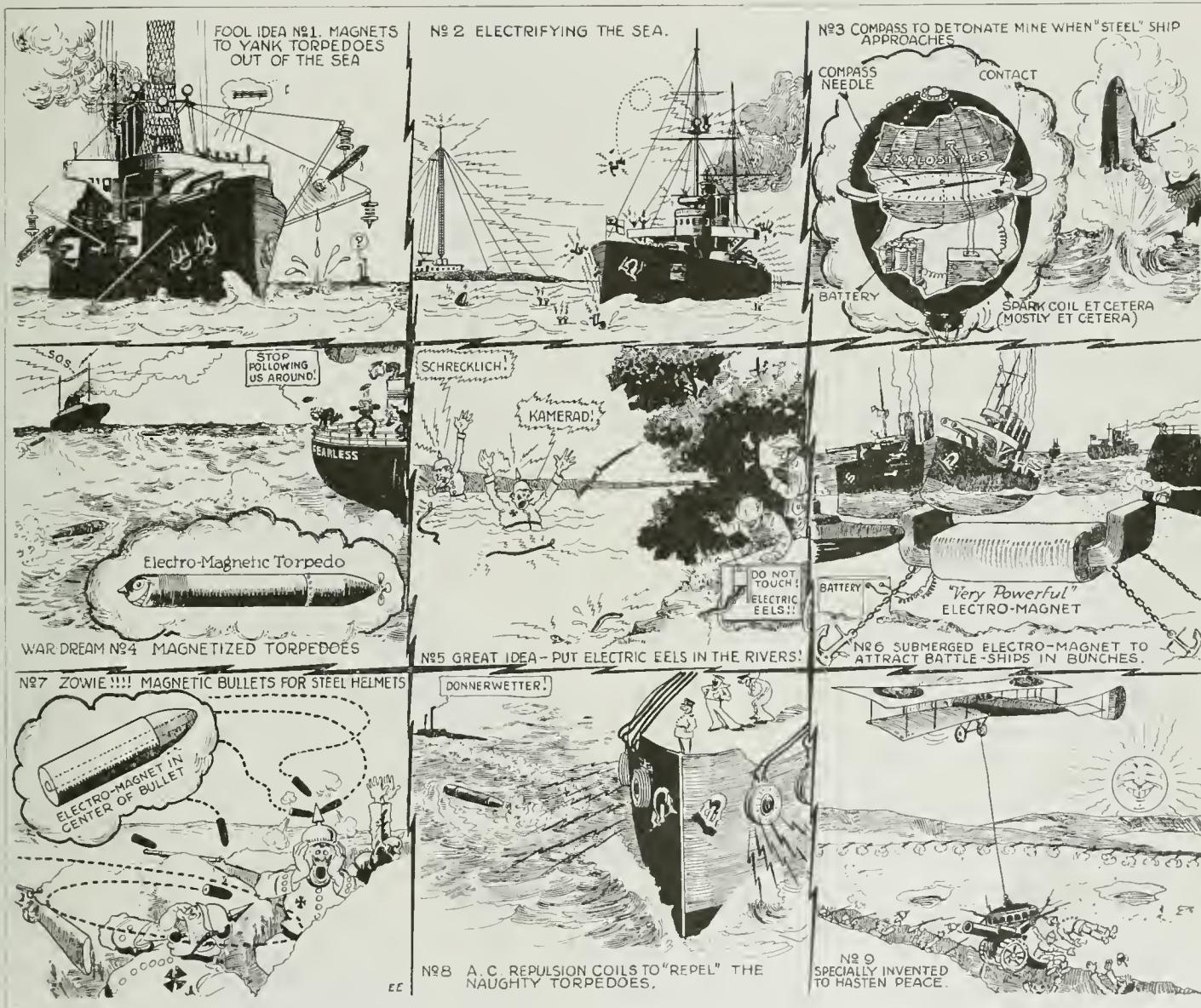
tended rather for the Naval Insulting Board, address Chillimycoat, Greenland, conveniently situated so that these precious ideas could be placed in cold storage and thus prevent their being lost to an ever waiting world.

One of the first would-be patents marked for the attention of the Naval Consulting Board was remarkable idea No. 1. This invention proposes to do nothing less than utilize my all-powerful magnetic attractive force at the ends of long booms, spaced liberally around the "dread-naught," so that

of steel plates when they were bank up against me, or at most not over an inch or so away from me and lying perfectly inert, that I could not lift a fraction of a ton or even a few pounds ten feet away!

And so the merry patent war goes on—inventors may come, and inventors may go, but the "magnet fiend" will live on forever.

While browsing around thru other more or less startling inventions, I ran across the masterpiece—No. 2—here illustrated by the editor. The "inventor" was no low-brow or cheap-skate by any means. He proposed



Here Are Just a Few of the Freak Ideas Electrical Inventors Have Proposed Since Uncle Sam Declared War. They Include Everything Imaginable and Some Not Imaginable—Schemes for Combing the Seas for U-Boats with Husky Electro-Magnets Consuming Thousands of Kilowatts, up to the Use of Electric Eels. 'Tis a Wonderful Collection.

most astounding stunts you ever dreamed of in your wildest metaphysical moments—and Brothers, if I may call you such, you ought to see some of those sketches and drawings of hair-raising and other electrical ideas marked, "Please forward to the Naval Consulting Board"! One look at some of the schemes with which their inventors propose to end the war in anywhere from six hours to twelve days would give you the impression that they were in-

when the naughty torpedoes come skipping along so joyfully thru the water, the chief electrician can throw in the main switch and feed me 110 volts and God-knows-how-many-amperes, so that I will instanter, according to his idea, proceed to exert an all-pervading magnetic power of presumably several thousand tons, thru a radius of several hundred feet. Maybe that bird would like to know that if I had a diameter of six feet, and could lift twenty tons

taking my co-ally, "High Potential," and injecting several billion kilowatts so as to boost the corona or effluve of my old friend "H. P.," so that he could hurl himself thru space to any convenient distance, say several hundred miles, so as to thoroly electrify all harbors, bays, inlets, and wherever enemy war vessels are wont to congregate, and even the ocean itself. Talk about your "Flying Dutchman." Gosh! but that's a
(Continued on page 496)

Why Is a "Blimp"?

By W. EDOUARD HAEUSSLER

KITE or observation balloons as they are termed, are used extensively in all of the theaters of the present war. Together with the innumerable airplanes employed by both sides, they constitute the most important means of

army balloon school at Ft. Omaha, which—as also the balloon units abroad—now utilize a portable automobile winch—i. e., a one-half inch steel cable drum and winch is mounted on a powerful auto truck. Greater flexibility is at once attained with this ar-

railroad locomotives in one case to haul down their observation balloons when a particularly rapid advance by the Allies threatened to envelop them, balloons and all. "Blimp" crews operate at altitudes of five thousand to six thousand feet usually, altho a twenty-five hundred to three thousand foot level is common, all depending upon the aerial activity of the enemy, and the extent of territory over which they have to observe.

Locomotives are also brought into play by the Allies in this interesting arm of the military activities, a very important branch when it is considered that the observation balloons are the eyes of the army. On a flat car there is mounted a motor-driven winch of the modern reciprocating, automatic adjustment, cable drum type, of extremely positive action. This car is trailed behind the locomotive in conjunction with an additional box car and another flat car. The box car is used to convey the gas stored under enormous pressure in steel "bottles," and the second flat car has the important service of carrying the balloon, bag and basket complete. The locomotive is of the armored type, and we therefore have a formidable "spy" in the shape of this aerial observation train and its equipment.

Beside carrying the gas on the flat cars, motor trucks or "camions" as they are now called thruout the Allied army, there are also generating stations situated behind the



Photo-Telephone Review

This Motor-car, Manned by French Soldiers on the Somme Battle-front, Carries the Winch and Telephone for the Handling of the "Blimp" Balloon. The U. S. Army Also Uses Automobile Winches.

observation and artillery fire control. Where there occurs a practical immobility of the lines for long periods of time, a case that is especially true in trench warfare, the observation balloons are particularly useful. It does not necessarily follow that these balloons cannot be used to advantage on marches. They can and are used even then, tho only under most favorable conditions.

Kite balloons are big and awkward to handle, and the manner of letting out and hauling in the balloons is interesting. The

arrangement, for in case of attack or due to sudden high winds, the winch truck can travel along in the proper direction while the balloon is being hauled in. These winches are arranged with a separate engine to wind up the cable, but the drum may be operated from the auto engine when necessary, or both engines can be used for either the auto mechanism or the cable winch. The Germans are said to have used



Photo © by Comm. on Public Information

Group of American Balloon Assistants on Duty at the "Gas Bottles"—Each Bottle Contains Hydrogen Gas for Filling the "Blimp."



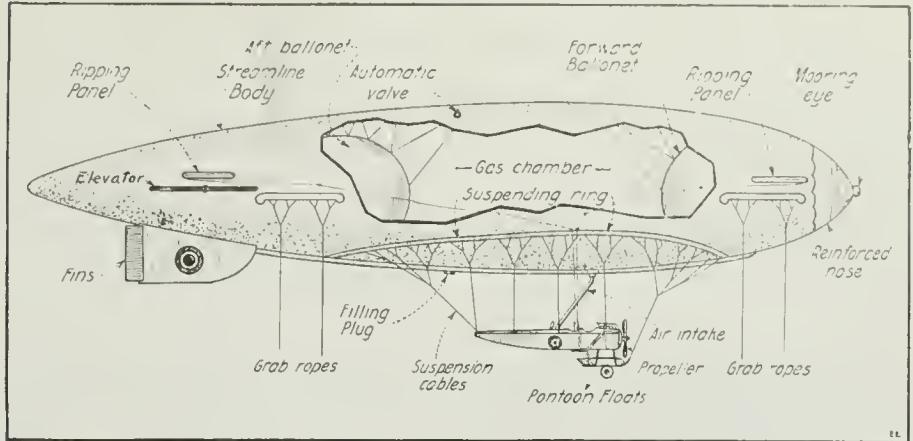
The Allies as Well as the Germans Have Used Locomotives as Winches to Haul Down "Blimps" in Emergency.

lines. Here the hydrogen gas is electrolytically produced on an enormous scale. The gas is generated in fairly large cement tanks that have been built into the ground, the tops of these tanks being placed flush with the level of the surrounding earth. These entire apparatus have camouflaged covers, hiding the plants from the eyes of the "boche" aviators. The cells are likewise made of cement, and are sixteen in number to a unit. The hydrogen gas is gathered by collector pipes that lead the gas to the gasometers or measuring instruments. It is then allowed to pass into the intake end of a force pump, compress and forced out of the exhaust side, into the steel containers—"gas bottles"—as they are popularly termed "Over There". The oxygen that is generated simultaneously with the production of the hydrogen gas, is stored

and used by the "Gas and Flame" Squads. The oxygen is combined with acetylene, thereby creating an intensely hot flame upon ignition.

In the construction of the balloon bag, almost without exception, the panel system of manufacturing is adopted, i. e., rectangular panels of fabric cemented and sewn together in the same form as bricks are laid. There are at least two plies of fabric in the ordinary balloon; in places there are three. This refers to the gas-holding envelope. The rudder and the interior ballonnet is generally only one ply thick. Where two or three-ply material is used, it is cemented on the bias, thus gaining enormously in resistance to tears. As a matter of fact, it is almost impossible to tear three-ply balloon fabric with one's hands.

The U. S. Army "blimps" are of the French type, measuring ninety feet long by thirty-five feet in diameter. The greatest beam, to speak nautically, is about one-third of the length from the bow to the stern. From here it tapers off somewhat toward the stern, thereby gaining a streamline effect.



A Longitudinal View of a Power Driven Airship. A "Blimp" It Is Termed by the Allies. It Is Cross-Sectioned in Order to Show the Essential Parts, the Relative Positions and the General Contour of This Type of Airship. The Completeness and Detail with Which the Above Schematic Illustration Has Been Executed, Should Prove Self-Explanatory.



Photo © by Comm. on Public Information, Raising an American Observation Balloon of the "Blimp" Class.

The "blimps" have air filled rudders which resemble a large "earth worm," extending clear around the center belt at the back of the gas bag, and also down and under the rear section. One side or the other of this air-rudder compartment is filled or emptied as required, thus presenting more or less head resistance to the wind and causing the "blimp" to swing around to the right or left as desired. The observer's basket is slung well below the gas bag so as to ride easily, and also to enable the pilot to cut loose with his parachute, in case the balloon is hit by an incendiary bullet or shell and set on fire.

The appendages attached to the rear of the balloon, are technically known as the air-rudders. Tho the principle involved in the operation of this air-rudder is extremely simple it is nevertheless rather difficult to describe in mere words. The action of the ballonnet can be better understood by referring to the illustration where the observation balloon is shown in section, looking at it from the bow at the point where the automatic valve cord runs transversely across the balloon. The reader, I trust, can understand from this illustration just how the valve works.

The automatic valves, H, are connected by a cord, X, to a stop immediately opposite to itself. Riding on this cord is an aluminum thimble, C; the thimble is fastened to a series of spider-legged cords, K,

which in turn are sewn to the upper surface of the ballonnet, A, consisting of a one ply thickness of balloon fabric and placed on the interior of the bag, separating it into two sections; the lower being the ballonnet, the size of which amounts to about one-third of the entire capacity of the balloon, and it is air filled. The inside portion of the bag above the separating ballonnet partition, comprises the other two-thirds of the containing factors of the bag, and is filled with the lifting agent, namely, hydrogen gas.

The balloon is not, as popular opinion seems to imagine, entirely filled

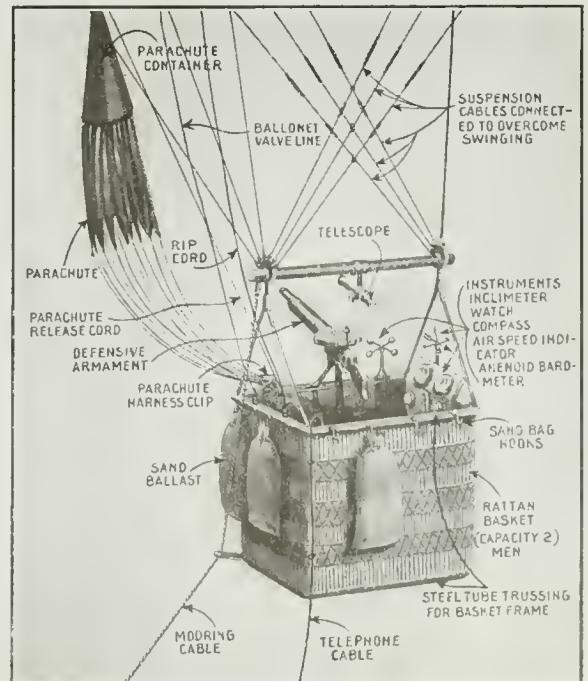
with this gas. Due to the expansion and contraction of gas in direct ratio to atmospheric conditions, some means necessarily had to be adopted in order that the shape of the balloon would remain the same at all times. In other words, the internal pressure had to be maintained at a certain constant. To accomplish this, the air-filled ballonnet was adopted. The ballonnet is located in the interior of the balloon proper, and it runs diagonally from end to end; from the lower surface at the forward end to the upper surface at the rear end, or stern of the observation balloon.

The physical action of the automatic valve comes into play when the gas in the upper portion of the envelope expands. This expansion of the gas forces the upper wall of the ballonnet downward, thereby keeping the internal pressure constant. As the ballonnet is forced down, it takes with it the spider legs, K, which in turn draw the aluminum thimble with them. The thimble, riding downward on the auto-

matic valve cord, X, pulls it, and the increased tension opens the valve, allowing the gas to escape.

As the gas escapes, the internal pressure tends to become less, and the pressure of the air in the ballonnet, which is equal to that of the wind, entering it indirectly from the air-rudder, forces the ballonnet, A, upward, and as the tension is removed from the thimble, the valves, H, due to their self-contained spring loading, automatically close. The hand valve produces the same action, and the gas can be made to escape by the pilot pulling this rope at his discretion.

An explanation of the air-rudder will not be amiss here, and it will serve to show how the air in the ballonnet is put under pressure by its action. This rudder is situated on the outside of the main bag, toward the stern and underneath. It is a sausage-like arrangement running towards the stern and ending in two small pipes which are communicant with the fins. These fins approximate the shape of the rudder, and are placed toward the stern of the bag and at its "equator". An aperture of about one inch in diameter is located at the forward



Close-Up View of "Basket" Used On "Blimps"—They Usually Have a Capacity of Two Men.

BACK NUMBERS!—Many readers desire to obtain back numbers of this journal. We have a limited quantity of these back issues on hand and can supply them at the following rates:—Back numbers of The Electrical Experimenter not over three months old, 15 cents each; over three months old, 20 cents each, over one year old, 35 cents each.

NOVEL X-RAYS

AN INTERVIEW WITH THE "ED"

By "Fips", Office Boy

AFTER several sleepless nights, I finally made up my mind to interview the Chief, even tho it would cost me my job. A certain matter disturbed me and I simply had to get it off my

around the machine were to be attired in "Frankfurter"-colored lingerie, while the Hun officers were to appear in Sauerkraut-colored pajamas, with X-Ray green complexions—indicating death by concentrated Sauerkraut-gas.

"War sure is hell", muttered the poor artist as he walked unsteadily from the sanctum as if in a trance, trying to memorize all those colors.

Trembling I entered the sanctum, altho I knew from experience that the Chief, having delivered himself of his monthly "atrocities", would be in a fair humor. Indeed he was. With his right hand he kept throwing rejected manuscripts into the waste-basket, while with his disengaged right foot he shoved hundreds of rejected "Phoney Patents" into a trap door in the floor. Down they went right into the automatic paper baling machine located in the cellar. The Chief, for once smiled. Why shouldn't he. Business was good—in rejected M.S.S. For if there was no money in the magazine business, due to preposterous paper prices—he always sold \$50.00

recently from your worshipping readers, who are begging you on their knees to publish your august countenance."

"Withering insecck," yelled the Chief, "fool, knave, wouldst thou deprive me of mine daily bread? Yon letters mean 50 simoleons in baled paper to mine income a day, at present market prices."

"I thought of all that, Chief. But suppose I know of a way to publish your picture, and still get the letters!"

Instantly the Chief was all attention and I explained my plan to him minutely.

Next morning I walked into his sanctum with the proof of the adjoining X-Ray photo of his head, and after he had snorted his approval of it, I began:

"Illustrious Mumbo-jumbo! Your eleemosynary servant would fain address several questions to his august master—"

"Why August?" exploded he, "this is September, is it not? But proceed and be short!"

"Chief," I began, "it is of paramount importance to your readers, just where all those classical ideas of yours originate? Do they find their birth in these white, blank spaces, of which there are so many scattered thruout your reverend dome?"

The Chief grew pensive: "No not all of them," he said, "only strictly ethereal ones."

"What accounts for the extraordinary emptiness of the upper, back section of your skull, Chief?" I continued.

"Very simply explained. At the time the exposure was taken, I thought of you. Naturally my mind was blank!"

(Continued on page 488)



Actual X-Ray Photo of Mr. H. Gernsback. This Picture Was Taken in 3 Seconds with a Powerful 5 K. W. X-Ray Machine. Mr. Gernsback Was Lying on a Photographic Plate, FACE DOWN, the X-Rays Penetrating the Entire Skull. Note the Upper Right Hand Gold Tooth. No Sensation is Felt While the Rays Penetrate the Skull, Except a Slight Contraction of the Two Eye Balls. Photo, Dr. B. Fidler, N. Y. C.

chest. So I cautiously pussyfooted in to his sanctum, climbed on a chair, and ambushed him by way of an open transom.

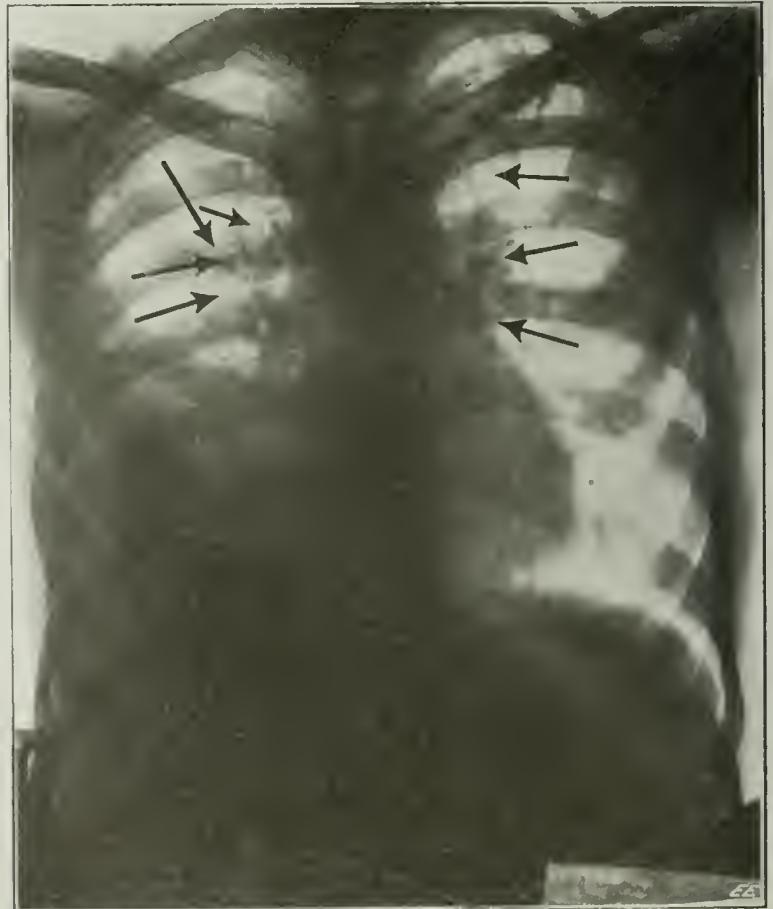
The prospect did not look very promising. Our Editor-in-Chief was very, very busy. With his left hindmost foot he was O.K.ing "E. E." press proofs, by means of a rubber stamp attached to his heel. He glanced at the proofs thru an inverted periscope. To his left ear was strapped a telephone receiver over which the latest electrical and scientific news came trickling in. Of these he made notes using his left hand to write them down in Morse code on a constantly moving paper tape. He was just discussing the next "E. E." cover with the cover artist, and that poor mortal was perspiring freely trying to devise some brand new color scheme that would—in the Chief's language—"knock 'em dead!" The Chief wanted an ultra-violet-sky, tinged with a carhuncle-heliotrope shade. The war machine—which sure was to win the war this trip—and which was to form the hair-raising subject of the cover—was to be a deep Hun-blooded red-vermillion, with garlic colored reflexes, while the wheels were to be of a deep-frozen helium-argon shaded gray, with canary-colored aigrettes on the hubs. Our soldiers were to be camouflaged in chameleon (changeable) colored uniforms, with lilac scented clodhoppers! The dead Huns piled sky high

worth of baled manuscript paper a day! And that didn't cost him one cent. Besides most contributors use good paper, too, which commands a higher price!

After discreetly coughing a couple hundred times to attract his attention, I finally caught the Chief's eye.

"Well, what is it?" thundered he, working right ahead with his four extremities.

"Anointed Chief," I said, "there have been millions of requests



Remarkable X-Ray Photo Showing Incipient Tuberculosis. In This Picture Right Is Left and Vice Versa. The Air in the Lungs Photographs White. Note That Right Lung Is Deeply Affected with Pleurisy, One Half of it Showing Black. The Arrows Point to Sections of Lungs Diseased with incipient Tuberculosis. Photo Courtesy Dr. B. Fidler, N. Y. C.

Electricity Aids Hun "Movie" Spies

By GEORGE HOLMES

AGAIN we have the unfailing "Movie" to supply the thrill which all must experience to get away from the humdrum of every day life. This time our reportorial eye was glued to see the "writing on the wall," as it were, and with a little sleuthing on our part we

Lertz gives him money to carry out the plot.

Dr. Wolf prepares germ cultures and from it a paste impregnated with the living germs. Thru this paste he permits common house flies to walk, thus transferring the germs to them. Then the flies are re-

This instrument gained the first information which the Secret Service received in regard to the plan of the Imperial German Government's spies and plotters in America to destroy the Du Pont de Nemours munitions plant at Hopewell, Va. A woman suspected of being in sympathy and in the con-



Below—Fig. 1. A Gripping Scene From "The Eagle's Eye," When Dr. Wolf, a German Born Chemist Residing in New York City, Determines to Spread Broadcast the Dread Epidemic—Poliomyelitis.

At Right—Fig. 2. Using the "Dictograph" to Get the Evidence on a Gang of Spys and Plotters. Thru the petty Jealousy of two Women the "Secret Service" Detective Learns All.

Below—Fig. 3. The Final Episode From "The Eagle's Eye"—Where the German Spies Try Their Best to Wreck a Big American Railroad. But Trust to Harrison Grant and Dashing Dixie Mason of the "Secret Service" to Watch the Telegraph Lines and Catch the Dastardly Plotters Just in the Nick of Time. This Movie Thriller Abounds in Electrical and Scientific Features.

came back with some more scenes from that truly dramatic photo-play masterpiece—"The Eagle's Eye"—which is doing much to show our stay-at-homes what the vigilance of the eternal Secret Service has protected us against.

First is the plot to spread the dread epidemic of infantile paralysis thruout the land. Dr. Wolf is a chemist, German born and trained, who has a small laboratory in a tenement section of New York. (See Fig. 1.) In a medical journal he learns that it is possible to isolate the poliomyelitis germ, the cause of infantile paralysis. A scheme for causing an epidemic occurs to him. He goes to Heinrich von Lertz and explains that the number of deaths which will result will so weaken the morale of Americans, that the possibility of the United States joining in the war against Imperial Germany would be removed forever. Von

leased to scatter the germs to the food of the city.

He next begins drinking, in an excess of enthusiasm over the success of his plot. He falls, in a drunken condition on the table of his laboratory, cutting his hand on a broken culture tube. He is infected with the dread disease he has caused in so many helpless children, and dies in agony.

Petty jealousies on the part of women have caused some of the greatest catastrophes of history. Yet this trait on the part of the eternal feminine has often been turned to good advantage, and in one instance it was the direct cause of the Secret Service gaining the first information of one of the most gigantic plots planned by the Imperial German Government's spies and plotters in America. In this case resort was made to the use of a *dictograph* to listen in on the conversation of the plotters.

confidence of Ambassador von Bernstorff, Captains Boy-ed and von Papen, and Dr. Heinrich Albert, the four leaders of the Kaiser's spy army in America was shadowed to a hotel. The operative who had followed them had no trouble in obtaining the room next to the one assigned to the suspect. The microphone was then attached to the door between the two rooms and the operative affix the head-phones. (See Fig. 2.)

Information was not long in coming. The suspect had a caller, also a woman. A quarrel ensued in which the suspect accused the other woman of attempting to usurp her place in the confidence of the Imperial German spy leaders in America. The quarrel exposed the fact that the accusation was based upon some plot suggested by the caller in regard to the munitions plant at Hopewell.

(Continued on page 504)

Electrified Barriers Stop Fish in Streams

ON many occasions, particularly where large irrigating ditches are in use, and also in many large fisheries where fish are hatched and often are guided thru different water channels from one lake to another,

composed of heavy iron or other metallic wire, which may extend nearly to the bed of the stream or ditch. The different strength currents are applied, as the illustration clearly shows, to the successive barriers, so that the weakest current of

of all sizes at such places will be turned back without fear of killing the smaller fish, by subjecting them to a sudden charge of excessively heavy current, which might easily be the case if but one electrode charged at a fairly high potential were employed. As will be seen, one side of each of the transformer secondary coils is connected to a common conductor which is grounded, i.e., connected to earth. Thus, the current will pass thru the earth, thence thru the water to the respective metal wire barriers hanging in the stream. The metal barrier wires or rods do not need to be very close together, and yet they will protect as efficiently as a small mesh net.

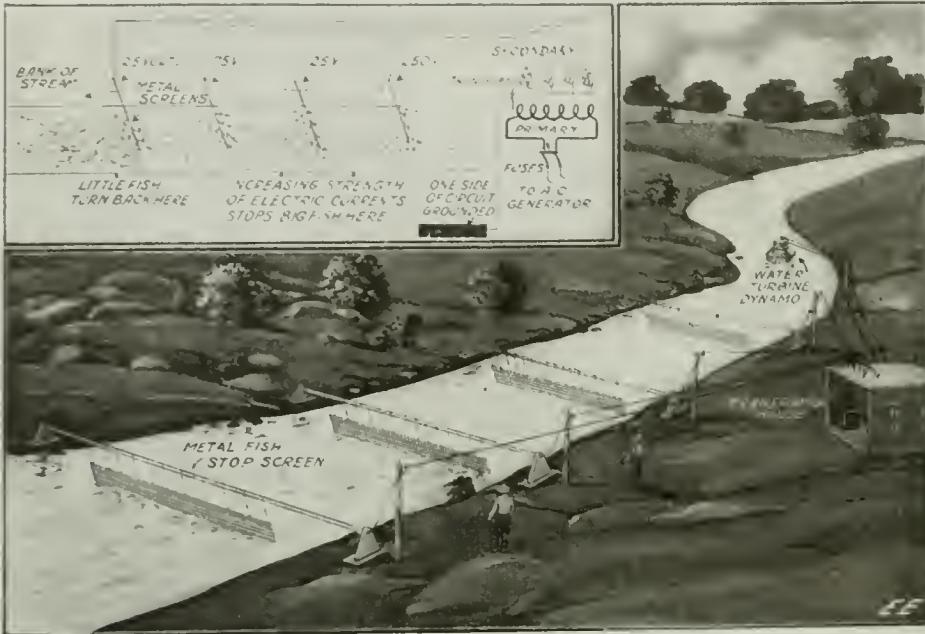
According to a French electrician, the temperature of the carbon filament in an incandescent lamp approached 2,000 degrees.

THESE SPECTACLES CARRY THEIR OWN LIGHT.

By Frank C. Perkins

The accompanying illustration shows an electric spectacle lamp and frame developed by an Idaho inventor, Mr. Ladislaus Zachara. This electric spectacle lamp and frame provides means of bringing powerful electric lighting on a spectacle lamp and frame around the eye or eyes in the forehead, in order to exclude shadow from the side of the object where it is desired to see it clearly and yet leave both hands of the user free. It has an electric wiring system inside of the spectacle frame. For instance, a hollow socket and a passage thru the center of the lamps may be provided and a dark sleeve inside the passage of the lamp will enable the user to see the object clearer.

There is provided a cylindrical passage in the lamp which curves out on the point of the lamp and this curving can be shaped to any desired design. It is intended to give the eyes protection from overstraining by virtue of limiting the view thru openings in which dark tubings are mounted, thus protecting the eyes from too powerful light rays, the wide protecting frame catching the rays and throwing them back from the direction of the face. The bulb can be equipt with small reflectors if desired.



The Old Way to Stop Fish from Going Up a Stream Was by Means of Nets, but the Newer Electrified Barrier Method Illustrated is Much Superior. By Means of a Water-Power Electric Generator, the Stream is Made to Furnish Its Own Electrifying Current.

etc., it is often very difficult to keep the fish from passing up undesired streams. It is not always feasible to prevent fish from following along such water channels by placing nets in the stream, for, in many cases, when a sufficiently small mesh net is available and placed in the stream, it will impede the flow of water too greatly. On the other hand, if a large mesh net is used, the small fish and young ones will readily pass thru the net. Not so, however, with the electrified fish-stop here illustrated, and which was recently patented by an Oklahoma genius, Henry T. Burkey, who often had the vexing experience of standing on the bank of one of his irrigation ditches, and seeing countless schools of fish of all sizes swarming along thru the ditch, even tho a number of nets had been properly placed to prevent their passing into that particular ditch.

To circumnavigate the shortcomings of the net method of preventing fish migration along undesired water channels such as this, Mr. Burkey thought of providing a *graduated electric fish shocker*, such as the one shown in the accompanying illustration.

The electric power for charging such a fish-stop can, moreover, be derived from the stream itself, by means of a small water turbine-dynamo placed into the stream. Electric power from the dynamo is carried to a small out-building housing a transformer which provides a series of graduated voltages. In other words, the transformer takes the current from the dynamo at a potential of, say, 110 volts, and converts it into currents of several gradually increasing voltages with potentials of 25, 75, 125 and 200 volts, for example.

The fish-stop barriers can be made from lengths of iron pipe supported on suitable insulating pedestals on the banks of the stream. The iron pipe carries a barrier

twenty-five volts is placed at the mouth or entrance of the ditch, and the current along the channel gradually increased in voltage to the rear of the outlet end, where a current of two hundred volts potential is met with—sufficient to turn back the largest fish.

In this way Mr. Burkey proposes to electrify any particular section of a stream or irrigation canal, with a gradually increasing intensity of electric current, whereby fish



The Mystic Trio—Who are They? Ah! the Secret is out, they are Wearing the very Latest in "Spectacles." Each Pair of Glasses Carries Its Own Electric Light Between the Lenses, Current Being Supplied from a Small Pocket Battery.

How Can We Tell "Real" Death?

By H. WINFIELD SECOR

CONSIDERABLE research in the realm of that branch of medical science dealing with *real* and *apparent* death shows that medical men practically agree that in view of the facts available on the matter, and also in view of their various experiences, that it is possible for a person to apparently die, and yet be in such a perfect trance or state of *syncope* that they can defy practically every ordinary test which the physician might apply, to determine if life had entirely left the body. Briefly, the facts in a number of such cases show that the respiration or breathing function may drop to such a low point that it is imperceptible and will not show on any ordinary indicating apparatus, as for instance the well known mirror test. Also the person may be in a state of *syncope* with the heart functioning at such a low state of activity that it is impossible by any ordinary means employed by the physician, to determine whether the person is actually dead for all time or only in a temporary trance. These facts are of vital importance to all of us and of supreme interest to be sure, for we have all heard or read of persons being buried alive or while in a trance state.

Many people probably have scoffed at such statements or stories, but there are a sufficient number of cases on record to prove that we do not as yet know all concerning human life, and as to what the real germ of life is. For instance, if one will go down to the New York Academy of Medicine, and there consult the records of a number of eminent British physicians and scientists who visited India some years ago, they will find the official records, many of which are sworn to, covering the wonderful performances of the so-called Hindu fakirs. These exponents of advanced science can place themselves in a state of *suspended animation*, or *syncope*, for long periods; even as long as a month. During the time he is in this *syncope*, the subject appears to all intents and purposes to be actually dead, and can even be buried in the earth in a *sealed* coffin. After the prescribed time is up, the subject is revived by his friends and he is as much alive as ever.

We have not the space here to discuss the most interesting phases of this entrancing branch of ultra-science, which has been but little investigated in a qualitative and quantitative way.

The writer has consulted a number of prominent New York physicians on this phase of medical science among others Dr. E. M. Overton, who attended the well-known actress Miss Anna Held, who re-

were pronounced dead to all intents and purposes, after all tests, including those of respiration and heart action had been thoroughly carried out. A very interesting and little known experiment was carried out in these two cases, that of injecting *adrenalin* into the heart proper with a long-needle syringe, a quantity of about one-half cubic centimeter being sufficient. These patients were brought back to life in this way (these experiments having been conducted at a well-known New York hospital) after all bodily processes and organic functions had ceased, in a period of *suspended animation* lasting about five minutes. One of these patients, a woman, was successfully resuscitated in this way and died eventually by contracting pneumonia. As Dr. Overton explained, "We cannot boost the heart or cause it to work beyond its limit, once the critical period in its life has been reached." But in this case the patient was an alcoholic and had been under severe exposure to the cold when received at the hospital. The second case was that of a man, and at last accounts he was still alive. The writer knows of a case where a woman thirty years of age past into a state of *suspended animation*, due undoubtedly to a severe sickness thru which she had past and who resuscitated herself after a *syncope* of twenty-four hours; this lady is alive and well today at the age of sixty-five years. The patient in this case had been pronounced dead by the attending physician, and came back to a regular state of life and activity when in her coffin.

Thus when all is said and done, we are vitally interested beyond the peradventure of a doubt in knowing what medical science has found out today in order to determine surely and accurately when life has past from the body, and below are given the principal tests which are used, as well as a number of newly suggested tests for this all important determination. Before going further it is well to remember that all undertakers today embalm the body, and the embalming fluid,



The Principal Known Methods of Determining the State of "Real" Death from a Trance or "Syncope" Are Illustrated Above. This Is One of the Most Baffling Problems In Science.

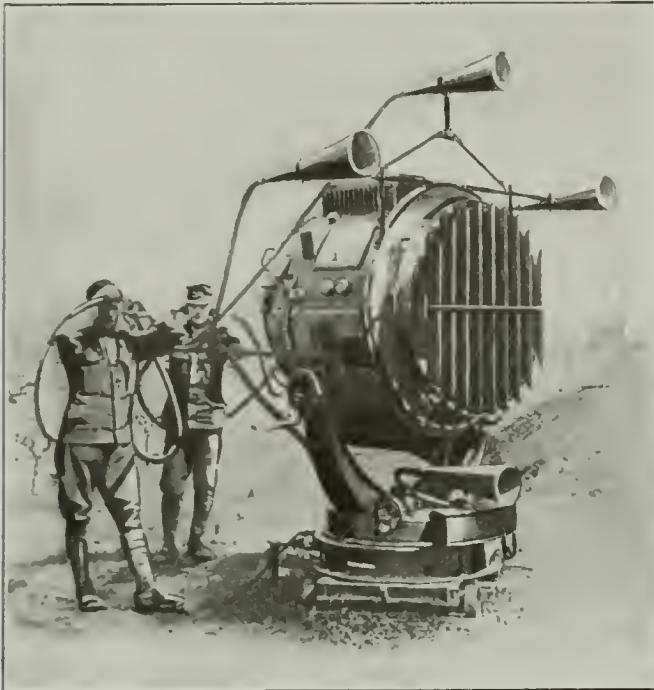
cently died of pneumonia with complications. It was reported in the daily press that she manifested a remarkable state of suspended animation for two hours, but this is not true. The patient, however, did present a remarkable case, and a short *syncope* did occur. Dr. Overton recalled two cases in his experience where a *syncope*, or state of "suspended animation," occurred for a period of about five minutes. The patients

in knowing what medical science has found out today in order to determine surely and accurately when life has past from the body, and below are given the principal tests which are used, as well as a number of newly suggested tests for this all important determination. Before going further it is well to remember that all undertakers today embalm the body, and the embalming fluid,

(Continued on page 498)

Searchlights With Aircraft Sound Detectors

The accompanying photograph shows one of the large Austrian searchlights used on the Italian front in the recent offensive by that country. As will be noted this search-



© Underwood & Underwood

An Austrian Searchlight on the Italian Front Equipt With Sound Detectors. Austrian Soldiers Are Listening for the Approach of Italian Aircraft.

light is equipt with special sound detectors comprising a series of large megaphones mounted in circular fashion about the searchlight frame, so when the operators quickly move the searchlight and adjust the mechanism, an approaching aeroplane, or fleet of enemy aeroplanes, will produce the maximum sound in the acoustic receivers attached to the megaphones. Thus the searchlight beam will automatically and simultaneously be focust in the same direction to that in which the megaphones are pointing.

This unique arrangement for locating and

revealing the enemy aircraft is used most efficaciously at night of course. It is quite surprising to learn that a simple megaphone of even small size, such as that here shown, will indicate the approach of an aeroplane, owing to the great volume of sound given off by the gasoline motor propelling the plane. The French Aerial Observation Corps have made very extensive use of these megaphone aircraft detectors. They have been much employed in the larger cities of France, including Paris, for detecting the approach of hostile aerial squadrons or even a single enemy plane, even when they are several miles away.

The object of using the megaphone horns is that they will respond with the maximum sound when they are pointed to within even a few degrees of the source from which the sound is emanating, which is in this case, of course, the enemy aeroplane motor. The photograph, as aforementioned,

shows Austrian observers listening for the approach of Italian aircraft. With such devices available it is possible for the military intelligence department to ascertain the approach of enemy bombing planes when they are at a considerable distance, and when thus armed with this advance information, it is a simple matter to bring up the anti-aircraft artillery, many of the guns of which are mounted on high-powered automobiles, and provide a very warm reception for the enemy intruder when they arrive on the proposed scene of action.

HEAT AND LIGHT TREATMENT LAMP.

The illustration shows a new and improved thermo light, which has been designed along scientific lines for the proper infusion of electric light and heat.

This unique reflector so directs the heat rays of the special lamp that they produce the best results with minimum current



Heat and Light Treatment Will Often Work Wonders Where Medicine Falls. This Thermo Light Connects With Any Current Outlet.

consumption and without the rapid deterioration of the filament.

The heat rays are effective over an area of approximately 50 square inches and not focust in a small burning spot.

The outside shell and inside reflector are constructed of aluminum, making the device very light in weight, which permits prolonged treatment without fatigue.

It comes complete with lamp, to operate on any direct or alternating circuit not exceeding 125 volts, 8 feet cable and attachment plug.

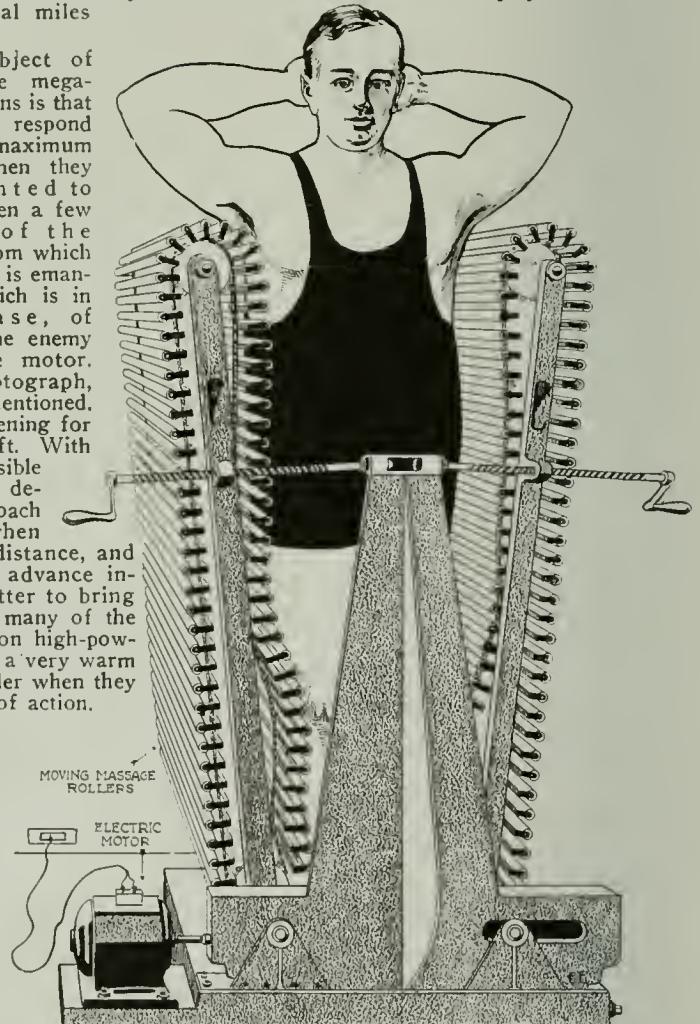
A group of European electricians decided, after experimenting, that better results were obtained by placing the carbons in arc lamps horizontally and one slightly above the other.

MOVING ELECTRIC ROLLERS MASSAGE WHOLE BODY AT ONCE.

Possibly you are one of those individuals who have become somewhat avoidupois, perhaps, several dozen pounds too much; in that case you may have had recourse to a masseur specialist, as many people have. Again, it is also quite possible that you did not attain the reduction in obesity that you had expected. Body massage, like many other things, is efficient only when kept up regularly and very thoroly.

The machine here illustrated aims toward the end of perfect thoroness in body massage, and the reader will see at once that the inventor of this recently patented contraption, no matter how uncomfortable it may appear first-hand, has evolved a very ingenious, and apparently very efficient massage machine, which, when adjusted to the patient's form, will proceed to massage the chest and leg muscles in a much more thoro manner than is the case when this treatment is performed by hand.

A small electric motor is employed with



The Latest in Body Massage Machines is Here Illustrated. The Motor-Driven Rollers Fit the Exact Contour of the Body and Are Adjustable.

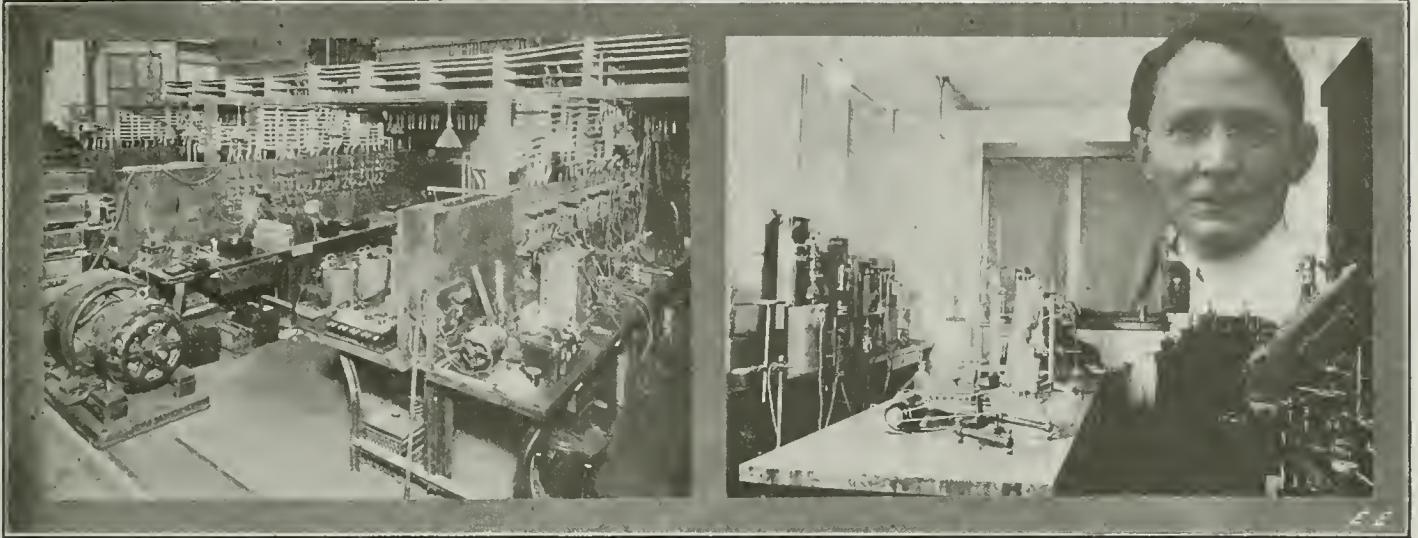
suitable gearing, so as to cause the two sets of wooden or other rollers to travel on endless chains. By means of the two handles shown on the right and left hand sides of the machine, the two uprights carrying the moving roller belts, can be moved toward or away from the "patient's" body, until they are adjusted accurately for each particular case. Also the upper rollers carrying the drums over which the roller belts travel, are adjustable and can be moved up and down vertically, so as to permit the belts of the top rollers to conform accurately to the shape of the body.

New Westinghouse Research Laboratory

THE research work of the great Westinghouse electrical concern has always been carried on under the direction of the engineering department. In 1906, the research division was organized as one of the several divi-

example, it has charge of the preparation of all specifications for the purchase of the materials used by the company, together with the experimental and development work leading up to the writing of these specifications, says Mr. C. E. Skinner, the chief en-

manufacture of its product. It has charge of the routine chemical and physical testing for all departments, including the inspection departments. It has technical control of the various metallurgical processes, such as those involved in the brass foundry,



Two Views of the New Westinghouse Research Laboratories and the Chief Engineer—Mr. C. E. Skinner. Here is Where Some of the Best Brains and Technical Talent in the Country Will Strive to Help Win the War for Uncle Sam.

sions of the engineering department, and it now has under its control seven laboratories.

The work of the division includes activities which are not usually clast as research work in other organizations. For

gineer and Mr. R. W. E. Moore, in a recent article describing these interesting laboratories. Mr. Skinner's photo is reproduced herewith. First there is a process section, which has technical control of all the various processes used by the company in the

copper mill, scrap-recovery plant, et cetera.

The laboratories under the control of the division are the chemical laboratory, the physical testing laboratory, the process laboratory, the electrical laboratory, the molded-
(Continued on page 503.)

Fair Telephone Operators Join Uncle Sam Overseas

HURRAH for the fourth unit of telephone operators, already taking its place in France beside the other three, and making things hum "over there!"

The cable "Arrived safely," is brief, to be sure, but what it really means to say is, "Sixty more French-speaking American girls have arrived in France to operate war switchboards for Uncle Sam and our boys."

They have volunteered to do this as their contribution toward winning the war, because they feel that it is the thing that they can do best. As one of them put it, if they didn't go they would feel like slackers, and would be slackers just as much as any man who shirked his duty. More are ready to go, but they are not needed at present, and are continuing their training over here.

With minds filled with the end to be attained, these girls and those who preceded them, together with those who are to follow, have traveled from the four corners of the United States,

Since every little town and every big city in the United States produces a different type of individual, these girls, when they meet, cannot help being surprised at the ways and characteristics of one another.

These operators hold a unique position in the army, being pioneers in their line. Many things in connection with their status in the army are not well defined as yet,

but will evolve with time. Need for such a unit was felt, the call went out, and the need was met. Minor details were left to time to be worked out.

For instance, after an elapse of several months, some changes have been made in the uniforms.

A summer outfit, consisting of a blue alpaca suit of the same cut as the heavy one, with a straw sailor, and a little aviation cap has been enthusiastically welcomed by the girls, who have felt the disadvantages of possessing one suit only, and that a very warm one for a hot day. Dark blue silk shirtwaists to supplement the white ones filled a much-felt need, and simplified the laundry question considerably, while rubber cloaks, arctics, and other accessories also helped to make up a complete, comfortable, and good-looking wardrobe.—
Photo, courtesy Telephone Review.



Hats Off to These American Telephone Operators Now Safely Landed In France and Helping General Pershing to Keep His Lines of Communication Working.

An electrically controlled machine for sorting coffee beans has been invented.

A Gyro Electric "Movie" Camera for the Battlefield

PHOTOGRAPHY fills a most important niche in this business of Kanning the Kaiser! There is hardly a branch of the service that is lacking a cameraman, whose business it is to bring back an indestructible, true and vivid record of what is going on "Over There" in the



The Latest Gyroscopic Electric "Movie" Camera for Use In Photographing Battlefield and Aerial Views. The Gyroscope Holds the Camera Steady at All Times.

fight for democracy. And thus will our children and their children's children be able to see the struggle that was made to preserve the liberty of the good old U. S. A.

The strides made in the art of recent years reflect what an advance has been made over the now seemingly antique methods of photography used in the Civil War.

In the days of '61 no great interest was evinced in the hazardous task of taking pictures under battle-front conditions and on the march. The very few men interested enough to undertake the task were mostly "free lances," doing things on their own hook. Considering everything we are to-day indeed fortunate in still having quite a number of these photographs, whose value shall increase in the years to come of that memorable struggle between the North and South.

All this is now changed. On every battle-front you will find the photographer. Whether on land, up in the air or on the sea, you will find him turning his crank or clicking his Graflex.

To overcome some of the difficulties experienced with the standard movie camera one large camera concern has devised a new type of machine adapted for use under the most adverse conditions.

It is constructed on much the same lines as the usual motion-picture camera, but more substantially, so that it will outlast the wear and tear of service on the battle-field. The film magazines, shutter, take-up arrangement, lenses, etc., are located on one side of the camera and identical with the usual machine.

On the opposite side may be seen the electrical drive for the film. See cut above. The motor is self-contained and fitted with ball-bearings to reduce the friction and make the driving almost noiseless. The motor is geared up so that at its maximum speed the machine takes about 24 pictures per second; the speed of the motor as well as the starting is controlled by a small lever on the side of the case which, when prest, causes resistance to be cut out of the circuit and the motor gains speed. Two dials are set in the top of the camera to show the speed of the film.

The all important feature is the small stabilizing gyroscope placed on the front

end of the camera and driven by a separate electric motor. After the gyroscope has attained its maximum speed of 5,000 r.p.m. (it takes about five minutes to do this) it becomes possible for the photographer to move about, run, walk, ride and do numerous other things, while he simply holds the camera by the two handles (one on each side). The camera will always maintain its horizontal plane and take distinct and clear pictures, without resort to a tripod or similar steadying device which would otherwise be necessary and always in the way.

The battery is carried in a separate cabinet and consists of a set of twelve storage cells, the casings of which are made of light celluloid and fixt into one solid unit. It delivers a maximum of twenty-

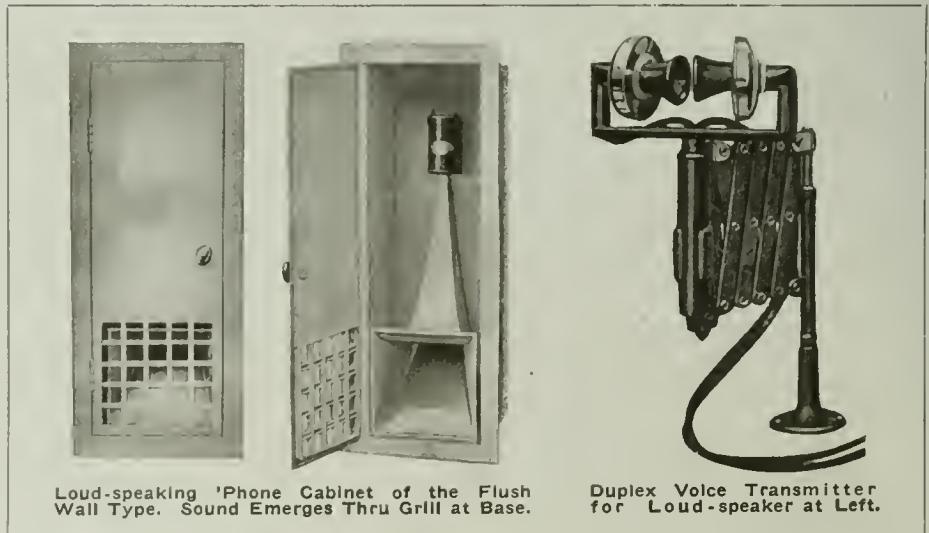
four volts and about ten amperes.

The cells are so arranged that the acid cannot spill should the battery be overturned or upset.



Extremely Compact Electric "Movie" Projector for War Camp Work, Y. M. C. A. "Huts," et cetera.

Next after taking our pictures and developing and printing them comes the need of seeing what we have taken. The regulation
(Continued on page 504.)



Loud-speaking 'Phone Cabinet of the Flush Wall Type. Sound Emerges Thru Grille at Base.

Duplex Voice Transmitter for Loud-speaker at Left.

IMPROVED LOUD-SPEAKING TELEPHONES.

The loud-speaking telephone has come to stay—only a few years ago it was practically unknown outside the laboratory. It finds many new applications daily and you are apt to meet it most anywhere nowadays.

A new type of duplex voice-transmitter is illustrated here. It is a very sturdy instrument manufactured for severe usage.

On quite a few installations of this apparatus as many as a thousand calls are made in twenty-four hours, day after day. Generally it is the telephone operator who uses this equipment. A telephone operator is always in a hurry and a transmitter designed for the operator to take up and lay down every time she uses it, does not stand up as well as a transmitter mounted on an extension telephone arm, one type of which is here shown. This improved type of transmitter is made without any movable joints and in as few pieces as possible.

The reproducer horns are located in the walls in flush type containing cabinets when possible, as this makes an unobtrusive installation. Since the reproducer horns are up out of the way where they are not subjected to wear, and because they have no moving parts to wear out, their life is practically unlimited.

The reproducer itself is mounted in a dust-proof case, and is fully protected against rusting.

Ordinarily there is but one switch used on these loud-talking systems and that is used for turning the current on and off. Standard switches are used.

The latest type of reproducer has as nearly permanent adjustment as possible. The reproducers are "seasoned" before shipment, so as to take care of any settling of parts.

The duplex voice-transmitter is designed for use on installations of from ten to twenty loud-speaking reproducer horns. It is approximately twice as powerful as the single-voice transmitter, because each transmitter energizes it's own individual circuit of reproducer horns. Approximately half of the reproducer horns being energized by each transmitter, there is no electrical connection between these transmitters, except that they are energized by the same current supply.

The concealed type horn and cabinet shown has been designed particularly for use in hospitals. The horn is white enameled and the cabinet is given a final coat of paint after being mounted in place, of the same color used on the walls. The hinged door gives ready access to the interior when it is desired to clean or dust inside.

Electric Trucks Aid War Work

ALONG with the great increase in woman labor in "the army behind the army," has come the use of a number of devices which make possible a much wider application of this labor than was originally thought of. Today women are making practically all of the great quantity of munitions that is being used by the British army.

One of the pictures herewith shows women workers loading shells on one of the trains of miniature railway cars, used for moving these shells about in one of the great British munition plants. Electricity is used wherever possible to expedite handling and delivery. Overhead cranes lift and carry the heavy shells and place them at their designated places in the shell warehouses. Women operators work the overhead cranes, direct the loading of the shells on the cars, as shown by the picture, and also drive the little storage battery tractor which transports these cars from building to building. It will be seen from the photograph that the girl in the foreground, driving the storage battery tractor, is quite youthful for the responsibility of this job. However, these tractors have been so simplified and safeguarded that their operation now can be performed by practically any person.

It is interesting to note that whereas the cars of the railroad trains run on tracks, the tractor which pushes these cars about does not do so. It can haul a string of cars in and then run past this string of cars, along the aisle, and do work elsewhere while this first string is being loaded. One of the desirable features of this storage battery tractor is that there is no overhead trolley and that all danger by reason of electric arcing, etc., is eliminated.

As our participation in the war assumes

greater and greater proportions we may expect to see large numbers of these little tractors in use in our own munition plants.

The other photo shows how the electric storage-battery equipt truck is "doing its bit" in our own country. During the present freight congestion and shortage of loco-

chanical and electrical perfection of the storage battery, insure that money-making result—most days in service per year.

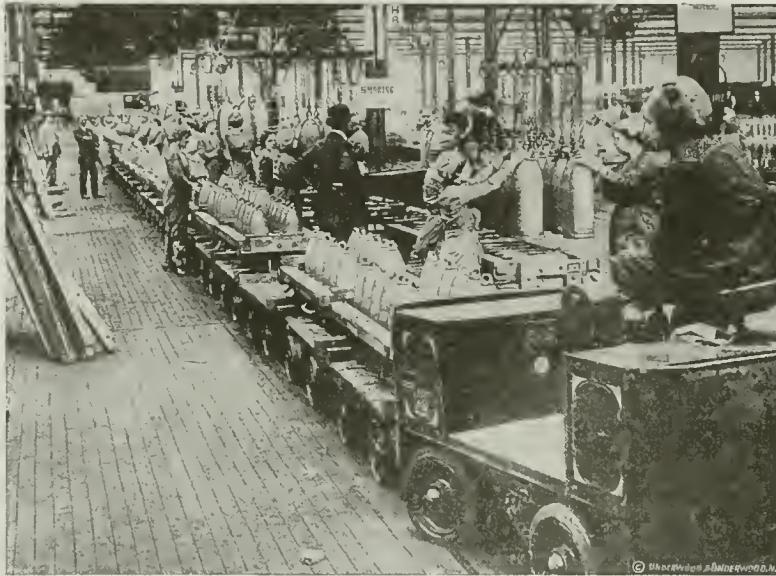
PLAN TO COMBINE ELECTRIC PLANTS.

Combination of electric generating systems and eliminating of hundreds of isolated and uneconomical plants is under consideration by the Fuel Administration as a means of saving fuel supplies. Representatives of the Fuel Administration left New York recently to attend hearings before the Public Service Commission at Washington, D. C., at which the subject will be taken up as affecting New York City.

Millions of tons of coal would be saved, officials say, by centralization. The plan, too, if executed, they say, would go far toward relieving terminal congestion and lightening the loads carried by rail and barge lines.

The coal administration is conducting a general investigation to determine how centralization best could be accomplished without working undue hardships on the owners of plants which might be closed.

"It already has been demonstrated," said a recent Fuel Administration order, "that in many localities centralization may be effected without hardship and with a considerable saving. England and France long ago have taken steps in this general direction. In fact, a commission appointed in England to investigate the subject has described centralization as an economic necessity. It is estimated in this report that an economic saving of \$600,000,000 would be effected and the fuel requirements of the industries now supplied with electrical power cut in half."

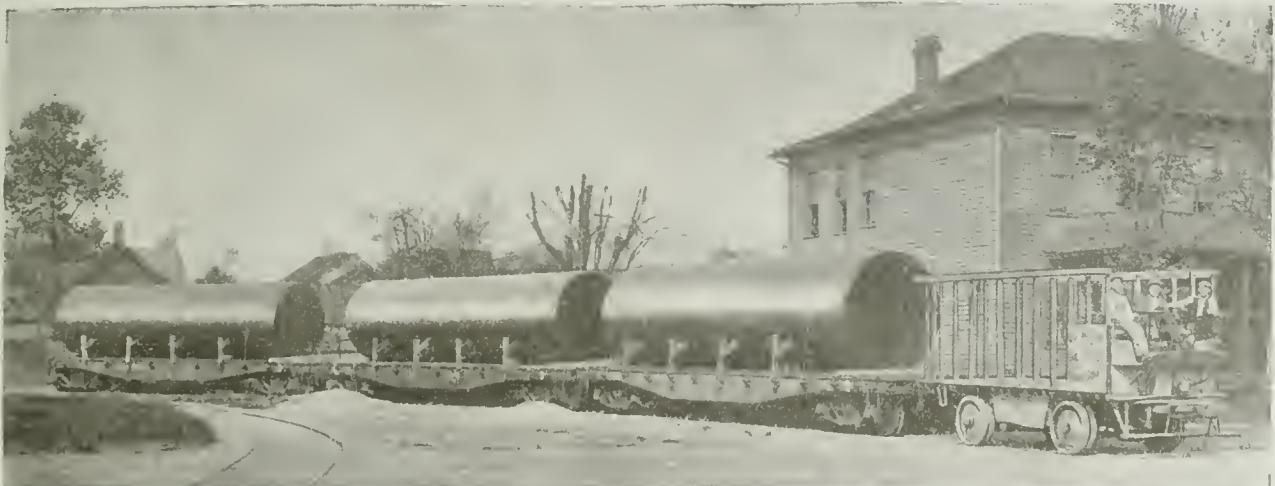


Miniature Electric Railway Used for Moving Shells in a British Munition Plant. Women Are Loading the Cars on the Second Track, While the String of Cars on the First Track Is About Ready to Be Moved Out. Notice that the Tractor for Moving the Cars Does Not Need to Run on the Rails. It Is a Mobile Unit, Able to Be Used Practically Anywhere. Electricity for This Tractor Is Furnished by Edison Storage Batteries in the Two Compartments.

motives these trucks have often proved useful in switching freight cars on sidings and in factory yards. The photo shows an electric truck hauling three hefty tank cars "somewhere in New Jersey."

The electric vehicle has a much wider range of service than most people appreciate. From the light 750-lb. delivery wagon to the 15,000-lb. truck, there is a choice for every industry.

The simplicity of the electric, whether small delivery or giant truck; its ease of operation and control, and freedom from mechanical troubles; together with the me-



An Electric Truck "Doing Its Bit" Somewhere in New Jersey. This Truck, Equipt with Edison Storage Batteries, Is Hauling Three Tank Cars Without a Whimper.

Popular Astronomy

THE SPIRAL NEBULAE AND THE ISLAND UNIVERSE THEORY—FIFTH PAPER

By ISABEL M. LEWIS

Of the U. S. Naval Observatory

THE mystery of the spiral nebulae is still unsolved. These peculiar structures exist in the heavens by hundreds of thousands. They range in size from The Great Andromeda Nebula, which covers a space about one and

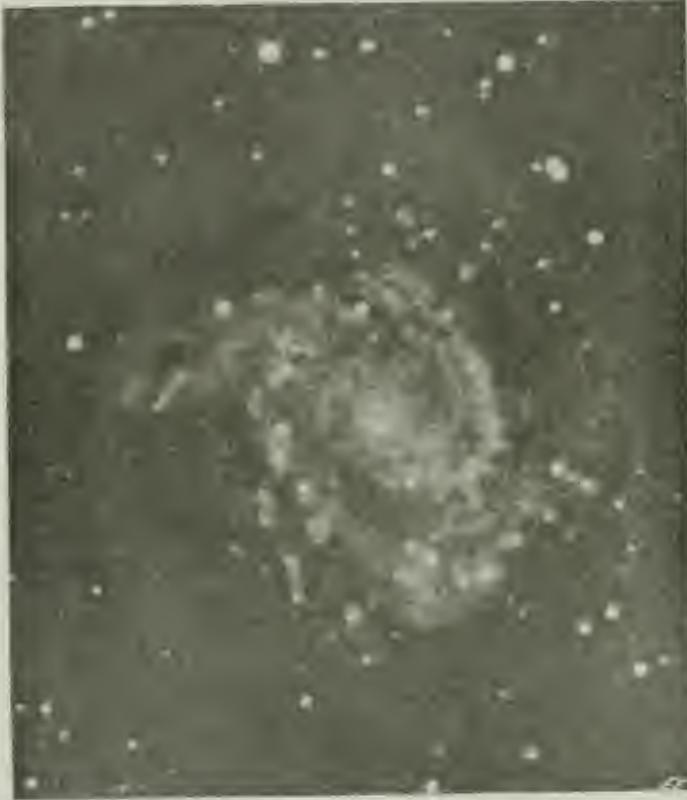
terring near the north pole of this plane and to a somewhat less degree near its south pole the distribution of the spirals is quite general thruout the heavens.

The reason that spiral nebulae should avoid the neighborhood of the Milky Way, which is the region favored by the gaseous nebulae, the planetary nebulae and the vast majority of the stars is not yet satisfactorily explained. The fact is most significant and must be considered in all theories dealing with the origin and nature of the spiral nebulae. The very fact that the spirals avoid the Milky Way shows that they are in some way affected by it.

A second most marked characteristic of the spiral nebulae is their extremely high velocity of motion thru space, the greatest for any class of celestial ob-

jects. A few stars spoken of as "runaway stars" have a velocity of one hundred or two hundred miles per second, but these are quite exceptional and they are sometimes referred to as visitors to our galactic regions from regions beyond. In fact celestial objects other than the spiral nebulae that have unusually high velocities of motion thru space such as the globular star clusters and a few isolated types of stars show the same avoidance of the plane of the Milky Way that is shown by the spiral nebulae. According to one explanation this is due to the fact that a strong gravitational field exists in this plane with its hosts of star clouds, and its vast tracts of nebulous matter, both luminous and non-luminous. Globular star clusters or spiral nebulae entering this field would not be able to remain intact but would be disrupted and scattered.

The spiral nebulae do not possess the "bright-line" spectrum characteristic of the strictly gaseous irregular and planetary nebulae that are found in the vicinity of the Milky Way but have the continuous type of spectrum such as comes from our own sun and such as would emanate from star-like bodies. The spiral nebulae are for this reason not considered to be strictly gaseous objects but a conglomeration of stars and nebulous matter. Dark streaks visible in a number of spirals that lie edgewise to the earth seem to show that these nebulae are surrounded by some dark gaseous matter



No. 3.—The Spiral Nebula in Centaurus (N. G. C. 5236) Photographed With the 40-Inch Reflector of the Lowell Observatory By C. O. Lampland. View of a Spiral Nebula Lying Across the Line of Sight.

one-half degrees in length by half a degree in width and is faintly visible without the aid of a telescope, down to the tiny flecks of light that are invisible to the human eye directly but appear on the photographic plates attached to our most powerful telescopes after an exposure of several hours duration.

Counts have been made of the number of spiral nebulae upon photographic plates within selected areas evenly distributed over the sky with a view to determining the probable number of these objects within the reach of great telescopes. It has been estimated as a result of these counts that there are at least seven hundred thousand small spirals photographically in reach of the largest reflectors, while the total number may easily exceed one million.

In some regions these spirals are crowded together in the greatest profusion. In a most wonderful region in the constellation Coma Berenices three hundred and four faint spiral nebulae have been counted upon a single photographic plate covering an area of about three-fourths of a square degree, tho a region of equal size only a few degrees distant contains but two spirals. Aside from a marked avoidance of the plane of the Galaxy and a noticeable clus-

jects. The radial velocity, that is velocity in the line of sight, has been found for some of the brighter spirals and it is now known that a number of spirals have a radial velocity of several hundred miles per second. Since motion in the line of sight is but one component of the actual motion of a body and can be shown to be equal to one half of the actual space velocity of the object it follows that some of the spirals are known to be moving thru space with a velocity of more than one thousand miles a second. The velocity of the stars averages about



No. 4.—The Whirlpool Nebula (N. G. C. 5194) in Canes Venatici. One of the Most Beautiful of the Spiral Nebulae. Its Spiral Structure Was First Detected By Lord Rosse in 1845. Photographed With the 40-Inch Reflector of the Lowell Observatory By C. O. Lampland. This Nebula Also Lies At Right-angles to the Line of Sight and Therefore the Spiral Formation is Very Noticeable.

that absorbs the light from the inner portions.

Believers in the *island universe* theory of the spiral nebulae consider that our stellar system is also a spiral nebula and that its form is essentially that depicted in the accompanying photographs of characteristic spiral nebulae. The spiral arms are represented in our system by the star clouds of the Milky Way. The well-known star streaming tendencies of the stars represent motions in and out along those spiral arms toward and away from the nucleus of the spiral. According to this theory dark nebulous matter may exist in outlying portions of the Milky Way similar to the nebulous matter producing the dark streaks in the accompanying photographs (Nos. 1 and 2). Such nebulous matter would hide from our view spiral nebulae lying in the neighborhood of the galactic plane and this would explain why the spirals apparently avoid the plane of the Milky Way. It has long been known that the vast majority of all the stars and the great irregular gaseous nebulae constituting what is known as our "stellar system," crowd toward one plane, that of the Milky Way; for all we know to the contrary all these stars and nebulae may form one vast spiral structure. The distance of the spiral nebulae is now known to be very great. At a distance of several hundred thousand light-years our whole system of hundreds of millions of stars would fade away into a small blurred speck in which no individual stars except the giants of the system would be distinguishable and we would appear as the faint spiral nebulae appear to us. So reason those who believe that the spiral nebulae are external universes separated from our Galaxy by distances so great that a ray of light travelling with the velocity of 186,000 miles per second would take not tens of thousands but hundreds of thousands years to span the abyss!

Until a year or so ago there appeared to be no way of arriving at a reliable estimate of the average distance of the spiral nebu-



No. 1.—The Dark-lane Nebula (N. G. C. 4594) in Virgo. Photographed With the 40-Inch Reflector of the Lowell Observatory By C. O. Lampland. A Spiral Nebula Viewed Edge-wise. This Nebula Is the First in Which Was Observed the High Velocity of Translation Thru Space Now Known to Be Characteristic of Many Spiral Nebulae. It Has a Velocity of Motion in the Line of Sight Toward the Solar System of About 685 Miles Per Second. Also the First Nebula in Which the Effect of Rotation Was Detected and Measured.

lae. Up to July, 1917, thirty two Novae or Temporary stars had been discovered. Of this number thirty were in the Milky Way, two were in spiral nebulae. No particular attention had been paid to the two exceptions. In July, however, Ritchey, at Mt. Wilson, found a faint star in a spiral

nebula that had not appeared on earlier photographic plates. Now one or possibly two Novae might chance to be in line with spirals but hardly three. The discovery started astronomers examining past photographs of spiral nebulae for Novae with the result that eight additional Novae were found to be connected with spiral nebulae. The facts were then that all known Novae to date had appeared either in the Milky Way or in spiral nebulae. The appearance of Novae in the Milky Way is usually explained as due to the encounter of a star with nebulous matter. The Novae of the Galaxy are suns suddenly raised to abnormal brightness thru the friction arising from the encounter of star with nebula. How then should the newly noted Novae in spirals be explained since the spiral nebulae conspicuously avoid the neighborhood of the Milky Way? It was a point in favor of the *island universe* theory, for if the spirals are similar in structure to the Milky Way and are great aggregations of stars and vast gaseous nebulae the appearance of Novae in spirals is not so strange. This theory was further borne out by the fact that the Novae of the Milky Way average eight magnitudes or nearly sixteen hundred times brighter than the Novae appearing in spirals. Since the apparent brightness of stars of equal magnitude varies as the squares of their distances the Novae in spirals must be on the average forty times more distant than the Novae of the Milky Way, which are members of our own system of stars. We do not know the distance of the Novae of the Milky Way, but if we assume they are at an average distance of five thousand light years the average distance of the spiral nebulae comes out two hundred thousand light years.

There is another class of celestial objects, the globular star clusters, that are now known to be at distances ranging from twenty thousand to more than two hundred thousand light years from the earth. Each

(Continued on page 507)



No. 2.—The Edge-view Spiral Nebula (N. G. G. 4565) in Coma Berenices. Photographed With the 40-inch Reflector of the Lowell Observatory By C. O. Lampland. The Dark Streak Thru the Center Is Due to the Presence of Dark Absorbing Gaseous Material on the Periphery That Shuts Off the Light From the Central Portions of the Nebula.

POWERFUL LIGHT RELIEVES PAIN.

It is rapidly becoming the practise, both in private and professional circles, to apply the rays of a powerful electric lamp to

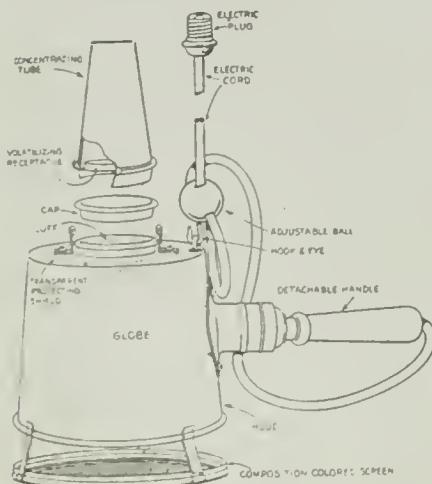


Showing Application of Rays Thru Concentrating Tube into the Mouth for Cold Sores, Canker Sores, Gum Bolls, Toothache, Tonsillitis. May be Applied to the Nose for Catarrh and Inflammatory Conditions.

various affected parts of the body. They will conquer and banish pain and other symptoms of most diseases, thereby giving Nature a better opportunity to overcome the underlying condition and lessening the amount of medicine required, it is said.

For instance, they will overcome the pain of wrenched or sprained muscles or pressure upon nerves, and help poor circulation, numbness and stiffness of any part following cold or injury. Nothing penetrates, heals and soothes sore areas and so promptly re-establishes the vim and vigor of the patient as the timely application of heat and light therapy.

When applied early after a bruise, as of the eye or face, they prevent swelling and discoloration of the skin. The light here shown is claimed to decrease the pain of a carbuncle, boil or abscess. In the early stages it may prevent the formation of pus; in the later stages it helps to ripen the abscess. The illustration shows a 400 candle-power cornucopia shape lamp, which consists of an aluminum hood, globe, han-



Semi-Sectional View of Powerful Light Treatment Lamp and Cone Reflector Illustrated in Use Above.

dle, seven feet of cord, plug and adjusting ball for raising and lowering lamp over patient. There are also available colored, adjustable, transparent composition violet, ruby amber and green screens.

230,000,000 K.W. WATER POWER PER YEAR AVAILABLE, SAYS STEINMETZ.

Dr. Steinmetz, in a recent paper presented before the American Institute of Electrical Engineers, warned his hearers, that water power can never be expected to do anything more than supplement the

ANNOUNCEMENT

With this issue the price of the ELECTRICAL EXPERIMENTER advances to 20 cents a copy. We have delayed this move as long as we dared, but economical conditions made the change necessary if the publication was to survive. We are forced to pay 10½ cents a pound for text paper now—an increase of 116% SINCE 1916. Our cover paper now costs 11 cents a pound—AN INCREASE OF 91%. Printing, art work, engravings—all have advanced 50% to 90% and the end is not yet. Take only one item—the two carloads of paper that go into making a single edition of this magazine, they now cost us \$2800.00 MORE than a year ago. The paper alone in a single copy of the EXPERIMENTER costs 5½ cents! Advancing the price of a publication never benefits a publisher. He loses a certain percentage of circulation, and his subscriptions fall off. New readers at the higher price are hard to find. We therefore can but hope that our old readers will bear with us, and support their EXPERIMENTER until such time when we return from a war, to a peace condition, and its accompanying recession of prices. In return for the higher price, we have already added a certain number of pages to this issue, and will continue to do so if we have the full support of our readers.

It is our belief that we offer more actual instruction and information than any kindred publication, and having the confidence of our readers we trust that they will support us as enthusiastically, now during times of stress, as they have during normal times.

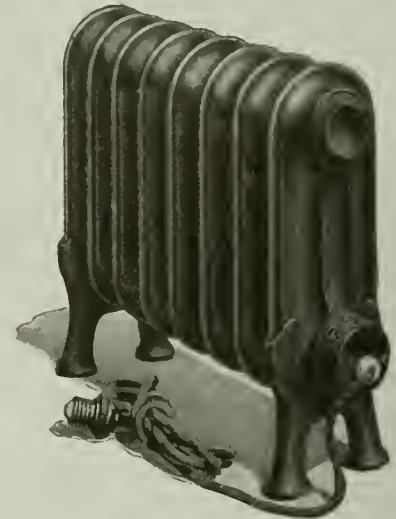
Subscription from 1 up to 5 years at the old rate of \$1.50 (foreign \$2.00) will be accepted up to and October 31st inclusive. After that date the new rate of \$2.00 a year, (\$2.50 foreign) will be in effect.

THE PUBLISHERS

use of coal. He estimated the possible hydraulic energy of all American water courses as 230,000,000 kilowatts a year, a little more than the total energy now produced in the United States, thru the medium of coal. "This means," he said, "that the theory by which we hope to use the water power of the country when coal begins to fail as an endless supply of energy is now a dream and must remain a dream. If all the potential powers of the land were now developed, and every raindrop used, it would not supply our present demand for energy.

A PORTABLE NITROGEN RADIATOR.

The latest offering to the public is the portable electric nitrogen radiator shown in the accompanying illustration. This radiator is said to be the only auxiliary electric



In this Newest Electric Radiator, the Heat-Element is Surrounded by a Chamber Filled with Nitrogen Gas. It is Absolutely Safe.

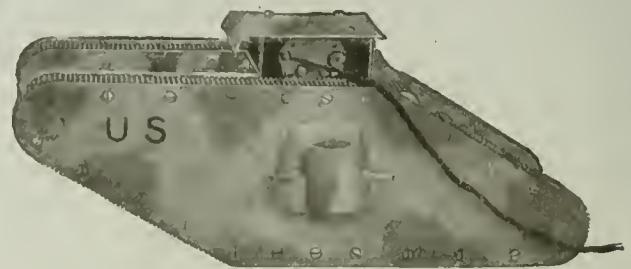
heating apparatus filled with nitrogen gas which is built on scientific principles adopted by heating engineers of standing—i. e., the radiator.

It maintains an average temperature of 350 deg. Fahr. (176.7 deg. C.), it is said. The radiator contains an electric heating element surrounded by nitrogen gas. The gas fills the entire inside of the radiator, which is hermetically sealed. The gas serves to carry the heat from the heating element to the radiating surfaces at a temperature higher than that of a steam radiator. One feature pointed out for this device is that there is no way by which clothing, drapery or anything else can catch fire, as it has no exposed red-hot open wires. The cost of operation of this radiator is very low. The stock radiators are made in four, six, eight and ten sections.

STAND BACK! HERE COME THE ELECTRIC TANKS!

The very latest addition to toyland is the miniature electric tank here shown. The tank is a miniature model of the famous British Tanks which are playing such an important part in the Great World War at the present time, and it works to perfection. There is no end to the fun boys can have with this small war model and it will climb over anything that is in its path. No matter what is in front, it keeps right on forcing its way ahead.

The tank is driven by a powerful battery motor and can be supplied with current from battery developing 8 volts, or thru an A. C. step-down transformer on 12 volts.



The Electric Tanks Threaten to Invade Toyland in New York and all Other U. S. Cities and Towns on Xmas.

The Gyro Electric Destroyer

By H. GERNSBACK

WE reprint below a few paragraphs relative to the Gyro Electric Destroyer, originally described by the writer in the February 1918 issue of the *ELECTRICAL EXPERIMENTER*. This article was widely republished all over the country, from the *New York World* to the *San Francisco Chronicle*. We republish part of the article for the benefit of those readers who did not see the original.

The great trouble with the Tank is its very slow speed. No tractors have been constructed so far that can move at more than eight to ten miles an hour, and as such they become easy prey to the enemy's guns which really get the range of the slow-moving vehicles, and begin to shell them. While the British claimed no losses in the last Cambrai offensive, the Germans claim that they shot twenty Tanks to pieces. Presuming that this amount is exaggerated, there probably is quite a good deal of truth to it.

Attention is called to the fact that the movable belt tread of the Tank is quite a sensitive affair. If hit, even the hullet of a small caliber gun will almost certainly cripple the Tank. The belt is the most vulnerable part of the tractor, and as soon as it stops moving, the Tank stops moving as well, and as far as offensive work is concerned, the machine is out of action.

The present gyro electric destroyer is a single steel wheel, as clearly shown in our accompanying illustration, it is about 45 feet high. The top of the wheel is not flat, but is in the shape of an arc which makes running a good deal easier. The wheel itself looks like a huge ferris wheel, and is constructed of channel steel thruout; in order to make it as light as possible, it has no continuous tread or rim, but rather the steel pieces at the circumference are spaced about one foot apart, leaving a clear space for two reasons. First, the weight is cut down. Second, much better purchase is had on the ground, the machine not being apt to slip, as would be the case if the top of the wheel was solid.

The wheel has one large shaft passing thru the center and extending at each side, as shown in the cross-section in our illustration. This shaft is hollow and need not weigh very much. It is constructed of steel. At the hubs and at the ends of the shaft the latter is provided with armored projections, which will not be damaged in case of shell fire. In the center of the wheel is suspended the engine cab which comprises a gasoline engine of some three hundred to five hundred horsepower, the energy being fed to a generator as shown. Two of the electric motors are used for propulsion of the wheel only; they are attached by means of a chain drive to the central shaft as shown.

Inasmuch as the wheel of the destroyer is not solid, but made of channel steel, it will be readily understood that even a large size shell will easily pass thru the lattice work of the destroyer without doing much damage, and here is where this machine shows its superiority over the tank. It will be almost impossible to damage this destroyer by means of shell shot. Even a "dead hit" from a medium caliber gun will not cause much damage, and even a good sized shot hitting the gyroscope will not hurt it very much, for the reason that the latter spins at enormous speed and it will almost certainly deflect the shot, unless, of course, it is a dead hit at right angles to the face of the wheel. The external chain drives are encased in heavy armor, and it should be as heavy as possible to prevent the machine being put out of action, and this can be readily done. It will be noted that this chain drive, the most vital part of the machine, presents but little surface to an on-coming shell. In contrast thereto you will notice the broad and very large moving

tread of a British tank, which comprises almost one-quarter of the surface of the entire tank. Imagine this machine starting on its offensive journey. It will first smash thru all the barbed wire entanglements without any trouble whatsoever. It simply mows them down as so many match sticks, thereby cutting open a path for the infantry that follows. Suppose a nest of machine guns is encountered. Their guns become practically useless, for if the destroyer runs over the machine guns or even threatens to do so, the enemy

pieces, then send along your contribution, using the accompanying blank. You might read the letters from enthusiastic readers who believe in the idea, reprinted herewith:

"EVERY LITTLE HELPS."

"I sure would like to give more, as I think it will work out all right.
"Hays, Kans." Chas. Harkness, Jr.

"CALL AGAIN!"

"Enclosed find Money Order for \$1.50 to go as part payment in the Gyro Electric Destroyer. I am sorry that I cannot at the present time give more, but if not enough is raised to build a fair sized model please call again. I am very glad you gave me the opportunity to do something of this sort before I am drafted, which I soon will be. When this Destroyer is completed, I should like to make a trip in it across No Man's Land. So tell the Military Authorities that I should like to be a part in the crew when it is completed. May I suggest that you submit the plans to Henry Ford. I would not be surprised if he could be induced to build it; this would save a lot of money which could go to build a larger model. He has the equipment and the experts to build it, also the steel to do it with. He would do it without any profit on his part and he will succeed in doing it. I am one of his employees in his Dearborn Tractor plant. Last March you answered my question in your Patent Advice column regarding an oil can for stocks and dies. The patent has been allowed to me by the U. S. Patent Office. Yours for a large Destroyer,
Fred Van Dyke,

52, Gibson Ave., Detroit, Mich."

"I HEARTILY BELIEVE IN THIS MONSTER."

"... I heartily believe in this monster, and I hope that your experiment succeeds and that every reader of the "E. E." contributes as much as possible. I do not take the "E. E." and so did not see the Destroyer in the February issue, but am going to buy them from now on until the Destroyer is finished.
"Walter Holey,

"Norwich, N. Y."

"HE SAW THE 'POW-WOW'!"

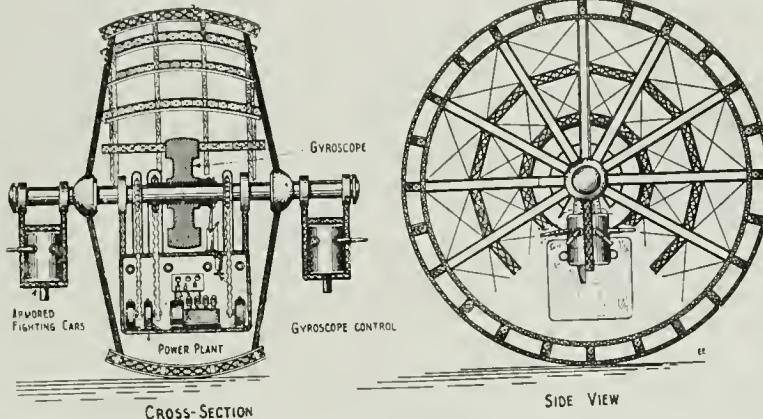
"I saw the 'pow-wow' in the 'E. E.' and agree with you. While it never occurred to me, I am contributing to the construction of that Gyro Electric Destroyer, now that it has been proposed. Enclosed you will find \$1.00. Since you have it up, get your battle-scarred brain to work and make it possible. Here's hoping that you will have the best of luck and the 'Bugs' all cooperate with you.
"Neil F. Beeson,

9 S. 3rd St.,
Marshalltown, Ia."

"A GENUINE BELIEVER."

"Please see my letter of August 19, in which I enclosed \$1.00 as my share of building a model of our Gyro Electric Destroyer. In that letter I mentioned the

(Continued on page 488)



Side and Sectional Views of the Gyro Electric Destroyer. Do You Believe In It? If So—Why Not Help to Build the First Model.

must of necessity abandon the guns, and the destroyer "walks" over them, crushing them into the ground. The same is the case with the large size guns. You may be quite sure that if the gunners see the machine coming, they will most certainly abandon their gun, and in this case the destroyer is powerful enough to run over the gun, thereby putting it out of action.

This machine is not designed, as might be supposed, to kill off as many of the enemy as possible. That is not at all its purpose. It is simply to put out of action other machines, preferably guns, not men. Its first purpose is to cut down barbed wire entanglements—second, to run over artillery, thereby putting it out of action. If we employed enough destroyers, it can be readily conceived how the enemy must invariably retreat as soon as these machines begin to advance, for the enemy denuded of all artillery must give up ground.

Many people, scientists and engineers, think the idea feasible, and all the details have been carefully worked out. A number of readers suggested that *EXPERIMENTER* readers contribute to a fund for actually building a model of the Gyro-Electric Destroyer. If enough money is forthcoming, an actual model will be built, which will be turned over to the United States Government in the name of *ELECTRICAL EXPERIMENTER* readers. The writer would refer to the September and October issues of this magazine for all further information on this idea.

If you are convinced that a machine of this kind will blast the Hun's artillery to

Editor *Electrical Experimenter*:

I enclose herewith \$..... as my contribution towards building a model of your Gyro Electric Destroyer.

You are to build as large a model as the funds will permit and the money is to be used for the sole purpose of building this war machine. You agree to publish an exact amount of all funds spent and all contributions are to be acknowledged thru the columns of the *Electrical Experimenter*.

You pledge yourself to construct the machine as quickly as possible and you will turn it over to the U. S. Government immediately upon its completion.

Name.....

Address.....

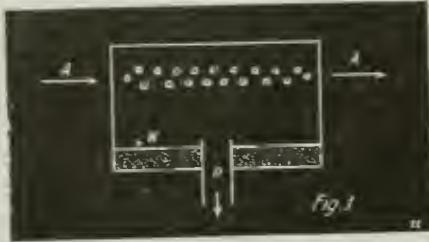
AMONG the hundreds of new devices and appliances published monthly in the *Electrical Experimenter*, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnished to you, free of charge, by addressing our Technical Information Bureau.

The Phenomena of Electrical Conduction in Gases

PART VI—MAKING IONS VISIBLE

By ROGERS D. RUSK, M. A.

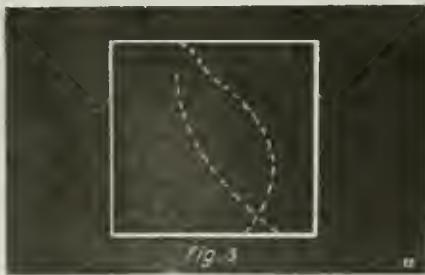
An ion is a pretty small particle of matter to be made visible. It may consist of several electrically charged molecules grouped together, a thousand times too small to be visible in the strongest microscope, or it



Form of Special Chamber Connected With a Vacuum Pump as Employed by Wilson to Make "Ions" Visible for Photographing. "W" represents Water. The Space Above the Water was First Cleared of Ions by an Electric Field; then an Alpha or Beta Particle was Allowed to Pass Thru the Chamber in the Direction A-A. The Air was Expanded and the Water Vapor Thus Formed, at Once Condensed About the Ions. A Train of These Drops Could be Photographed, Wilson Found.

may be an electron or free atom of electricity which would be more than *one hundred thousand times smaller still*. As has been previously stated these almost infinitely small particles can never be seen by the human eye which has such a limited range of vision. However, tho they may never be directly visible they have already been made indirectly visible by the experiments of C. T. R. Wilson. These experiments not only are very striking in their nature but they have told us things about electricity and matter which we could have known in no other way. Electrons, and *alpha* and *beta* rays from radium may pass directly thru ordinary molecules, and molecules themselves are not solid discrete particles as they were once thought to be, but are spheres containing points of electrical energy far, far apart in relation to their size.

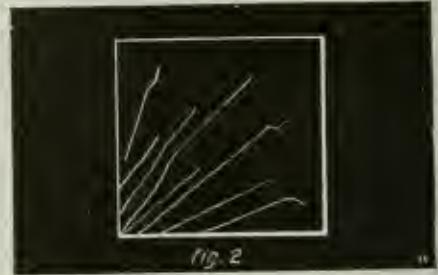
C. T. R. Wilson in 1912 made ions visible indirectly by photographing their path in the following remarkable manner: The principle made use of was the fact that an ion of high velocity forms other ions by collision with the ordinary molecules in its path, as mentioned in a previous article by the author. So he used a chamber of the form shown in Fig. 1, in which an expan-



This Chart Shows the Paths of "Beta Particles" — After Photograph by Wilson. Note the Difference Between Path Routes of Alpha Particles Delineated in Fig. 2. The Alpha Particles Travel in Nearly Straight Lines, While the Beta Particles Follow a Slightly Crooked Path, and Produce Fewer Ions Than Do the Alpha Particles. Beta Particles May Travel 7 Centimeters in Air.

sion of the air could be obtained thru the opening P, connected with a pump. The space above the water W was first cleared of ions by an electric field and then an alpha or beta particle from radium or any other suitable ionizing agent was allowed to pass thru the chamber in the direction of the arrow A. Next the air in the chamber was allowed to expand suddenly and the water vapor thus formed immediately condensed in small drops about the ions just produced by the passage of the alpha or beta particle. A train of drops such as these could be actually photographed and it thus marks the path of the particle. A study of different types of paths gives us some surprising results. Wilson took photographs of the paths of alpha particles, beta particles and gamma and X-rays. Fig. 2 represents the paths of alpha particles as photographed in the manner explained above. Fig. 3 represents the paths of beta particles and Fig. 4 represents the paths of X-rays. It will be noticed that these paths are strikingly different. The alpha particle travels in a straight line and the ions produced by it are so close together that it makes the line look continuous. The beta particle travels in a fairly straight line but it produces fewer

smaller than the distance, given above, that an alpha or beta particle may travel. Evidently these particles do not stop for the molecules in their way, nor are they



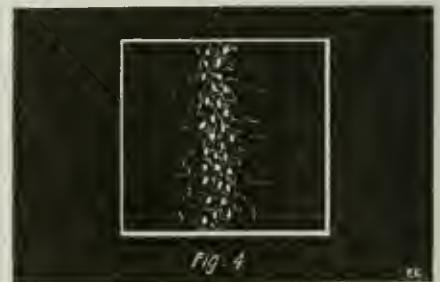
The Paths Taken by "Alpha Particles" in Air—After Photograph Taken by Wilson with the Arrangement Described and Illustrated at Fig. 1. Alpha Particles May Travel 12 Centimeters Thru Air.

deflected by them. Still they must hit them or else they would not produce ions as they pass along. The only alternative left is that they must pass directly thru them.

If that is the case it can be computed, from the size of a molecule and the number per cubic centimeter, how many will be past thru in this manner. In the case of the alpha particle it is about *half a million* during its average flight, and in the case of the beta particle, which is so small it misses more of them completely, about *ten thousand* are past thru. Evidently a molecule is far from being a solid particle.

Let us see then what we can learn from these facts concerning the nature of the molecules of matter, and the atom of electricity. If some of the older scientists had been told that one molecule might pass completely thru another molecule and not even touch it, they would have held up their hands in amazement, and yet an alpha particle, which is a positively charged atom of helium, passes thru half a million air molecules before it encounters any force strong enough to deflect it! This completely disproves the old idea that a molecule is a solid discrete particle something like a marble of ultra-microscopic size. It shows more than this that there is very little really material in the atom and that practically the whole of the *electron* is empty, or as one writer puts it, consists of "betweens." The fact that ions are produced by these particles may indicate some degree of collision in the passage of a particle thru a molecule, and yet by the photo-

(Continued on page 513)



This Shows the Paths of X-rays. The Study of Such Photographs as These Has Brought to Light the Fact That the "Molecule"—Which Scientists Once Thought Solid—Is Mostly Made Up of "Betweens." Why Do X-rays Pass Thru Body Tissue, Wood and Stone? The Electron Theory and Structure Makes It Perfectly Clear.

LAST CALL

On November 1st the subscription price of the "Electrical Experimenter" advances to \$2.00 in U. S. (Canada and Foreign, \$2.50.) This is the last chance to subscribe at the old rates (\$1.50 in U. S., Canada and Foreign \$2.00). No subscription for more than five years at the old rate accepted.—THE PUBLISHERS

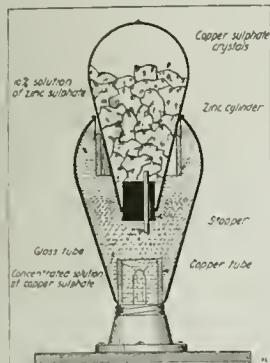
ions. Each speck represents a drop of water which has condensed about an ion, but they were not numerous enough and close enough together to make the path appear as a continuous line. This is what we might expect, for the alpha particle is known to be an atom of helium and the beta particle is known to be a free electron of only 1/8000 the mass. Naturally the larger particle would be expected to collide with more of the molecules of the air and produce more ions than the small electron. At length, however, the alpha and beta particles are deflected, and this is shown most clearly in the case of the alpha particle, whose path suffers a sharp turn near the end which indicates that the speed of the particle was decreasing and that finally it suffered a collision which deflected it. From measurements of these paths it is found that alpha particles may travel 12 cm. in air and beta particles may travel 7 cm. and more and on account of their small size may even pass thru appreciable thicknesses of glass or metal.

The most surprising fact is yet to be obtained from the photographs of the paths of these particles. It is known that the distance an ordinary gas molecule travels between collisions is many, many times

Burnt-Out Lamp Contest

By H. GERNSBACK

THE present article which closes our contest on Burnt-Out Lamps illustrates that the idea has not been entirely exhausted. Since we publish the results of our last contest in our June, 1918, issue, we have received over two thousand more suggestions from contestants located practically all over the world. Most of these of course were duplicates, and were along the lines of the ideas which we had published in former issues,



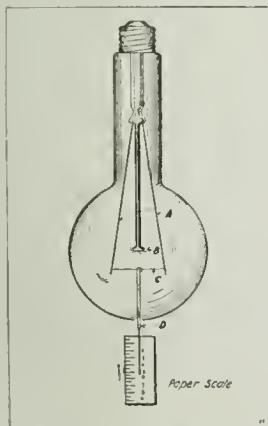
From the Trenches of France; a Meidinger Battery.

darner, cord (ball) holder, a swimming device, an apparatus to catch fish, and last but not least, a transparency representing the Kaiser to be shot at with a gun.

Perhaps the most original one which we publish here comes from France from M. G. Mohr-Desforges, Roulet, France. M. Desforges, who serves in the French army, has evolved a really good battery which we are pleased to illustrate and describe in full herewith. While it cannot be used for lighting or similar work, forty of them would certainly make a very fine battery for audion circuits, while for measuring work, etc., the Meidinger battery can hardly be surpassed. Of course, all copper sulfate batteries must be used on closed circuit, they cannot be left on open circuit.

or otherwise were variations of them. There were all kinds of fantastical ideas, and we give below a few of the suggestions which came to the editor's desk, but which were not of sufficient importance to warrant publishing separately. Among these were the following: Gold fish globe, a sort of steam turbine, stocking

the following: Gold fish globe, a sort of steam turbine, stocking

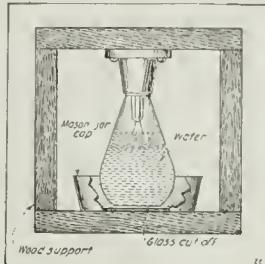


Novel Hot-Wire Ammeter Made From Old Bulb.

Orient, Roulet (Charente), France. It is a very clever design of a Meidinger type battery with two solutions. This battery is well-known in Europe and works almost automatic. It must be used on closed circuit, open circuit work not being permissible. M. Desforges constructs his battery as follows:

A large burnt-out lamp globe is cut off at the top to accommodate another similar globe as shown in our illustration. After removing the glass stem of the lower globe, a small copper tube is soldered to the former filament; connections as shown. This

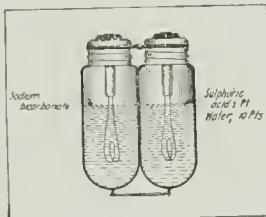
forms the positive pole of the battery. From the stationary globe is suspended a zinc cylinder made of sheet zinc of suitable thickness and about in proportion as shown, which is suspended from the globe by means of wires. These wires may be copper, but in order to safeguard against local action, they must be well painted with asphaltum before being inserted in the solution. One wire forms the negative pole.



Chick Automatic Water Fountain.

The other globe is filled with copper sulfate crystals and the open end is closed by means of a paraffined cork thru which a short piece of glass tubing passes. M. Desforges continues as follows: (French translation). "This is how I accomplish it:

"I first fill one-third of the lower globe with a 10% solution of sulfate of zinc. Then by means of a glass funnel which must go all the way down, I pour a concentrated solution of sulfate of copper, which being of a heavier specific gravity stays at the bottom and raises the sulfate of zinc solution. A sharp dark blue mark shows the line separating the two liquids. The lower globe will now be found to be about three-quarters full. I now insert the upper globe carefully, taking care not to shake the liquids which would otherwise mix. The battery is now ready for work. It gives approximately 1.07 volts.

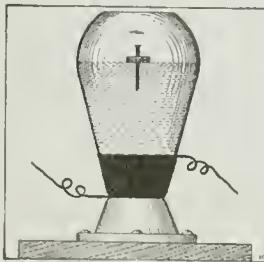


A Useful Hand Grenade Fire Extinguisher.

"As the battery works, the copper sulfate at the bottom is used up, but a new supply is always at hand on account of the upper globe being filled with crystals that dissolve very slowly, the resultant solution descending by gravity to the bottom."

A SIMPLE HOT-WIRE AMMETER.

An efficient yet simple hot-wire ammeter can be constructed at small cost from a 100 watt Type "C" lamp. First break off the tip of the bulb, leaving a hole about 1/8 of an inch in diameter. Insert a forked wire with which to remove the spiral filament, and carefully bend the small supporting ribs "B", back so as not to short-circuit the main leads.



A Simple Battery Gage; Coil of Wire and a Bulb.

Next get a

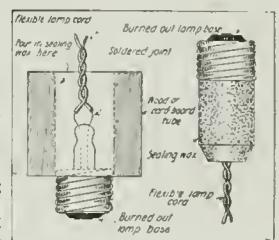
piece of No. 32 Manganin wire about two inches long, and solder each end firmly to a six-inch piece of iron wire for a handle. Having first arranged the ends of the lead wires so they are about an inch apart, insert the fine wire and wrap a half inch of each end about each lead, and break off the iron wire. Solder the joints by using a piece of resin core solder as one electrode of a storage battery circuit, the joint as the other, and the arc developed will melt the solder. It may be necessary to spread the leads "A" slightly after this operation to tighten the hot-wire "C".

A short piece of No. 14 aluminum wire "D" is hung over the center of "C" and the ammeter is complete. Hang in an inverted position, and a current passing thru "C" allows it to sag, increasing the length of "D" protruding at the tip of the lamp.

ARNO A. KLUGE, Lincoln, Nebr.

CHICK AUTOMATIC FOUNTAIN CUP.

My idea makes use of a burnt-out electric light bulb. It is an A Handy Attachment Plug From Lamp Base. "automatic chick fountain." Fill the bulb, (which is broken off at the bottom for about one-half inch down) with water and invert it in a "Mason" jar top. You could cut a bulb off at the top and use that for a receptacle for the water in the bulb.



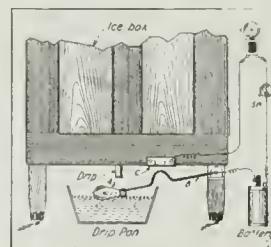
A Handy Attachment Plug From Lamp Base.

JAMES B. WALKER, Waterbury, Conn.

FIRE EXTINGUISHER GRENADE.

Make up two solutions, one of one part of sulfuric acid and ten parts of water.

Make up a second solution of five parts sodium bicarbonate and five parts of water. Break off the tip of one of the show case bulbs under the acid solution and break off the tip of the other under the sodium bicarbonate solution. Close the fine holes with sealing wax. Bind the two bulbs tightly together, and when a fire breaks out in the laboratory or elsewhere, just hurl the two bulbs at the flaming place, the two bulbs will burst, their contents will unite in mortal contest, liberating much carbon dioxide gas, which will extinguish the flames.



Ice Box Float Switch for the Drip Pan.

BENSON FREEMAN, Atlanta, Ga.

BATTERY TESTER.

Take a burnt-out lamp, it does not matter what kind, and cut the top off with a three-cornered file as shown at left. Also pull out all lead wires. Just above the base of the lamp wind 15 to 20 feet of No. 22 wire. Then take a 1/8-inch nail and a small bit of cork. File off the nail as shown and cut the cork so that there is just enough cork (Continued on page 471)



Notice to All Radio Readers

As most of our radio readers are undoubtedly aware, the U. S. Government has decided that all Amateur Wireless Stations, whether licensed or unlicensed, or equipt for receiving or transmitting, shall be closed.

This is a very important consideration, especially to those who are readers of the **ELECTRICAL EXPERIMENTER**, for the reason that we desire to continue to publish valuable articles on the wireless art from time to time, and which may treat on both transmitting and receiving apparatus. In the first place, there are a great many students among our readers who will demand and expect a continuation of the usual class of Radio subjects, which we have published in the past four years, and secondly, there will be hundreds and even thousands of new radio pupils in the various naval and civilian schools throuout the country who will be benefited by up-to-date wireless articles treating on both the transmitting as well as receiving equipment. Remember that you must not connect up radio apparatus to any form of antenna.—The Editors.

Senatore Marconi Head of Italy's Banking System

WE have not heard a great deal of Senatore Guglielmo Marconi of late, due no doubt to the enormous weight of the several large enterprises and governmental positions of which he is the dominant figure. The recent reports of his activities state that he was to have come to the United States as the High Commissioner representing Italy. However, his country's need of him was so urgent as to cause a cancellation of this particular mission. We, in a way, regret this decision as men of Marconi's calibre are a valuable asset to any nation, locality or city which they may honor with their presence.

Senatore Marconi has rendered a very great service to Italy, and the nations of the world in general, by his abolishment of all traces of the Teutonic financial supremacy, which, up to the time that his revision became effective, had been paramount, and the Germans had wielded a very powerful persuasive, namely the capitalization of very nearly all of the large enterprises in Italy. Dr. Marconi originated and organized the new banking system now in vogue in that country, and with him as the "moving spirit" of the undertaking, its future success is amply assured. As an irrepresible worker, Dr. Marconi possesses animation, vigor and vivacity, and corrals all prizes. He is ever "on the job" whether it be day or night.

He last visited this country as a member of the Italian Mission to the United States, and the photograph which accompanies this note, was taken at that time, when he received fifty young ladies from the *Wireless Class* of Hunter College, New York. He spoke to these women on their work as an aid to the Government. The highest title Guglielmo Marconi has had bestowed upon him is the one of Senatore. He is one of the youngest Italian Senators. A title second in importance is that of Chief of Communications of the Italian Navy. Dr. Marconi is a member of the Institution of Electrical Engineers and numerous other well-known electrical and scientific societies throuout the world. His work has been recog-

nized by many governments and seats of learning; he has been decorated by the King of Italy and the late Czar of Russia; he is an honorary doctor (LL. D. D. Sc.) of many universities, including Oxford, Glasgow, Aberdeen, Liverpool and Pennsylvania, besides having received the freedom of the principal Italian cities. He was accorded the Nobel Prize for Physics, which is per-

haps the highest distinction that can be obtained by any scientist. He has also been the recipient of scientific rewards granted by many and various societies and other institutions throuout the world.

RADIO FLASHES 12,000 MILES.

Direct communication with Australia is the latest development of radio-communication.

Connection was established on October 1st, when Commonwealth Premier Hughes and Sir Joseph Cook, Minister for the English Navy, sent two messages to the Amalgamated Wireless Company of Australia at Sydney from the new Marconi station at Carnarvon, Wales, and altho the distance of direct transmission was fully 12,000 miles the messages were received with perfect clearness. The Hertzian waves of wireless message move equally in all directions. If, therefore, the messages between Wales and Australia went half way round the globe in one direction, they did so in all other directions, and these messages may be said to have enveloped the globe.

U. S. MAGNETIC SURVEY.

The Magnetic Survey Vessel, *Carnegie*, arrived safely at her home port, Washington, D. C., on June 10, where she will be put out of commission probably during the period of the war. During her cruise from Buenos Aires, Argentina, round the Horn to Valparaiso, Chile, Callao, Peru, thence thru the Panama Canal to Newport News, she was in command of Dr. N. W. Edmonds; the other members of the scientific staff aboard were: Messrs. A. D. Power, Bradley Jones, L. L. Tanguy, J. M. McFadden, and Walter E. Scott.

DO YOU KNOW?

That hydrogen and ozone play the most important part in your make-up. Your body is more than three-quarters water, the water is two-thirds hydrogen and one-third oxygen.



Senatore Guglielmo Marconi, LL. D., D. Sc., Appointed Head of the New Italian Banking System. Besides This Responsibility He Serves as Chief of Communications to the Italian Navy. He is Also at the Head of the Italian Radio System.

PLAN 4,600-MILE RADIO STATION TO SERVE JAPAN AND U. S.

The installation of a new high power wireless system between Japan and the United States is actively occupying the Department of Communications. Officials announce that the project is a result in part of the congestion and delay in cable transmission which prevents the desired freedom of communication between Japan and the United States.

The present Japanese high power wireless station communicates direct with Hawaii. The proposed station will work with a station on the Pacific Coast, the site of which probably will be near San Francisco, a distance of 4,600 miles. This will be one of the longest direct wireless services in the world. The estimated cost of the system is about \$400,000. While another cable linking the two hemispheres is desired a line from Japan to Guam alone would cost \$3,000,000.

NEW CUTTER USEFUL IN QUENCHED GAP MAKING

The new adjustable cutter consists of a steel casting, on which are mounted two cutting tools which may be adjusted to various diameters. This part of the device is rotated by means of a ratchet wrench. Pressure is applied to the cutting tools by means of a heavy coil spring. The device is held in place by a round stud, which is placed thru a $\frac{3}{8}$ " pilot hole in the metal to be cut (in the case of iron conduit boxes) and fastened on the back of this metal by means of a flange nut.

It is obvious that this cutter can be operated in positions that would otherwise be inaccessible.

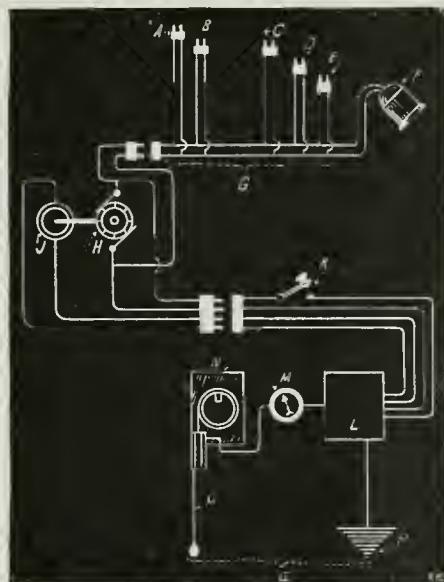
The old method of drilling a large number of small holes and then punching out the metal makes a crude job at the best and is slow, costly and very laborious. Not only can this device be applied to cutting holes and grooves in steel cabinets, boilers, tanks, etc., but also can be used for cutting metal, such as slate, marble and fibre. It is used for cutting holes or grooves $1\frac{1}{4}$ " to 3". The larger size cuts holes from $1\frac{3}{8}$ " to 6". A still larger size cutter will cut holes or grooves up to 12" in diameter.



A New Cutter which Lends Itself Well to the Making of Amateur Quenched Spark Gaps.

GERMAN RADIO APPARATUS ON AIRPLANES.

Lieutenant Jean-Abel Lefranc, writing in a recent issue of *La Nature* on the evolution of German Aviation, states that for some little time the enemy machines have been occasionally equipt with continuous wave receivers of the valve type. Regarding the transmitting apparatus, Lieut. Lefranc says that the generator produces alternating current (270 volts 3 amps.) and continuous current (50 volts 4 amps.) The machine is driven either by a small airscrew rotating at 4,500 revolutions per minute, or by the motor. The alternating current produced by this generator is utilised by the *oscillating circuit* which gives rise to the oscillations creating the Hertzian waves. The *Telefunken sender* consists of a rectangular box containing a transformer, a condenser, a plate discharger and a wave-meter. Special arrangements permit of variation of wave length and intensity of transmission.



Radio Outfit on a German Airplane.

The aerial consists of a copper wire approximately 35 to 40 meters in length. On the ground this wire is rolled up on a bobbin. During flight it is suspended from the machine.

The range of these sets is about 35 km. (21 miles) and their weight in all 26 kg. (about 60 lbs.) The latest giant airplanes guide themselves at night by *radiogoniometers*, as the Zeppelins do.

It will be noticed from the diagram reproduced herewith that the generator supplies current for several purposes. Thus the leads A go to the electric warming apparatus in the pilot's clothes; B to the lamps on the instrument board; C to the observer's clothes; D and E to heating apparatus on the camera and machine gun respectively. F is the searchlight for night landings. All G is therefore concerned with lighting and heating. H and J are the D.C. and A.C. sides of the generator, while K is obviously the transmitting key. L contains the Telefunken transmitters; M and N and O are the

NEW METERS FOR RADIO AND HIGH-FREQUENCY WORK.

A high grade hot wire measuring instrument designed particularly for wireless and other high-frequency work, depending for



Two New Radio Frequency Ammeters.

its operation upon the expansion of a metal strip which is heated by the current to be measured has recently been developed. The slight sag in this conducting strip is magnified several hundred times on the scale by means of a combination of wires and a deflecting spring.

The conducting strip is made of special non-corrosive material. The separating posts have the same temperature coefficient of expansion as the conducting strip, so that the changes in room temperature do not cause an error in the reading of the instrument.

The scale plate is made of metal, and the scale subtends an arc of 90 degrees, being $2\frac{3}{8}$ inches long.

The flush-mounting type meters have a guaranteed accuracy of 2 per cent, while the portable type, with hand marked scale, can be expected to show an accuracy within 1 per cent of full scale. Standard meters are for 1, 2 and 5 amperes. Care must be used not to subject the instrument to more than 200 per cent load.—Photos courtesy Westinghouse Electric & Mfg. Co.

aerial ammeter, the aerial reel and the antenna itself. All Q is the purely wireless apparatus.

NEW HIGH-POWER RADIO STATION AT ANNAPOLIS, MD., IS OPENED.

The new high-power radio station at Annapolis, Md., the most powerful in America, was formally opened recently, Secretary Daniels signaling the occasion by sending messages to the first lord of the British Admiralty, London; the French minister of marine, in Paris; and the Italian minister of marine, in Rome.

The station completed cost about \$1,500,000, and is capable of maintaining uninterrupted communication over a distance of at least 4,000 miles.

There are four steel towers, each 650 feet high supporting the antennae which, with the ground system, required 160 miles of wire for their completion. The power installations is in duplicate, so that it will always be possible to maintain communication. The operation of the station requires the services of 100 men, all of whom are drawn from the enlisted force of the Navy. Suitable provision has been made for the protection of the station.

These messages were transmitted to London, Paris, and Rome with the utmost ease, which is especially gratifying to Navy officials, since this powerful plant was erected and equipt by the Navy in the short space of 10 months. Under conditions that prevailed before our entry into the war its erection would have taken two years.

Bunque

By ALAN C. ROCKWOOD

Greetings.

FOR those people who insist on blowing out the gas the following scheme is suggested when they have only electric lights at hand: 1. Fill mouth with water. 2. Tip the socket so the key is upward. 3. Place mouth above the opening around the key. 4. Blow. If this does not succeed, take off the shell of the socket and repeat the operation.

God's Death!!! as Shakespeare says—what next?

Unconscious sarcasm.—The official abbreviation of the United States Navy (USN) is assigned to the Kaiserin Elizabeth of the Austrian Navy as a radio call letter.

Speaking of call letters—some of the pleasures still to come are the calling up of some station as RAH RAH RAH when you feel like applauding; the calling up WOW WOW WOW when happy; or WAT WAT WAT when curious. These calls are still unassigned according to the last issue of "Radio Stations of the World."

Here are epithets which are used or can be used as call letters. See if you can't find your favorite call letter among them:—BAD (H.M.S. Albemarle, British); DAM (Germany, unassigned); MAD (Musician, British); MUG (British, unassigned); MUT (Pembrokeshire, British); PIG (Netherlands, unassigned); HOG (unassigned); DOG (Germany, unassigned); PUP (Jequitinhona, Brazil). Too bad more of them are not assigned. The operators could then throw mud about a little more freely.

Dippy Diversions Number I.—Receiving Arlington with the aerial grounded.

Radium at \$36.050 a gram gives off emanations for 2500 years before changing to polonium. Limburger cheese costs 45 cents per pound and sapsago cheese even less. They have the advantage over radium that their radiations constantly increase in strength. If any intelligent inventor has an idea for an armor steel motor to use such power he should send it to the Fony Patent Offis at once.

The latest scheme of Wireless Telegraphy is to use trombones, tubas, or sousaphones; playing a quarter note for a dash and an eighth note for a dot. This has been tried once and was successful, but there was an inexplicable diminution of population in the immediate neighborhood.

I recently saw the advertisement of a Chronic Plunge Battery. I don't know about Chronic Plunge batteries but I've certainly had plenty of experience with Chronically Discharged Batteries.

A prominent radio experimenter who has

wanderings may appear again. The compiler, however, needs some help on the job. If you have any electrical or radio quips send them along. Full discredit will be given or withheld as desired. Address "Bunque" care of the publishers of Electrical Experimenter.



"Great Moments We All Have Known!" Fellow Radio Operators. Sent to this Journal by a Knight of the Key—One, Mr. H. B. Burney, H. M. C. S. Stadacona. Mr. Burney Draws as Well as He Operates.

been using his three-step electron relay (amplification 1000 times) in connection with his fonograf for dancing purposes, says that he found a sixteen pound sledge on his porch the other morning and wonders why it was left there.

Since the attempt to use our large stock of copperheads as the rotors of alternating current generators has failed the outcome of the experiments to see if they can be used to relieve the copper shortage is awaited with interest.

Do you know that the human finger nail grows .000,000,002 yard per second?

If all the inventions contrived to end the war were tested out by one man, that man would need to live as long as Methuselah.

The following poem was found on the fly-leaf of a book in the Crear Library:
 If there should be another flood,
 For refuge hither fly;
 Tho all the world should be submerged,
 This book would still be dry.
 Pretty appropriate for some electrical textbooks, isn't it?

Are you a quodlibetarian? Many experimenters are, to the annoyance of their friends. What is it? Webster defines the word as "one who discusses any subject at pleasure."

Dire secret!!! This column of mental

Thank you.

A RADIO ECHO FROM THE PAST.

Mr. Godfrey Isaacs, in the course of a recent address in London referred to the achievements of wireless telegraphy and the progress that had been made in the twenty odd years of Mr. Marconi's labors. This reference on the part of the Managing Director of the Marconi International Company brought forth a reminiscence from a Member of Parliament which appeared in the pages of Town Topics, and is worth reading again:

"It is just twenty years ago since Mr. Marconi, now Senatore Marconi, gave an exhibition of his wireless invention to members of the House of Commons.

He wanted to prove that a wireless message could be sent from the Terrace to St. Thomas's Hospital, some three or four hundred yards across the river, and members flocked to the Terrace to witness the experiment. There were considerable doubts as to the result. John Burns busied himself in the arrangement of the small instrument in one of the passages leading to the Terrace, and in fixing, to Mr. Marconi's instructions, the eight- or ten-foot pole that stood against the Terrace wall some thirty feet from the instrument.

"When arrangements were completed, Mr. Marconi invited the writer of these notes to send any message he liked to the party in charge of the machine at the hospital.

"At that moment the news came in that Gladstone had died, and the message transmitted recorded that fact, and added a few words about the great statesman. The instrument was set to work, and scarcely had the words been tapt off when acknowledgment was announced from the other side. Hearty cheers were given for the great inventor, but still there were some present who doubted whether the invention would ever be of any practical use."

A scientist in Sweden has advanced the theory that bearded grains draw electricity from the air to aid them in their growth.

By liquefying the gas helium a European scientist has succeeded in reaching temperatures within six degrees of the absolute zero.

A Sensitive Wireless Recorder

By ARNO A. KLUGE

NOW that the radio experimenter is taking an enforced "vacation" which may continue for some time to come, altho we hope not too long, perhaps it would not be amiss to attempt the construction of a more difficult piece of apparatus than the ordinary instrument, and yet one which has great possibilities for the operator.

With this thought in mind, I present herewith the details for making an *ultra-sensitive relay*, one which can be used for amplifying weak radio signals, so that they actuate a tape recorder or an audible buzzer. At first thought this device may seem rather complicated, but with a little skill, patience, and the expenditure of very little money, a suitable relay can be constructed that will rival any in existence.

The principle of this device is that of the capillary electrometer, which was first discussed by Prof. Lippmann several years ago. A "U"-shaped glass tube, A, Fig. 1, about 1/4 inch inside diameter, is filled with chemically pure mercury, so that it comes within 1/2 inch of the top of the shorter arm. A small quantity of 20 per cent sulfuric acid is then poured in on the top, at B. A plunger, C, carrying an electrode, is inserted in the long arm for varying the height of the mercury, and the whole apparatus is supported by a laboratory stand-ard or a board.

Next we take a small glass tube that will fit inside the large one, and draw one end out into a fine capillary tube, by heating in a Bunsen flame. The bore of this tube at the capillary end should be about the size of a human hair, but it is best to make several different sizes to find the right diameter. This tube should be about two inches long, and is supported directly above the short arm of the large tube, so that it just dips into the sulfuric acid. A small quantity of mercury is then poured into it, connections are brought out at C and D, and the apparatus is ready to adjust.

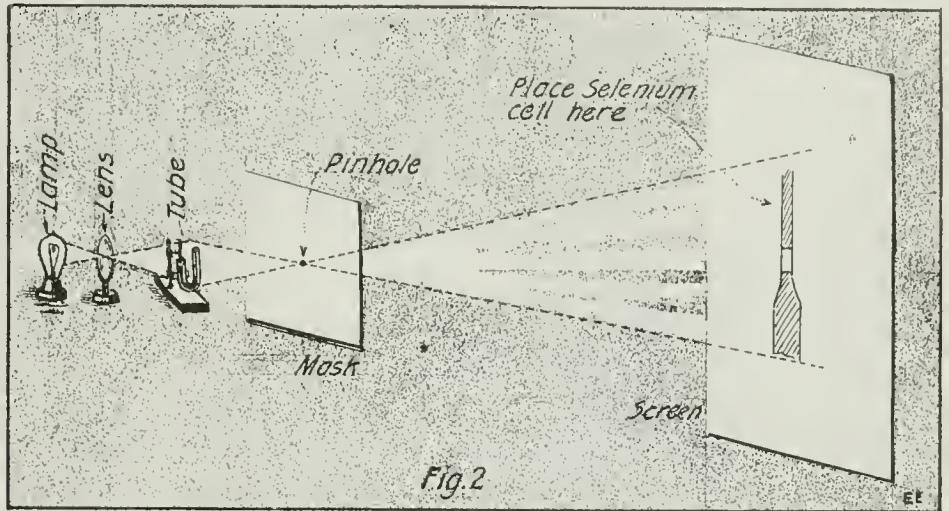
This is done by blowing in the tube D until a small stream of mercury is forced thru the capillary tube into the acid. The pressure is then released, and, due to the

tween the two mercury columns is now regulated by the plunger C, until the instrument works best.

To test the instrument, it is only necessary to place the moistened fingers across

flexible lamp cord to the two wires projecting from the glass.

Then take a brace and 1" bit and bore a hole thru a short piece of 2" x 2" wood. Into one end of the hole start the brass base



A Novel Radio Recording Apparatus Which Can Be Easily Built in the Experimenter's Laboratory and Tested Out Without Radio Apparatus; Simply Connect Up a Buzzer Exciter Thru a High Resistance to Give Imitation Received Radio Currents. The Instrument Acts on the Principle of the Capillary Electrometer.

the binding posts, and the difference of potential between the two masses of mercury will affect the *surface tension*, and cause the point at the junction of the liquids to move up and down. The movement from such a slight potential is very small, visible only with a magnifying glass, but with strong wireless signals it becomes more pronounced, and is visible even to the naked eye.

To apply the instrument in operating a relay or recorder, it is necessary to use a beam of light, as shown by Fig. 2, playing upon a *selenium cell*, the construction of which will be evident to the experimenter. The same beam of light could also be used in giving a screen demonstration of radio, or a photo-recorder could be built, and the signals recorded upon sensitive paper, as the operator chooses.

And while it is not possible to use this device in wireless at present, it has many other interesting uses which will suggest themselves to the experimenter, such as recording the fluctuations of the voice upon the screen, recording the sine wave of an alternating current by means of a revolving mirror, etc.

BURNT-OUT LAMP CONTEST

(Continued from page 467)

to float the nail. Now fill the lamp with water and drop the cork with the nail in the water. By connecting the two leads of the magnet coil to a battery the cork will go down and rise again as soon as the current is shut off. The harder and faster the cork goes down the more current the battery contains.

EDWARD N. HEUBNER,
New York, N. Y.

CONNECTING PLUG.

First break away the glass globe down to the brass base of a burnt-out lamp bulb; leaving the glass part which holds the two wires. Next solder on the two ends of a

just enough to hold it tight; and let the wires extend on thru to the other side. (Or otherwise use a tight-fitting paper or cardboard tube.)

Next heat some sealing wax and pour into the mould, being sure that the wires do not touch where they are bare and that they are in the middle of the casting. The base should be heated gradually so that the hot sealing wax will not break the glass projection when poured into the mould. Now remove the block of wood (or paper tube) either by splitting or slipping off, when the wax has cooled. Next smooth the casting off and bevel the corner down to the wires as shown.

DONALD WILSON,
Monroe City, Missouri.

DRIP PAN ALARM

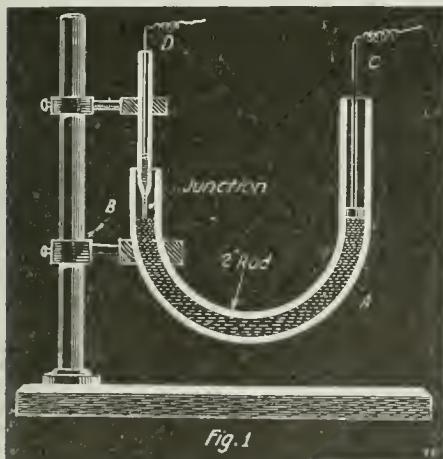
All that is needed in constructing and installing this drip alarm is a burnt-out lamp bulb, batteries, wire, electric bell and a strip of brass about a foot long, 1/2-inch wide, and 1/8-inch in thickness.

The burnt-out lamp bulb is soldered to the brass strip "B" while the other terminal should be pivoted. Fasten the bell where you desire it and connect the batteries as shown with a switch. When the drip pan fills the float rises and the brass strip "B" contracts to "C" and closes the circuit, thus giving the alarm.

CAESAR HASIMOTO,
Honolulu, T. H.

A French system of rapid telegraphy, by which 40,000 words an hour can be transmitted, has worked successfully for distances up to 900 miles in that country.

The government of Ecuador has established seven land wireless stations and equipt three war vessels with radio telegraphy.



The Capillary Electrometer Used in Building the Radio Recorder Here Described. It Employs a Fine Jet of Mercury Which Coacts with the Column of Mercury in Large Tube "A", the Junction Between Them Rising and Falling as Radio Currents Are Applied to It.

capillary action, the mercury will recede a trifle, and will draw a quantity of the sulfuric acid up with it. The separation be-

The How and Why of Radio Apparatus

By H. WINFIELD SECOR, Assoc. I. R. E.

No. 10—Radio Amplifiers.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the tenth paper is RADIO AMPLIFIERS.

RADIO amplifiers of many kinds have been tried out in the twenty years that wireless telegraphy has been with us. The more prominent types of current intensifying devices will be discussed here, reference being made to some of the novel or interesting ones. An amplifier is usually considered to be a device acting by electro-magnetic or other means so as to boost the strength of a received radio signal. Such apparatus is of the greatest importance in radio work, not only for the purpose of intensifying weak signals to audibility, but also for the control or modulation of heavy radio-telephonic transmitter currents.

The electro-magnetic amplifier illustrated in Fig. 1, known as the "Multi-Audi-Phone," is claimed to boost incoming wireless messages fifteen hundred times their original audible strength of signals.

The amplifier consists of a special chemical placed between two electrodes, which arrangement changes the resistance by virtue of a diafram attracted to an electro-magnet. This will be more clearly understood by referring to a cross-section view of this instrument, Fig. 1. It consists of a permanent magnet A, supporting a metallic case N, having a threaded screw cap M. The case contains the amplification parts, comprising the electro-magnet B, which has a small iron core E connected to a very fine steel diafram D, carrying a cup F upon its surface. Another cup G is placed on the opposite side and within it, the special chemical is placed at I. A tube H is provided so that the material is retained within the cups. The cup G is connected to a threaded rod J and lever K, supported by a rubber standard L on the steel magnet A. The diafram D is gold-plated in order that the chemical will not affect the steel. The electro-magnet B is connected by means of the wires O, while diafram D is joined to wire P. Rod J connects to terminal Q.

In order to regulate the pressure on the chemical mixture between the cup electrodes, adjustment is made by nut K.

The action of this amplifier is somewhat microphonic, and as the diafram is caused to vibrate by the incoming signals it varies the distance between the electrodes, consequently varying the resistance of the chemical and thus also the 'phone circuit. A 5-ohm 'phone is used in connection with this amplifier, so it is evident that a large current is used in this secondary circuit. A horn is usually fitted to the receiver, so that messages can be heard about the room without using a pair of head 'phones. If two or more of these units are used in cascade, signals can be boosted to such an audibility that one can hardly stay in the room on account of the loudness of the signals.

The "Brown" Radio and Telephonic Relay.—The electro-magnetic telephone and telegraph relay designed by Brown, of England, is widely used for telephone current

intensifying, and has been successfully employed for boosting radio signals.

Its make-up will be gleaned from Fig. 2, where N S is a permanent steel magnet frame surmounted by two magnetizing coils K, and two 4,400-ohm coils H (same size pole-pieces, etc., as used in a telephone receiver). A light spring or reed P carries a soft iron head to be attracted by the pole-pieces. Attached to the moving reed is a rod joined to a delicate microphone M, filled with polished carbon grains.

Referring to the diagram of connections in radio circuits we see that terminals A are joined in place of the regular telephones. The magnet coils K are energized by current from a battery of six volts thru the primary (17 ohms) of an auto-transformer P. S. Across the transformer

THE HOW AND WHY OF RADIO APPARATUS Series to Date

No. 1. *The Induction Coil*, Page 493, November, 1916.

No. 2. *The Transformer*, Page 656, January, 1917.

No. 3. *Condensers*, Page 735, February, 1917.

No. 4. *Spark Gaps*, Page 113, June, 1917.

No. 5. *Radio Transmitting Inductances*, Page 537, December, 1917.

No. 6. *Radio Receiving Tuners*, Page 685, February, 1918.

No. 7. *Radio Receiving Condensers*, Page 766, March, 1918.

No. 8. *Detectors*, Page 30, May, 1918.

No. 9. *Telephone Receivers*, Page 176, July, 1918.

Radio men everywhere will undoubtedly like to obtain the complete set of these specially prepared papers on the "How and Why of Radio Apparatus." Also the following three important and timely papers on the "Calculation and Measurement of Inductance," by Mr. Secor and Samuel D. Cohen.

Nos. 1, 2 and 3 "Calculation and Measurement of Inductance," appearing in the March, April and September, 1917, issues.

Those interested in these valuable papers can obtain prices of individual back numbers containing them by writing to the "Circulation Department."

secondary (26 ohms) at 3, 1, is connected a 2 M. F. condenser in series with a pair of 120-ohm telephone receivers. Its action will now be clearly understood. The varying Hertzian currents react thru coils H on the relay magnetic circuit balance, and cause its armature reed P and the microphone M to vary their positions. The microphone thus changes the resistance of the circuit, and these changes are transmitted thru the transformer P S and condenser to the head telephones.

This style of Brown relay has an intensifying factor of about 20 times received strength of signal. Newer types can intensify 100 times and more, or several may be joined in cascade to give as high a ratio as required.

The "Telefunken" system utilizes a unique amplifier of the tuned reed microphone type, which is outlined at Fig. 3. A radio coupling circuit is joined to a "tuned" reed microphone relay F₁ M₁, and this re-

acts or controls the battery thru a second "tuned" reed microphone M₂, etc., etc. Three microphones are commonly used. Two of these "tuned" amplifiers can receive two distinct messages on an aerial simultaneously without interference, if they and the incoming waves have a tune frequency differing by 20 per cent or over, it is claimed. Such microphonic apparatus is extremely delicate and must be very carefully adjusted and supported on elastic bands or otherwise supported in a shock-proof manner by employing felt, etc. The third microphone circuit may control a "loud talker" or Morse tape recorder as desired. These microphones are extremely well built to permit of the most exact adjustment. The resistance of each microphone circuit, as well as the potential applied, is made finely adjustable.

The "Detectiphone" Amplifier.—We come to an interesting application of the "Detectiphone" or dictograph, in the form of an amplifier for feeble or weak electric currents. At Fig. 4 there is outlined a system which has been tried out and which, when carefully and properly made, will yield good results.

Considering first the regular radio receiving instruments, with aerial A, ground G, loose coupler L C (or tuning coil), we see that the regular sensitive telephone receiver R 1, is mounted close up to a "Detectiphone" transmitter. An ordinary detector, finely adjusted, is connected at D, while C is the usual blocking condenser. The detector may be a crystal type or a Radioson, which requires no adjustment. This circuit, shown schematically at Fig. 4, is for a 2 stage amplifier, but a 3rd "Detectiphone" set gives better results of course. The batteries A and B are the regular ones supplied with the instruments, or they may be ordinary 4½-volt flash-light batteries. At T 1 is the first transmitter of a "Detectiphone" and its receiver at R 2; T 2 is the second transmitter and R 3 its regular receiver. The only high resistance wireless type receiver is that indicated at R 1. This should be a first class 'phone, and have at least 1,000 ohms resistance, and better yet 1,500 to 2,000 ohms; so as to be as sensitive to the rectified detector currents as possible. This arrangement of the apparatus works on the principle that if a faint sound, such as a radiotelegraphic signal, be reproduced close to the ultra-sensitive transmitter of the "Detectiphone," then that faint signal will cause the diafram of the transmitter to vibrate, and thus cause variations in its resistance; which in turn are manifested in the receiver of the first "Detectiphone." These signals actuate the second microphone, and this in turn controls the third and final "Detectiphone" receiver R 3. It is well to place a 10-ohm adjustable rheostat in series with each amplifying circuit, to enable the battery current to be regulated to a nicety. Not over 6 to 7 volts should be applied in any case to these "Detectiphone" circuits.

Several different arrangements and modifications of the apparatus may be made, and thus the experimenter and student is left a good chance for research work along this line. Step-up transformers can also be employed, as well as telephone induction coils, etc.

In making up such an amplifying set, care should be exercised to have the receivers and transmitters very close to each other, each unit mounted in a sound-proof, airtight wooden box packed with felt, or other sound-deadening material. This is insured by carefully removing the front threaded

(Continued on page 507)

THE HOW AND WHY OF RADIO APPARATUS—RADIO AMPLIFIERS

The diagrams are arranged in a 4x3 grid:

- Diagram 1:** Multi-Audi-Phone Amplifier. Shows a transformer with primary windings connected to a radio set and secondary windings connected to a telephone receiver. A battery is connected to the primary.
- Diagram 2:** The Brawn Relay. A mechanical relay assembly with a coil and contacts, connected to a 6V battery.
- Diagram 3:** Telefunken tuned Reed Relay. A circuit with an antenna, LC circuit, and two reed relays (B-1, B-2) connected to a speaker and a Morse inner.
- Diagram 4:** "Detectiphone" Amplifier. A circuit with an antenna, LC circuit, and a transformer connected to a telephone receiver. Includes a photo of the physical assembly with labels for felt, rubber bands, and terminals.
- Diagram 5:** The Helmholtz Acoustic Resonance Amplifier. Part A shows a Helmholtz resonator (a light bulb) connected to a receiver. Part B shows a microphone connected to an adjustable resonance tube amplifier, which is connected to a radio receiver.
- Diagram 6:** Compressed air Amplifier. A mechanical amplifier using a piston valve, diaphragm, and horn on a loud-falmer, connected to a radio receiver and compressed air source.
- Diagram 7:** Lowenstein Magnetic Relay - 1 micro-amp sensitivity. A complex magnetic relay assembly with multiple coils and a central magnet.
- Diagram 8:** The Selenium Relay. A circuit with an aerial, fine plat wire, reflector, and a selenium relay connected to a box and a 5.6 cell battery.
- Diagram 9:** The 2(or more) Audion Amplifier. A circuit with an antenna, LC circuit, and two Audion tubes connected to a speaker. Includes a photo of the physical assembly.
- Diagram 10:** "Lieben-Riez" Gas Relay. A circuit with an antenna, LC circuit, and a gas valve tube connected to a 30 volt bat and a 220 volts DC source.
- Diagram 11:** The Pliotron Vacuum tube Amplifier. A vacuum tube assembly with a coupling transformer and a receiver connection.
- Diagram 12:** Alexanderson Electro-Magnetic Amplifier. A circuit with an HF alternator and an iron frame connected to a speaker. Includes a photo of the physical assembly.

(For Description See Opposite Page)



The Oscillograph—How It Works

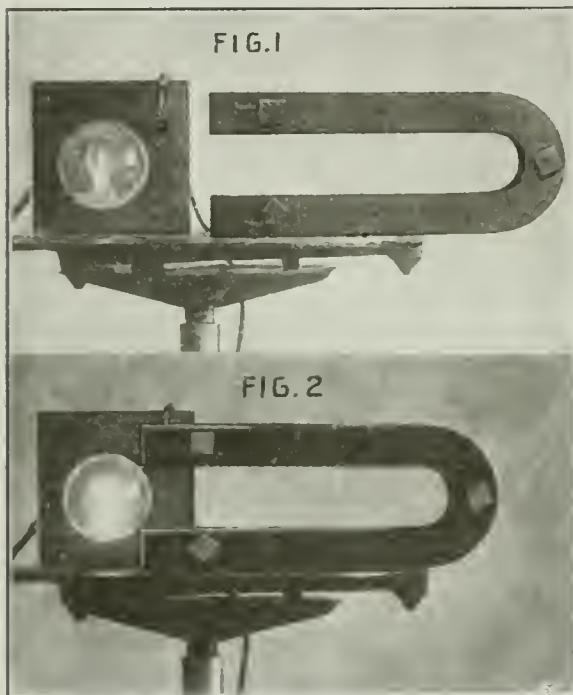
By PROF. LINDLEY PYLE, Professor of Physics, Washington University

THE oscillograph is one of the simplest yet one of the most marvelous of our electrical instruments,—simple because it consists of a single loop of wire hanging in the air-gap of an electromagnet, and marvelous in that it

ing current. In the case of a loop the current at any instant is in opposite directions in the two legs; the two forces are therefore opposite and the filament is twisted. If the current is reversed the electromagnetic forces change direction and the loop is twisted the other way. The amount of twist depends upon the strength of current in the loop. Since the lamp in the illustration carries a current alternating in direction at the rate of 60 complete to-and-fro oscillations per second, the lamp filament is thereby forced to make 60 to-and-fro twists per second, or 120 single vibrations per second. Now this motion is too rapid for the eye to follow and the incandescent filament spreads out into an apparent ribbon of light as illustrated. So much for the illustration of the principle.

Fig. 4 is a diagrammatic sketch of the commercial type of Duddell oscillograph. *N* and *S* are the two poles of an electro-magnet; *L* is a loop of fine phosphor-bronze wire, the ends of which, *b, b*, are attached to binding posts. A spring, *s*, attached to a small spreader (sometimes a small pulley) at the turn of the loop, exerts a stout pull. The parallel wires of the loop are close together, a thirty-second of an inch apart or less and a small mirror, *m*, is fastened across the wires where they pass thru the magnetic gap. The resemblance to Fig. 2 is very clear. With a steady current traversing the coils of the electro-magnet and an alternating current thru *L*, the behavior of the loop is exactly like that of the filament of the lamp in Fig. 2. If one wire of the loop *L* is moving forward the other is moving backward and the little

mirror, *m*, wags to and fro in accordance with the behavior of the current in the loop. How shall we now interpret



Figs. 1 and 2—Showing the Effect Produced by Bringing a Steel Magnet Close to a Carbon Filament Lamp Operated by 60 Cycle A. C. Magnet Away—Filament Still; Magnet Close—Filament Twisted Back and Forth 60 Times Per Second. This is the Fundamental Principle of the Oscillograph.

takes a moving picture of the behavior of an electrical current showing variations occurring in a time interval of one-thousandth of a second or less.

The principle of the oscillograph is made clear by reference to figures 1 and 2. Figure 1 shows an incandescent lamp burning on a 110 volt, 60 cycle A. C. circuit. The carbon filament in this lamp takes the form of a long single loop (hair-pin type). The tip of the lamp is toward the observer and the incandescent filament is clearly observable, along with some bright reflections in the glass globe. The horseshoe magnet in the illustration 1 is drawn away so that it has no appreciable influence. Now note in Fig. 2 the behavior of the loop filament when the magnet is brought close:—the filament is thrown into a violent twisting vibration. When one leg of the loop moves toward the magnet the other leg moves away, and when the first mentioned leg starts back the second starts forward. It is only necessary to recall that—a current-carrying conductor extending across the lines of force of a magnetic field is urged sideways by a force PROPORTIONAL TO the strength of the travers-

magnet and an alternating current thru *L*, the behavior of the loop is exactly like that of the filament of the lamp in Fig. 2. If one wire of the loop *L* is moving forward the other is moving backward and the little

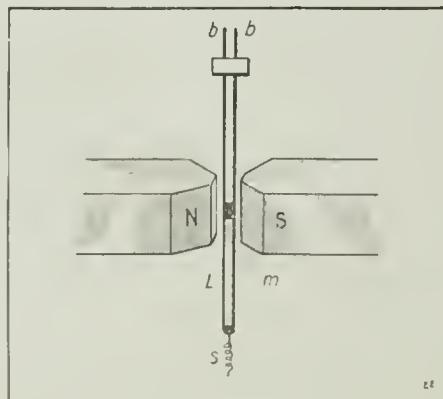


Fig. 4. Arrangement of Moving Element—Wires "b b" and Tiny Mirror "m"—Used in the Commercial Oscillograph. N-S Are Poles of Powerful Electro-magnet.

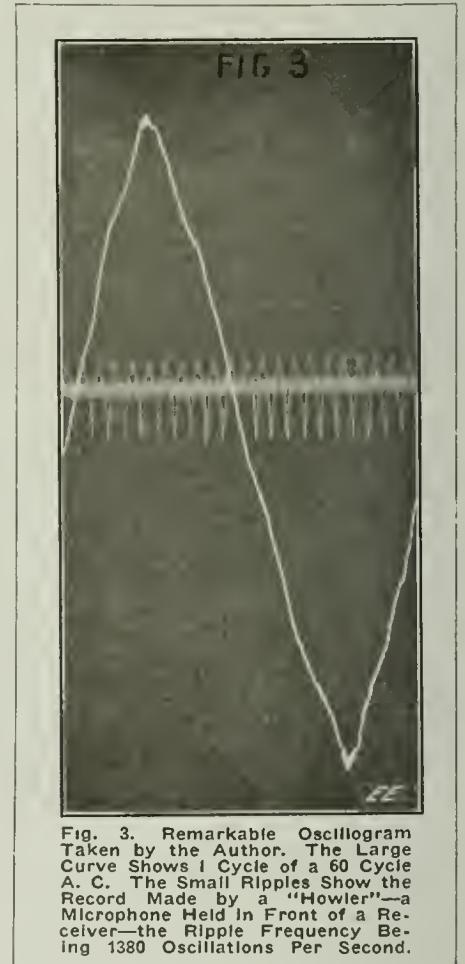


Fig. 3. Remarkable Oscillogram Taken by the Author. The Large Curve Shows 1 Cycle of a 60 Cycle A. C. The Small Ripples Show the Record Made by a "Howler"—a Microphone Held in Front of a Receiver—the Ripple Frequency Being 1380 Oscillations Per Second.

what the mirror is trying to tell us?

Imagine the whole apparatus to be in a darkened room and allow a beam of light from the sun or an arc light to enter the room thru a small hole and to fall upon the moving mirror. The reflected beam of light will sway to and fro in accordance with the movement of the mirror. Take an unexposed photographic plate, hold its face toward the mirror, and chop it down across the reflected beam. Develop and fix the plate and a wavy line will be shown on the plate representing the displacement of the mirror at every instant. This method of registration is easy to understand if one takes a pencil and draws on a sheet of paper a line parallel to the top edge of the sheet. Now while running the pencil to and fro across this line, take hold of the top of the sheet and pull it out from under the moving pencil. The result is a wavy line drawn on the sheet of paper. If the

(Continued on page 488)

A Thermostatic Time Switch

By ALBERT H. BEILER

I'LL admit right at the start that this thermostatic time switch might better be placed in the E. E. category of "phony patents." If you ask me what real use it has, I can't tell you, but if you are the sort of "bug" who occasionally wants something novel—the commercial use

thermostat. Also if you try to arrange to cool it, then when R contracts what is to keep the circuit from being opened at C?

Our problem, then, is this: Let a circuit be closed at C after a minute or so by the expansion of R, but as soon as this is done let the heating coil circuit become opened.

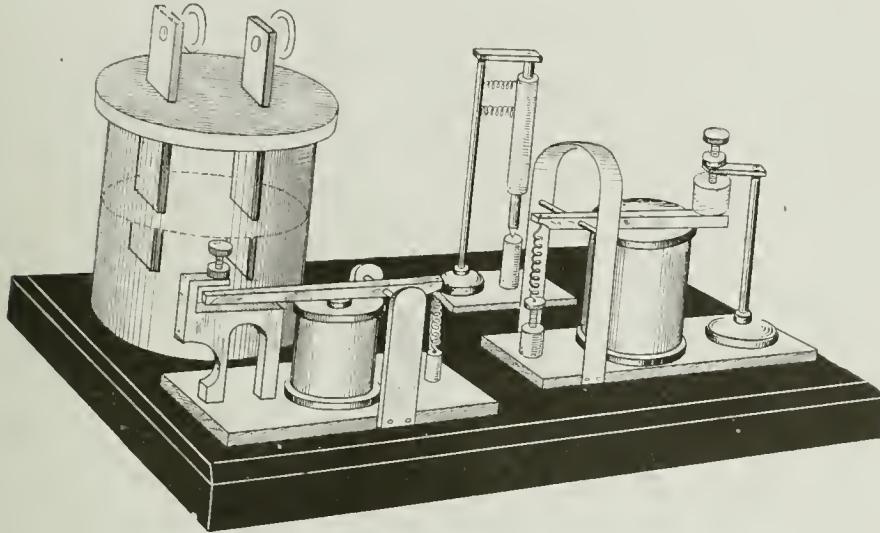
A circuit is then completed from the positive main thru the rod R, contact C, magnet M, lamps L and back to the negative main. The lights light and the magnet attracts its armature A. As soon as A leaves C" the thermostat circuit is opened and it commences to cool.

"But," you will say, "as soon as it cools armature A will—" Well, wait a minute. Give me time. As soon as A touches the core of M, it closes the magnet circuit independently of rod R and contact C as follows: From the positive main thru S, armature A, core of M, magnet M, lamps L and back to the negative main. R can cool all it wants to now. Magnet M doesn't care a rap. Its circuit is complete and the lamps remain lit until the switch S is opened again. In actual practise a slightly different arrangement was employed. The front contact C" carries the current for the heating coil, which is about 3 amperes. When the break occurred, a bad arc formed and so an oil switch was employed to quench it. This oil switch uses glycerine and was described by the writer on page 403 of the October, 1917, issue of the ELECTRICAL EXPERIMENTER. The details of construction of M are so simple that they hardly require any explanation. The thermostat used was a zinc rod 3/16 inches in diameter and 4 inches long, wound with four layers of No. 26 D. C. C. copper magnet wire for a distance of 3 inches on the rod. See illustration.

In conjunction with the time switch a short-circuiting push-button to light the lamps without the time element was employed. Also instead of the time switch being a knife or other closed-circuit switch, a push-button was used to obviate the necessity of adjusting any switch but the main S. To affect this substitution, another stick relay had to be shunted around the time push-button to keep the circuit closed, once the time push had closed it for an instant.

The complete wiring as installed in the writer's home is shown in Fig. 4 and may be briefly explained. The push P lights the lamps instantaneously and the circuit remains closed because M is a stick relay. To light the lamps on the time push, T P is depress. The stick relay T M keeps the circuit closed when T P has opened. After the heating interval when R touches C and closes M's circuit, M attracts A and opens the circuit of the heating coil and T M at C". Thus as soon as A leaves C" and goes down, the armature of T M goes up.

(Continued on page 496)



When You Close the Circuit Containing This "Thermostatic Time Switch," the Lamps Connected in the Circuit Light Up About Two Minutes Later—Why? Read the Article. It Explains Just How to Make This Mystic Apparatus.

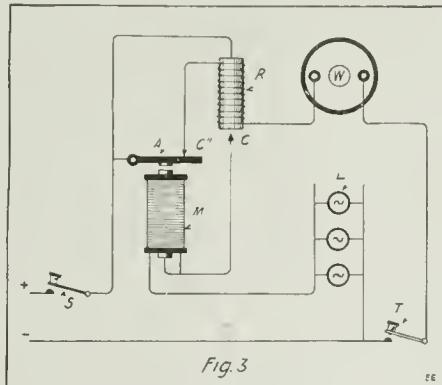
go hang—then continue reading, my Boy! The thermostatic time switch is as complicated as its name sounds when multiplied by two. And all it accomplishes is to light some lamps about two minutes after you close a switch. No time clock. Oh, no! nothing that simple! It works on the thermostat principle.

"Oh, I know all about it," some of you will say. "Heating effect of resistance coil expands a rod which makes contact and closes circuit after a minute or two. Nothing simpler." However, there's a bit more to it than that. Most of you are more or less familiar with the principle on which those signs work when the lights flash on and off at intervals of a minute or so. To briefly explain the principle: In Fig. 1, L is the sign lamp and R a metal rod having some thin resistance wire wound on it. One end of the wire is connected to the rod. C is a contact separated from R by a very small distance, so small that when R expands, due to the heat of the coil, it touches C. When the switch S is closed, current passes thru the lamp and the heating coil. The resistance of the latter is so great that the lamp lights dimly or not at all. The coil heats rod R, which eventually touches C and lights lamp L brightly by short-circuiting the coil. After a minute or so the rod has cooled sufficiently to contract and break contact at C and the process is again repeated.

This on and off cycle is just what is desired on a sign in order to attract attention. But suppose it were required to light lamp L by the thermostat and keep it lit permanently? That is quite another problem. At first thought it seems that an arrangement as seen in Fig. 2 will solve the difficulty. Here when the switch is closed the coil heats up and after a while R touches C and the lamp lights. Very fine, but meanwhile what about our friend the heating coil? If it is kept on for any length of time it will soon burn itself out and no more

Further, when R contracts on cooling let it have no effect on the continuity of the lamp circuit.

To accomplish this we will use our old friend the stick relay which the writer

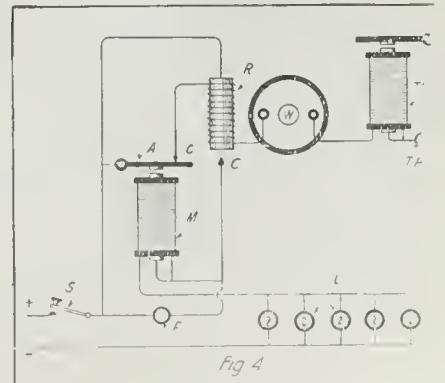


Thermostatic Time Switch Circuit Containing the Thermal Element R, Water Rheostat W, "Stick" Relay M, Lamps L, Etc.

described in his article on "Burglar Alarms" in the July, 1917, issue of the ELECTRICAL EXPERIMENTER. Fig. 3 illustrates the circuit, and the mode of operation is as follows:

M is an electromagnet, one end of whose coil is grounded to the core. R is the rod with the heating coil wound on it, W is a water rheostat to regulate the current of the heating coil. T is the time switch, S the main switch and L the lamps. C is the thermostat contact and C" is a rear contact for magnet M.

When S is closed but T open all circuits are open. When T is closed current travels from the + main thru switch S, armature A, contact C", heating coil, rheostat, switch T and back to the negative main. Soon the coil heats up enough so that R touches C.



Thermostatic Time Switch Control Circuit Involving the Use of Two "Stick" Relays.

A Water-Jet Blast Apparatus

By Professor HERBERT E. METCALF

ONE of the handiest articles around the laboratory is a blast lamp. Usually it is not extensively used because of the fact that most laboratories are not fortunate enough to be equipt with compressed air, and are

the open end. A bubble will blow out from the heated portion which may be chipt off. Thus a hole is formed. This is the air inlet. Another tube is now made exactly like the first.

A piece of tubing which will fit inside the injector tube loosely, should be drawn out into a constriction so that the final lumen of this smaller tube will be slightly smaller than the constriction in the lumen of the injector tube. This, if cut in the middle of the constriction, will furnish jets for both injector tubes.

The two jets are then sealed firmly in the short end of the injector tubes by means of sealing wax. The point of the jet should be as near the constriction as possible, leaving only enough distance to allow sufficient air to be carried by the end of the jet.

The large collecting tube should be as long as possible and may be made out of tubing, a bottle or a broken graduate. If a bottle is used the bottom may be cut out by winding string around it, saturating the string with alcohol, burning and plunging into cold water. The two large rubber corks which are used one in each end, should be of a size to fit very tightly when forced into the tube. The upper cork is perforated with three holes, two for the injectors, and one for the air outlet tube. The lower cork should have a large hole for the water outlet. This outlet tube should be plenty large enough to allow all of the water to escape. In the apparatus as made, the lower tube consisted of a cut-off test tube.

The two injectors are now put thru their holes and adjusted in their final positions. A large cork will do for the baffle plate. This is to break the force of the water, and to allow the air bubbles to rise in the collecting tube. This cork should have two holes bored partway thru to receive the ends of the injectors, and then a series of small holes around the outside so as to allow the water and air to come out at right angles to the injectors.

The air delivery tube is then put in the top rubber cork, the baffle plate cork adjusted and paraffined, and the top cork prest firmly into place. The bottom cork with its outlet tube in place is then forced in also. In order that both jets function, a double delivery tube is made from glass, and connection made with the faucet with heavy-walled pressure tubing. All joints should be wired because of the high pressure caused by the small size of the jets.

On the water outlet tube, and on the air delivery tube, there should be placed adjustable pinch-cocks over rubber tubing. These are very important because without their proper regulation the apparatus will not function. Turn on the water full force. If water rises rapidly and threatens to come out the air delivery tube, the air pinch-cock must be tightened. The back pressure of the air will cause the water to go down. If too much air escapes out (Continued on page 504)

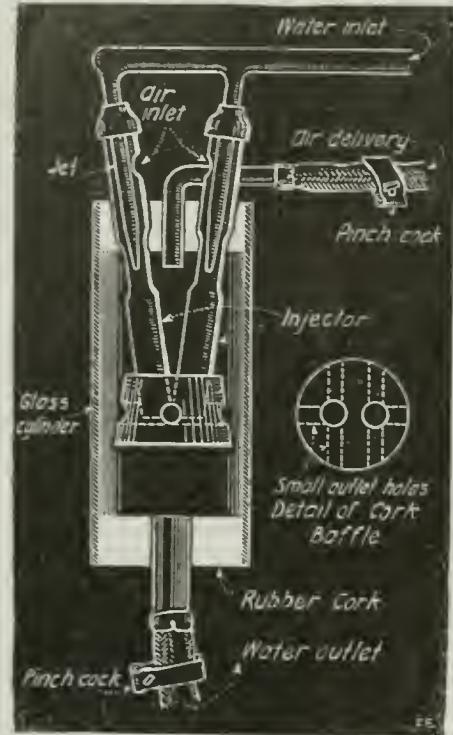
TESTING THREE-PHASE MOTORS FOR CONNECTIONS.

By HERBERT J. MALONEY, Engineer. (Australia.)

Many times electricians working among alternating current machinery are called upon to ascertain whether a three-phase motor is star or mesh connected. Little difficulty is experienced when the motor is of open type, where the wiring can be easily traced, but the difficulty arises when they are confronted with a totally enclosed motor with only three connecting leads projecting. The method here described is a simple way of tackling the situation by means of a megger and bridge, Wheatstone bridge or volt and ammeters. The resistance between the stator leads is taken; after that is obtained bridge two of the leads and measure the resistance between the two bridged leads and the remaining one. If the resulting resistance is half of that obtained by the first reading, it is a mesh connected motor, but if it is more than half or near the result obtained in the first reading, the motor is star connected.

The author used for tests for this article two Siemens 3 H.P. induction motors, one mesh and the other star connected. Fig. 2 shows the motor of star connection with two of the leads bridged. Fig. 3 is Fig. 2 in simpler form; as seen, we have phases A and B in parallel and C in series with them, with a resulting resistance of 1.27 ohms, according to the motor used, which is more than half of 1.72 (see Fig. 1) the resistance before the bridge was placed proving that it is a star connected motor. Fig. 6 shows the mesh wiring with two leads bridged. Fig. 7 is Fig. 6 simplified—phase A is shorted or bridged with phases B C in parallel. The resistance of which is equal to .44 ohms, which is half of .88 ohms, the resistance minus the bridge. Fig. 5 proves that the motor is of mesh connection.

Fig. 4 and Fig. 8 show star and mesh motors respectively, with two leads bridged with volt and ammeters, using Ohm's laws to find resistance ($R \text{ equals } \frac{E}{C}$) and either D. C. or A. C. can be used. A study of the diagrams shows the simplicity of the method.



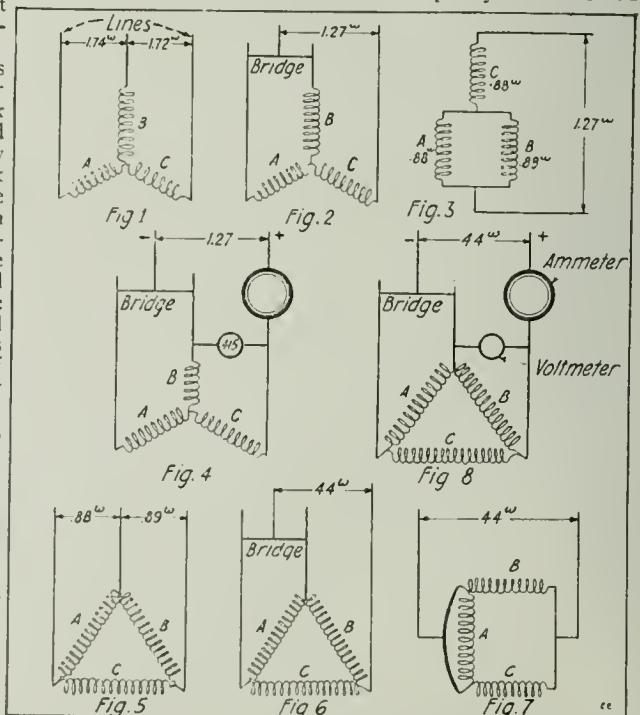
A Home-Made Water Jet Blast Apparatus for the Amateur Scientist. Hook Up Your Spigot to the Water Inlet and Presto! You Have a Fine Blast of Air, Sufficient for Two Blast Lamps. It Will Yield at Least Five Pounds Air Pressure.

obliged to make use of a foot blower to obtain the necessary air pressure. The foot blower has a number of disadvantages, such as giving an unsteady pressure, awkwardness in handling, and deterioration of the rubber back. Also its first cost is considerable. The water-jet blast apparatus to be described costs only a fraction as much as a foot blower, will deliver a steady stream of air, and can be made in a very short time with but little knowledge of glass blowing.

In general the water-jet blast apparatus consists of two injectors, a baffle plate, and a large collecting tube. The injectors are the essentials of the outfit, and upon their efficiency depends the amount of air finally obtained.

A piece of heavy walled glass tubing, about 12 inches long is drawn out in the flame making a constriction about one inch and a half from one end. This constriction should be made so that its walls are as thick or thicker than the original wall of the tube, as otherwise they will break in handling. This is done by thickening the glass tube at the point of the constriction by heating it and pinching it together, heating and drawing out very slowly. The lumen of the constricted portion should be straight and about 2 - 3 millimeters in diameter.

Next plug one end with a cork. Center a very fine flame on the short part of the tube just above the constriction until that portion of the wall is white hot and bending in under the flame. Then blow gently into



The Practical Electrician Will Appreciate the Methods Above Outlined for Testing Three-Phase Motor Connections, Especially in the Case of the Star-Connected Winding, Where the Center Lead is not Accessible. Both Star and Mesh (Delta) Connections Are Considered.

Experimental Mechanics

By SAMUEL D. COHEN

LESSON VII.

LATHE CHUCKS

THE next exercise of importance which the novice should try, is to locate the cutting of shoulders on a piece of work. One way is to mark the actual position and then proceed to cut down the material to the mark and

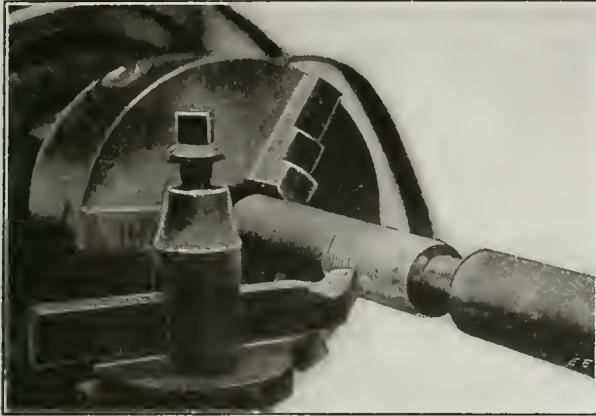
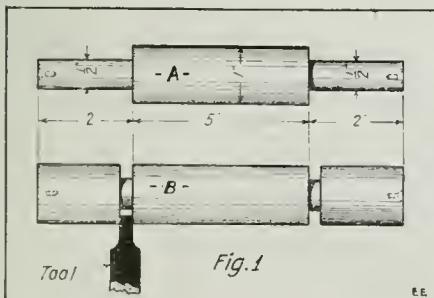


Fig. 2. Appearance of a Three-Jaw Automatic Universal Lathe Chuck. A Speedy Chuck and a Type Widely Used in All Machine Shops. The Jaws Can Be Reversed, Thus Giving a Very Wide Scope of Action.

to the required diameter as indicated in A, Fig. 1. To accomplish the same result with better accuracy and speed, the use of the cutting-off tool is employed as indicated at B of the same figure, which shows a typical job with proper dimensions to be turned out on the lathe.

To proceed with the job it is first necessary to obtain a piece of material one inch in diameter and eleven inches long. Square up both ends by placing the material in the live chuck and using a side cutting tool. Drill a counter-sink hole on the square faces and set stock between live and dead centers, securing material to live center with a lathe dog. Adjust the tail stock center so that the shaft plays slightly on the centers. Fasten the tail stock spindle by binding clamp, and keep dead center well oiled. Mark cutting position on work, starting from dead center towards live center. The cutting-off tool is started about 1/32 of an inch from the finishing line of the shoulder, and kept in position until the required diameter is reached, plus 1/32 of an inch more so as to allow for clean finishing. In this case it will be necessary at first to set the outside measuring calipers to read 17/32 inch. Then with the aid of a diamond-point tool, the remaining stock is cut off. To finish the face of the shoulder, use a side cutting tool. The



Method of Accurately Cutting Shoulders On a Lathe and Turning Down a Piece of Shafting to a Smaller Diameter at the Two Ends.

final step is to measure nine inches from the dead center and set the tool to cut off the stock to its proper length, in this particular case nine inches.

Altho this job seems to be quite simple at first glance, yet ninety-five per cent of the beginners will find it difficult to produce the

work with the required dimensions. A great deal can be learned from this job. First and foremost the use of the cutting-tool, which gives most trouble to the novice; and secondly, accuracy in laying out work to rigid specifications.

While preparing this lesson the writer thought it well to omit giving exercises at this early period and considered that further details on

the use of the lathe and other tools should supercede everything else. This was found to be essential in that it is important to know practically everything about tools and their uses before it is possible to proceed with building a machined article or work-

ing on exercises, altho the last two mentioned are of importance, as they give the amateur the fundamental practise necessary to become familiar with the working of the lathe.

Owing to lack of space and the great number of new feature articles we have had to postpone publishing the following articles this month:
 "Spectroscopic Methods and Spectra"—Part II—by D. S. Binnington.
 "The Secret of the Magnet Poles," by Walter E. Keever.
 "A Practical Electrical Photo Printer," by Dr. E. Bade.
 But these, as well as a host of other "brand-new" features, will all be in the DECEMBER number.

In order that various shapes of work may be held on the lathe, special tools called chucks are used. There are many different forms of chucks on the market, depending upon their use. The chuck is one of the handiest tools that can be attached to the lathe, increasing its usefulness many times.

One of the commonest and most used chucks is the so-called self-centering chuck, which is shown in photograph, Fig. 2. This particular chuck has three jaws. However, there are chucks equipt with four jaws. The jaws are usually opened and closed simultaneously by turning the handle which is attached to a screw, the screw being geared to a worm connecting all of the jaws. As each jaw moves thru exactly the same distance toward or away from the center, it is obvious that a drill or any piece of work placed between the jaws will be held directly in the center. For holding twist drills, metal rods, bolts and small

castings, these chucks are particularly useful and great time savers. Another type of chuck is shown in Fig. 3. This is called an independent chuck, and each jaw is moved in or out by its own screw, which works independently of the other jaws. In this device the work is chucked by moving the

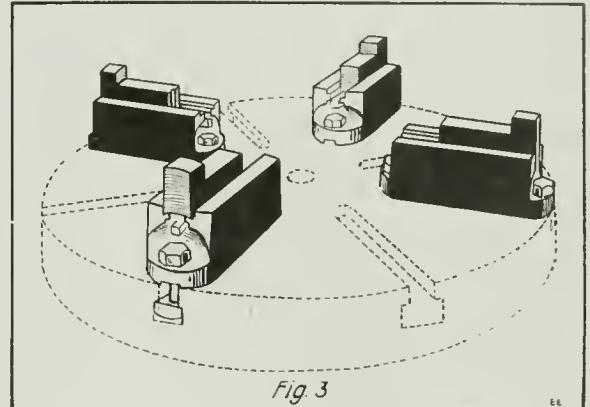


Fig. 3. Converting a Face-Plate Into a Four-Jaw Independent Chuck, Capable of a Wide Variety of Machine Shop Work. The Jaws Can Be Purchased Separately and Fit Any Face Plate.

step (knurled) jaws in or out by the screws with which they are controlled, the jaws sliding in the block grooves. The jaw blocks are bolted against the face plate of the lathe as shown in the figure. A single jaw is shown in Fig. 4. These jaws are adaptable for face plates, also for a great variety of work, and are rapidly taking the place of the larger sized chucks for several reasons. They are better adapted for use, being easily attached to the machine, and may be connected to or taken off the plate by one man alone without the use of tackle.

These jaws are reversible, facing them in or out. The sliding jaw may be quickly run out and turned end for end, also the blocks may be reversed if necessary. The last, but not least, item is their cost, and in this case they are much cheaper than other jaws, as they can be secured to the face plate furnished with the lathe. The independent chuck is very handy, especially in working with irregular shaped articles,
 (Continued on page 488)

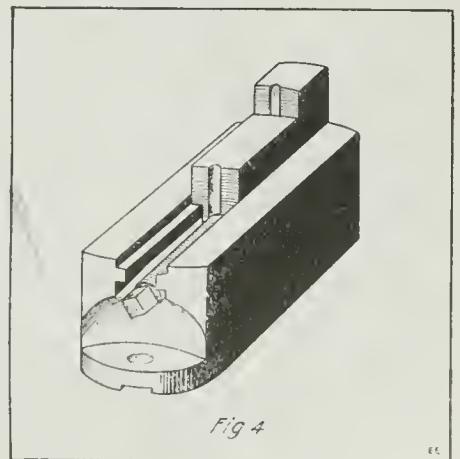


Fig. 4. Single Independent Chuck Block of the Type Illustrated in Use at Fig. 3. A Worm Screw and Key Moves the Knurled Jaw Back and Forth.

Experimental Chemistry

By ALBERT W. WILSDON

Thirtieth Lesson

THE HALOGENS.

Continued.

BROMIN, FLUORIN, AND IODIN

BROMIN: History.

THIS element was discovered in 1826 by Balard, who obtained and isolated it from the bitter or mother liquor of common salt. It was the last non-metal discovered previous to fluorin and argon.

Occurrence.

It occurs chiefly as magnesium bromid in sea water, and as the magnesium, calcium, and sodium salt in many rock-salt deposits and salt wells. It never occurs in the uncombined state in Nature. Large quantities of this element are produced at Stassfurt, and a considerable quantity is manufactured from the residues after the preparation of iodin from kelp, but the larger portion of our supply is derived from "bittern", the mother liquor of the salt industry. Bromides and chlorides of sodium, potassium, calcium and magnesium are contained in the natural salt brine.

Preparation.

1. For preparation in the laboratory, it is liberated from its most common compound, potassium bromid, by the action of manganese dioxide and sulfuric acid, analogous to the preparation of chlorin from sodium chlorid.

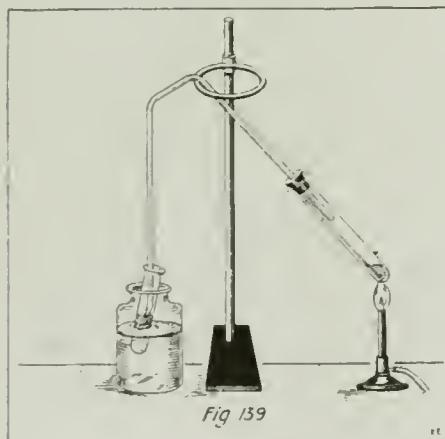
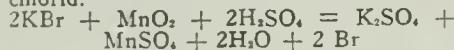


Fig. 139—This Apparatus May Be Employed for the Preparation of Bromin or Iodin on a Small Scale, Where a Retort Is Not Available. The Operation Is the Same as With the Retort.—See Figure 138.

Observe that oxygen and all the hydrogen combine to form water, and that each metal forms a sulfate, leaving bromid free. Compare, chlorin and iodin.

2. On the large scale from brine springs, the water is partially evaporated, leaving sodium chlorid to crystallize out. The thick liquid left, called *Bittern* or *Mother Liquor*, and containing in solution salts like magnesium bromid, is separated from the crystals, and to it are added manganese dioxide and sulfuric acid. Heating caused the same reaction as above, in addition to which some chlorin is set free from the sodium chlorid. This reacts with the magnesium bromid, sodium bromid, potassium bromid, and liberates bromid.



Properties.

PHYSICAL. 1. It is a thin, volatile, deep red liquid.

2. It possesses a very pungent, stifling odor as a gas.



Fig. 138—Retort Method of Preparing Bromin from Potassium Bromid, Manganese Dioxid and Sulfuric Acid.

3. Its specific gravity is 2.99 at 15 degrees.
4. It is intensely poisonous, attacking the membranes, especially the eyes. It burns into the flesh and makes sores difficult to heal.

5. It is soluble in 28 parts of water. Its water solution being commercially known as Bromin Water. It is more soluble in carbon disulfid, alcohol or ether.

6. It freezes at -7 degrees, but rapidly evaporates at all temperatures above that.
7. At 1200 degrees the bromin molecule splits into its atoms. This makes one atom per molecule.

CHEMICAL. 1. Its chemical properties are very much like those of chlorin.

2. It has great affinity for hydrogen, and for metals, with which it forms bromides.

3. When dissolved in water it gradually combines with hydrogen and frees oxygen.

4. Antimony powder burns in bromin as in chlorin.

5. Bromin will not unite with oxygen, and no oxid of bromin is known.

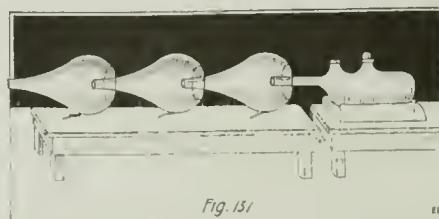


Fig. 137—Aludels, Which Consist of Flask-Shaped Glass Vessels With Circular Openings in the Bottom to Admit the Necks of Other Flasks, Used in the Commercial Sublimation of Iodin. Over the Furnace at the Right Is the Retort Where the Reaction Takes Place. The Hot Iodin Vapor Sublimes on the Sides and Necks of the Aludels.

Uses.—In the free state it is employed in the manufacture of bromides and of many bromin derivatives of the coal-tar compounds. It is also used somewhat in the manufacture of anilin colors. Potassium bromid is employed in medicine, and is the basis of other bromin compounds. Silver bromid is employed extensively in photography, especially for the negative.

FLUORIN: History.

The art of etching glass by means of a mixture of fluorspar and sulfuric acid was known as far back as 1670. Many attempts have been made in recent years to isolate this element. In 1886, Moissan, by passing a current of 50 volts and 15 amperes thru anhydrous hydrofluoric acid, cooled to -23 degs., and contained in a U-shaped platinum tube, succeeded in obtaining the free element fluorin, as a colorless gas which has since been obtained in solid liquid form. Fluorin was liquefied by Moissan and Dewar, by utilizing liquid air as a refrigerant, at the temperature of -187 degrees.

Occurrence.

It occurs chiefly as calcium fluorid—Fluorspar— CaF_2 , which is widely distributed over the globe, and as sodium and aluminum fluorid—Cryolite— $(\text{Na}_3\text{AlF}_6)$ which is found in deposits in Greenland. It has been found in small quantity in sea water, in many mineral waters, in the bones and teeth of man, and in milk.

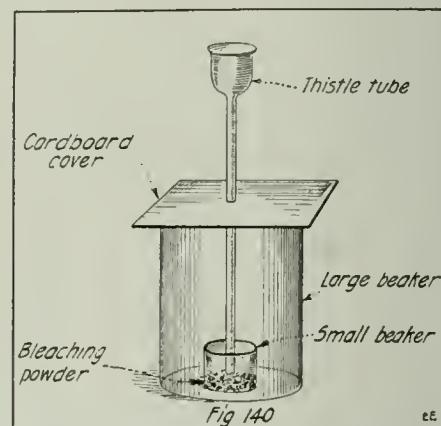


Fig. 140—A Large and a Small Beaker Comprises the Apparatus Necessary for Obtaining Chlorin from Bleaching Powder.

Properties.

It is a pale greenish-yellow gas, possessing a very penetrating odor. It is chemically the most violently active of all known elements. It combines with all of the common elements except oxygen, platinum and gold. It readily and energetically attacks silica—glass—thus its application for etching glass.

Its most important use is for etching glass, when in the form of the compound hydrogen fluorid—hydrofluoric acid.

IODIN: History.

In 1811 or 1812, Courtois, a soap-boiler of Paris, observed a peculiar corrosion of his copper kettle during the evaporation of kelp liquor, after crystallizing the sodium carbonate from it. Subsequently he obtained

(Continued on page 491)

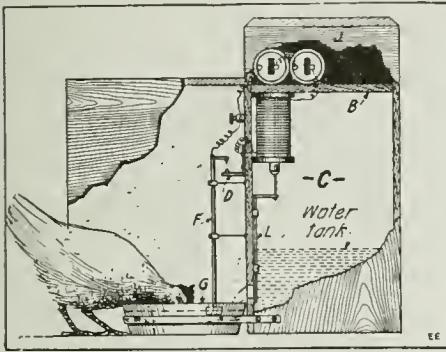


This department will award the following monthly prizes: First Prize, \$3.00; Second Prize, \$2.00; Third Prize, \$1.00. The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of \$3.00 is awarded; for the second best idea a \$2.00 prize, and for the third best prize of \$1.00. 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, \$3.00

AN ELECTRIC POULTRY WATERER.

When the family is gone for a long while an electric waterer will come in very handy. A lump of ice may be added in the



An Automatic Electric Waterer for the Chickens. A Dry Cell Or Two Runs the Outfit for a Long Time. In Making the Contact At "D" Be Sure to Form It of Springy Brass So the Magnet and Valve Have a Chance to Function Before the Circuit Is Opened.

summer time to keep the water cool. C, is a waterproof box made by putting on about two coats of waterproof varnish. B, is a board 1 inch wide. This is nailed at the sides of the box so that it will extend across the box. The box can be of any width and height.

An electro-magnet is screwed to the bottom of the board B. On the top of this door is soldered a clamp attached to the solenoid. The water pressure will hold the door tight against the hole in the box to prevent leakage. The pan G should be right under the door L.

A piece of heavy wire F, should be sharpened at one end and stuck into a cork. The rod F, is put in the pan G, with the cork at the bottom. At the other end is fastened a piece of brass an inch long.

A piece of brass D, is mounted as shown so the bottom will be as far below the contact on the rod F, as the pan is deep. The wiring is shown clearly. The pan G, is filled with water; so is the box C. As the water is drunk by the poultry the float F, goes down with the water. Finally when the pan is empty the contact on the rod F touches the fixt contact D—this closes the circuit and the solenoid draws the door L up, the water in the box C rushes out of the hole in the side of the box which was closed by tin door L and starts to fill pan G. The float F goes up and the contact on the upper end breaks the circuit; the door drops down and the water stops flowing.

One battery is sufficient to run this waterer for a long time.

Contributed by WILBUR BRITTON.

SECOND PRIZE, \$2.00

PHENOLPHTHALEIN POLARITY INDICATOR.

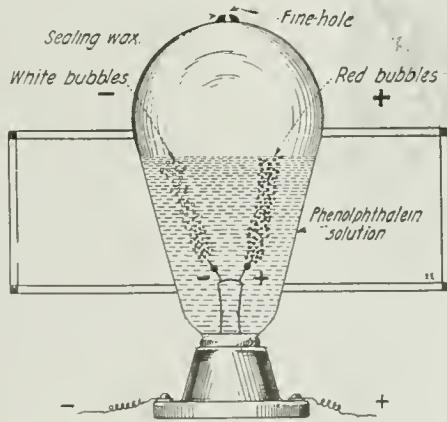
The accompanying illustration shows a very simple and accurate way to make a polarity indicator. Altho there have been many articles on a simple way to make polarity indicators many of them have failed, because they did not prove accurate when a small current was past thru it.

For this indicator, make a 25% solution of phenolphthalein, which can be bought at any drug store or chemical supply house. Then take a carbon filament bulb and file the tip off; pass a wire into the bulb and break the filament as in illustration, and fill the bulb about 3/4 full of phenolphthalein solution, and seal the tip of the bulb with sealing wax. By passing a current thru the indicator, the wire leading to the positive

LAST CALL

On November 1st the subscription price of the "Electrical Experimenter" advances to \$2.00 in U. S. (Canada and Foreign, \$2.50.) This is the last chance to subscribe at the old rates (\$1.50 in U. S., Canada and Foreign, \$2.00). No subscription for more than five years at the old rate accepted.—THE PUBLISHERS

filament, will give off red bubbles, while the negative filament will give off white bubbles. After the current is shut off shake bulb so



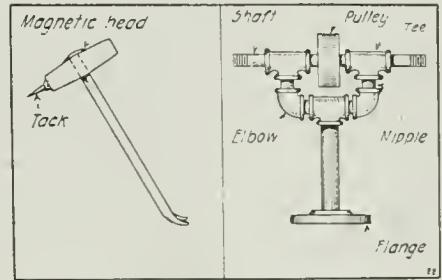
An Excellent Idea In "Polarity Indicators" for the Shop Work-bench. It is Made From a Burned Out Incandescent Lamp. The Tip is Broken Off and the Bulb Filled With a Phenolphthalein Solution.

as to make the coloration about the positive filament disappear. It is then ready to be

THIRD PRIZE, \$1.00

USE A "MAGNETIC" TACK HAMMER.

! ? * & ! ? ? that "blankety-blank" hammer! That's the third time! For the benefit of the reader I will say that the above is not a new form of writ-



At Left—The "Cuss-less" Magnetic Tack Hammer. At Right—Home-Made Pipe Frame for Polishing Head Described in Detail Below.

ing or sign language, but merely a pleasant way any man has of expressing his candid opinion of the common indoor sport of laying carpets. For some reason or other, when one tries to indulge in this pastime the hammer has a cute and exasperating practise of colliding with the thumb or forefinger, and the result is far from agreeable.

But here's a little idea that will not make friend wife hold her ears in horror and bid her better half to "remember that the children are around." As intimated by the title, it consists merely in having the hammer head magnetic, which may be done by bringing it in contact with a permanent or electro-magnet, in the usual method of magnetizing. The tack will then be held in the proper position, as shown by the sketch, without the necessity of using either the thumb or forefinger, as heretofore.

Contributed by JOHN T. DWYER.

HOME-MADE POLISHING HEAD.

The sketch above shows a practical "Polishing Head" made of ordinary pipe and pipe fittings. First secure from a plumber the following pipe and fittings:—3 tees, 2 male-female elbows, 2 nipples 1 inch long, 1 flange and one piece of pipe 5 inches long.

Fit them together according to the accompanying diagram, and thread a shaft of the right size 2 inches on each end. A pulley, either flat or grooved is fastened in the middle of the shaft by a set screw.

This can be used as a polishing head or for a grindstone.

Contributed by L. H. DECKER, JR.

used again. With this indicator no one can hardly make a mistake, even when passing a small current thru it.

Contributed by THOS. A. HORIWITZ.

YOUNG MAN, Y

There's
a War
On—

Wake Up!

Some of
the many
valuable
F R E E
advantages
enjoyed by
my students

1. I give each student, absolutely free of cost to him, a fine outfit of high grade electrical tools, materials and instruments.

2. I teach each student soon after he enrolls a special branch of electrical science, so he can begin to make money from the start.

3. And before you finish I will give you, also, **F R E E**, additional instruction in a special branch of electrical science, designed to place you absolutely in the ranks of the most successful and best paid men in the profession.



L. L. COOKE,

Chief Engineer, Chicago Engineering Works.
The well known Consulting and Advisory Engineer, formerly
Member of Engineering Staff of American Bridge Co., Pressed
Steel Car Co., and Millikan Bros., Great International Engi-
neers of New York, London and South Africa. YOUR AD-
VISOR AND INSTRUCTOR.

BE A CERTIF

Never before has there been such a big demand for trained graduate electricians, and never at such splendid pay. There are not enough trained men in the country. More men must be trained to meet this urgent need. Here is your opportunity!

You — yes *you* — are wanted, but as a **TRAINED ELECTRICAL MAN**. In these days there is no place for idlers, and there is no place for the untrained man. In civil or military life he is not only useless, but he is a burden. It is now up to every one of us to prepare to be just as useful to the country as possible. And after the war the untrained man will be up against it still worse, because he will be unable to compete with the skilled men now being trained. How does this hit you?

BE A CERTIFICATED ELECTRICIAN Earn \$45 to \$100 a Week

There is only one thing to it; you simply have to prepare for a real business if you expect to ever get ahead; and I can easily train you so you will soon be ready for a fine Electrical position, if you will only follow my advice and instruction. My system of **Instruction at Home**, without interfering with your work, is simple and clear yet thorough and complete. A few months snappy training of the right kind will prepare you to earn a good salary and start you on the way to a big success.

I have trained thousands of men and I know what I can do for you. In fact, I know so well that I will **Guarantee under Bond** to return every cent of your tuition if you are not entirely satisfied when you receive your *Electric Certificate* as a graduate of my school.

How have other successful men gotten ahead? Not by idly drifting along, but by preparing for bigger things. They have no more brains than you, but they have trained them. You can do the same and soon be earning a fine income.

L. L. COOKE, Ch

CHICAGO ENGINEER

DEPT. 20X

441 Cass Str

YOU'RE WANTED! EDUCATED ELECTRICIAN

You Men of Draft Age Don't delay taking up this course because you may be drafted. That's the very reason you *should* begin immediately. It is your patriotic duty to make yourself worth the most possible to your country—and to yourself—and of course the trained man with technical education is the one who rises in rank and pay. If you begin at once you may finish the course before you are called, but if not the part you have covered will be a benefit to you. Write me about it today.

What Can You Do as a Trained Man? This is absolutely the day of the specialist. Success in any line depends upon training. What line will you take up? There is no field that offers such a wide range of application, such wonderful opportunities for financial advancement and such urgent need for more trained men as Electricity. I can very quickly train you so that you can handle your share of the business of the nation. But it is up to YOU. You must act for yourself. But if you will give me your confidence and your co-operation I will take you along the way to a real success.

The Only School In addition to the fact that I am Chief Engineer of Chicago Engineering Works and can help you better than anybody else, here we have large finely equipped shops where you can come at any time for special instruction without charge. No other correspondence school has such equipment or can make you such an offer.

Special Offer Right now I am giving a big valuable surprise that I cannot explain here, to every student who answers this ad. Be sure to get this. Write today.

FREE LESSONS AND OUTFIT

Send me the Free Outfit coupon at once. Do it *now!* For a limited time I am making a slashing cut in the cost of tuition and giving each new student a fine Outfit of Electrical Tools, Materials and Instruments—*Absolutely Free.* I will also send you—free and fully prepaid—Proof Lessons to show you how easily you can be trained at home to enter this great profession, by means of my new, revised and original system of mail instruction which has proved so successful for my students.

Valuable Book Free

To everyone who answers this ad I will also send without charge my free book "How to Become An Electrical Expert". Write for it today.

Tear Off and Mail The Coupon Now!

It will not cost you a nickel to find out all about this, and it may mean everything to your future life. Don't neglect it. Tear off the coupon right now. Fill in your name and address and send it to me. Then what I will send back to you will show you the wonderful opportunity I am offering you and how easily you can take advantage of it. Now tear off the coupon.

Chief Engineer

CHICAGO ENGINEERING WORKS

Chicago, Ill.

FREE "OUTFIT" COUPON

CHIEF ENGINEER COOKE,
Chicago Engineering Works,
Dept. 20X-441 Cass Street,
Chicago, Ill.

Please send me at once—fully prepaid and entirely free—complete particulars of your great offer for this month.

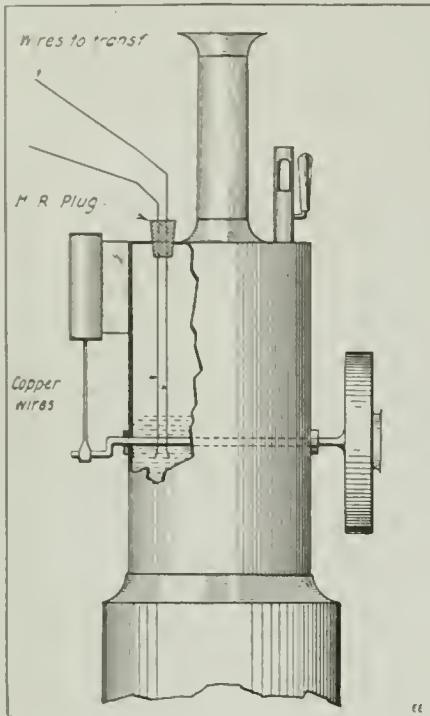
Name

Address

City State

ELECTRICALLY OPERATED TOY STEAM ENGINE.

The accompanying sketch shows how to operate a model steam engine by electricity.



Running a Toy Steam Engine With Electrolytically Produced Steam. Two Wires Are Past Thru a Rubber Plug and Connected With a Step-down A. C. Transformer.

Procure a firm rubber plug the size of the water hole in the boiler. Bore two small holes thru it, then force two pieces of copper wire thru the holes—No. 20 B. & S. will do. Fill the boiler about half full of water, then insert the plug in the water hole so that the ends of the wires will be about one-half inch in the water. Have the wires as close together as possible without letting them touch.

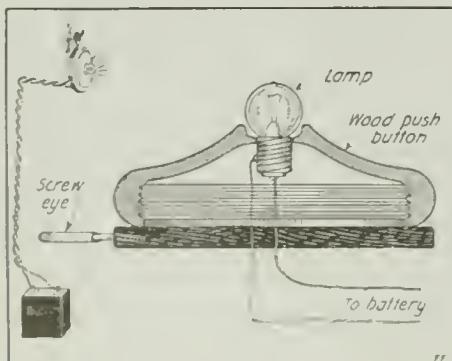
Connect the protruding ends of the copper wires to a transformer that gives 25-30 volts, switch on the current and the engine will run as good as if a spirit lamp was used to heat it. The resistance of the water between the two wires will, of course, cause the water to boil and therefore generate steam.

By using this method and starting with cold water I have had steam up and the engine running in *two minutes!*

Contributed by A. E. WOODHOUSE.

A "PUSH-BUTTON" LAMP SOCKET.

Secure an ordinary wooden push-button and remove the button, inside contacts, etc. Enlarge the hole in the front of it so as to



A Good Use for Old Wood and Composition Push Buttons—Make Lamp Sockets Out of 'Em. A Screw-eye Permits Them to Be Hung Anywhere.

admit the socket part (base) of the lamp and fasten it in place with a little sealing wax.

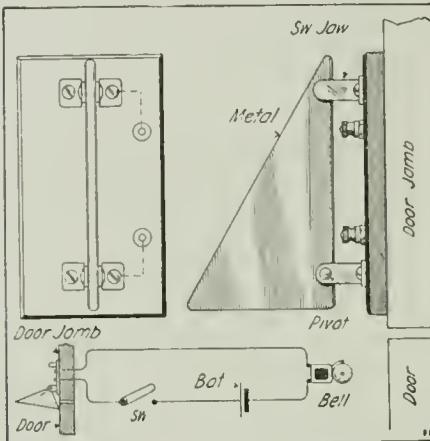
Next pass the wires thru the base of the push-button and screw it to wall. Solder the wires to the base of the lamp, and fasten the two parts together by screwing on to the base.

Contributed by HORACE C. LEEDS.

ELECTRIC DOOR ALARM.

This device can be made of material found in every amateur's junk box. The materials needed are: 2 switch jaws (one drilled), 2 binding posts, and a right-angle triangle of any material. Size is left to the maker. This door alarm will ring if the door is moved, even if only one inch, and won't stop its noise until the proper concealed switch is thrown off.

Contributed by H. PIERVIS.

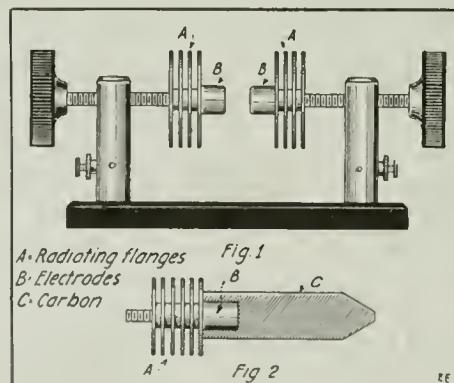


Easily Made Form of Automatic Door Switch Which Gives Alarm As Soon As Door is Opened.

EXPERIMENTAL ARC LAMP FROM SPARK GAP.

Wishing to pass on a little idea to fellow experimenters I respectfully submit the following:

Any one possessing a spark gap such as in Fig. 1 can make a good experimental



Take Your Temporarily Obsolete Spark Gap, Fit It With Carbon Electrodes, and Presto! You Have a Fine Experimental Arc Lamp.

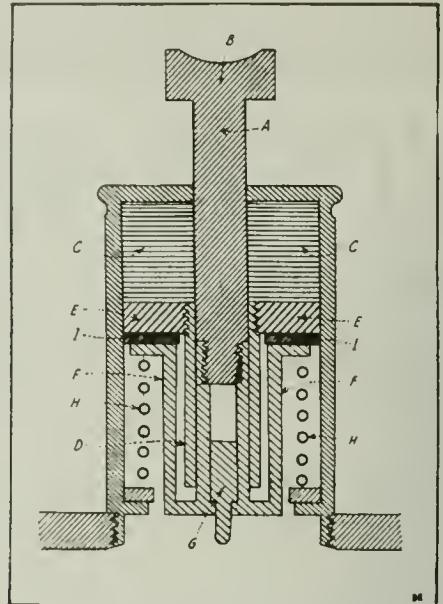
"arc" out of it without changing it at all. Secure a piece of carbon and drill a hole in one end the size of the electrode. After pointing the carbon force it on until it reaches the flanges. Fasten a similar piece on the other electrode and it is ready for use. The radiators tend to prevent overheating. These arcs work best on from 50 volts to 220, suitable choke coils or resistance being used, of course.

Contributed by N. KENNETH MEHAFFIC.

AN AUTOMATIC ELECTROSCOPE CHARGER.

Did you ever want a means of charging an electroscopes quickly and at any

time? An illustrated description of a convenient automatic device for charging a sensitive aluminum-leaf electroscopes for laboratory and field work with radioactive minerals, is given by L. Kolowrat in the *Philos. Mag.* As shown, it consists

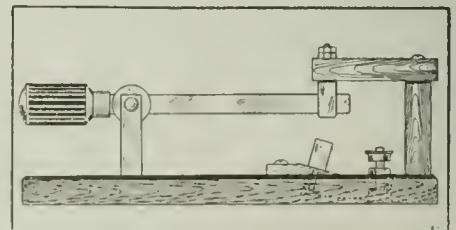


Did You Ever Wish for a Simple Means of Charging An Electroscopes Quickly? Here's a Simple Device for Doing Just This Thing.

essentially of an ebonite rod *A* which, while being pushed down by means of the button *B*, is rubbed against cloth placed at *C*—e.g., in form of a pile of perforated disks. During the subsequent motion the charge thus produced is collected on the fixed brass tube *D*, insulated by the ebonite collar *E*. This tube remains, on the other hand, in permanent connection with the piece *FF*, consisting of two coaxial cylinders and moved together with *A*. When the rod is at the end of its path a small finger *G* lightly touches the support of the leaf to be charged. By releasing the pressure on *B* the spring *H* brings the rod to its original position, simultaneously connecting *F* with the brass disk *I*, and consequently with the electroscopes case. The dimensions being chosen consistent with the capacity of the leaf support, things are easily adjusted so as to produce a convenient deflection of the lead with a single push of the button. A good plan is to overcharge the leaf a little and to keep the button down until the system has discharged itself to the desired point.

HANDY QUICK THROW SWITCH

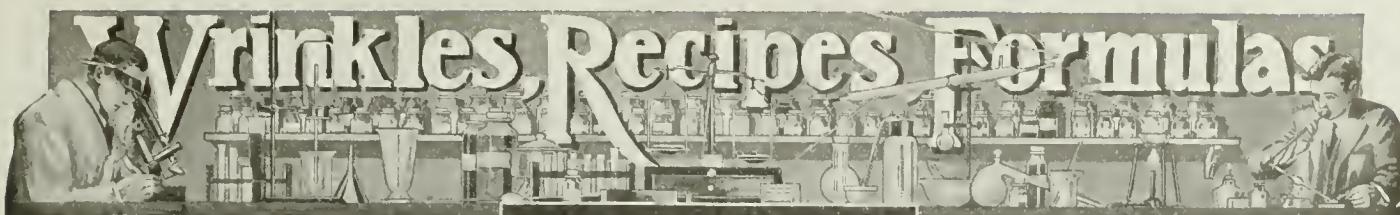
Here is a switch of novel design allowing quick changes and at the same time is well constructed, besides being very easy to insulate. As will be noticed it works on the UP and DOWN-ward movement, the blade



For Many Purposes a Rapid Quick-throw Switch is Often Necessary. This Design Gives a Good Contact With Plenty of Speed.

revolving near the handle on a shaft secured to two wooden or other posts. Two blades or even three could be used.

Contributed by E. T. J.

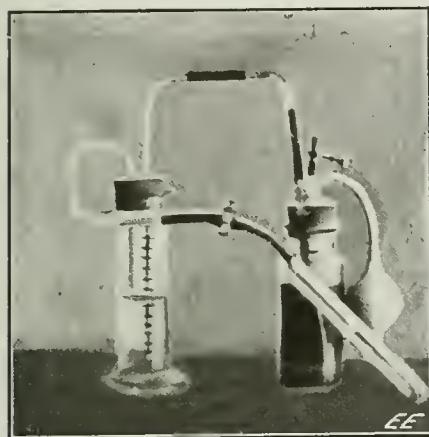


EDITED BY S. GERNSBACH

A PRACTICAL HYDROGEN SULFID GENERATOR FOR THE CHEMIST.

By K. BURNETT

HYDROGEN SULFID is an absolute necessity in every laboratory where analysis is carried out, but, as this gas is quite poisonous and, furthermore, pos-



This Novel Hydrogen Sulfid Gas Generator Can Be Constructed from Parts Found About the Workshop.

sesses a characteristic, disagreeable odor, it is essential that it be generated at the time of using.

Below is described a simple generator of my own design, which, from my experience, has proved a complete success. As will be seen, the action is essentially the same as in the well-known "Kipp", but, as the construction of this differs somewhat from my own design, I have found it necessary to add certain additional parts.

- The materials needed are:
- 1 Wide mouth glass bottle G.
- 1 Gas cylinder.
- 1 Tube (6" x 1" diameter) made from narrow bottle.
- 1 Atomizer bulb.
- 3 Glass taps, or pinch cocks.
- 3 Rubber corks to fit tube, cylinder and bottle.
- 1 Thin one-holed cork (to hold FeS in tube).
- Rubber connections and glass tubing.
- Chemicals:—Ferrous sulfid.
- Hydrochloric acid.

The essential working of the generator is as follows:

When tap A is turned (see figure) the acid rises in tube B, coming in contact with the ferrous sulfid, thus generating hydrogen sulfid gas, which, passing thru the wash bottle C is purified and escapes at D.

Use of the Bulb.—The pressure in tube B required to overcome the counter pressure exerted by the water in the wash bottle is often strong enough to force down the acid in tube B, and thus from further contact with the ferrous sulfid. The result is "no gas". Upon squeezing the bulb, however, the pressure is overcome and the acid rises in tube B, thus forcing out the gas. I have proved this in practise. It is essential that a bulb having an air inlet

A SIMPLE WAY TO MAKE YOUR OWN VELOX PAPER.

Take any smooth piece of paper about 4"x4" (glossy paper is best) and cover with a coating of silver nitrat (Ag_2NO_3) using a camel's hair brush. If this is exposed under a good negative toward the sun a fine print will be obtained of a delightful dark brown. It can be fixt in sodium thiosulfate (hypo.) about 5 grams to 200 c.c. of water. Do not leave in solution over three minutes, as it will take the color out of the print. Then wash.

A Simple Freezing Mixture: Take a tumbler full of powdered sodium sulfate and drench with common hydrochloric acid (HCl). Then plunge a test tube of water into the mixture and in two minutes it will freeze.

Contributed by IRVING ROTH.

HOW TO MAKE BENGAL LIGHTS.

Take 8 parts saltpetre, sublimed sulfur 4 parts, and antimony 1 part and mix well into powder. Beat firmly in stout iron cup and set on fire. Such lights are made use of for signaling long distances at sea. If a little camfor is added it will burn brighter.

Waterproofing paper: Plunge unsized paper once or twice into oil of turpentine, and dry by gentle heat.

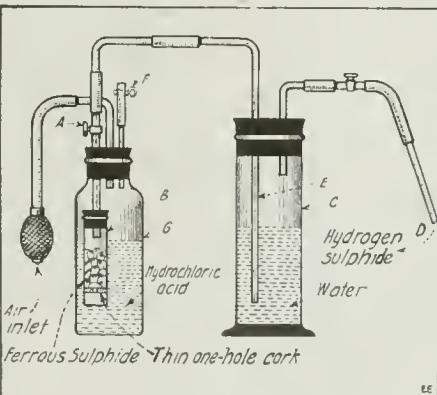
To handle fire without harm: Mercury neutralized in vinegar and the white of an egg smeared on will preserve anything from fire.

Contributed by WORTH C. KNOWLES.

is employed, otherwise it is useless.

Use of the Pinch Cock "F".—In order that the acid may rise in tube B it is necessary to open the pinch cock F to admit air. This is also necessary, when shutting off the generator, in order to expel air, but it should be kept closed when the acid has reached "low level", to prevent rise in case of leakage or lessening of pressure, due to the hydrogen sulfid dissolving in the acid.

Any amateur chemist may set up this apparatus without much expense and I am

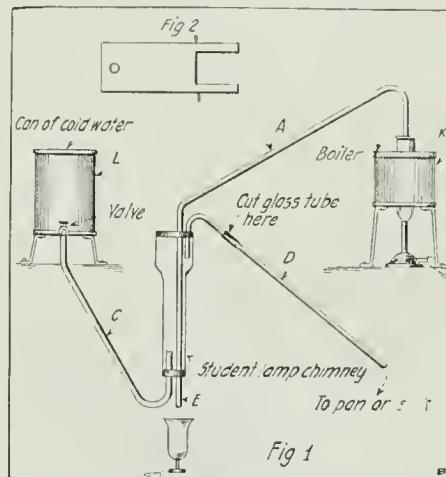


Details of Hydrogen Sulfid Gas Generator.

confident that, if constructed upon this plan, it will give no trouble and the result is an odorless and convenient generator which makes a fine looking piece of apparatus for any laboratory.

HOME-MADE DISTILLING APPARATUS.

The accompanying sketch illustrates a home-made Distilling Apparatus. The condenser is made from a student lamp chimney. Insert a cork at both ends and bore them for glass tubing. Tube A should extend straight thru the condenser; tube D should extend about an inch below the cork. I found that if tube D is cut off about four inches below the bend and a long piece of rubber tubing used instead of a



Easily Made Distilling Apparatus Which Every Amateur Chemist Will Find Extremely Useful About the Laboratory.

long glass one it would cost less and be more serviceable. Tube C should extend about 1 inch above the bottom cork. The condenser is held in place by a piece of wood, shaped as in Fig. 2, fastened on a shelf above the bench.

The boiler K is an empty coffee can. A hole is cut in the cover and the neck of an empty maple syrup can is soldered over it. The cover is then soldered on the can so that the steam cannot escape. Three pieces of tin are next soldered on to form a support.

Another can L is fitted with a small faucet which can be obtained off an old gas jet. This can is supported on legs like the boiler. Care should be taken that the bottom of the can L is on a level or higher than the top of the condenser.

When the water boils in can K, the steam passes thru tube A. The faucet on can L is turned on; cold water flows thru tube C and circulates thru the condenser and flows out thru tube D into a sink or a large pan. The distillate is caught at E.

If, when the water is turned on, the lower cork leaks some melted paraffin should be poured slowly into the tube and allowed to harden. This may be done on both sides of the lower cork.

If anything besides water is to be distilled a glass flask must be used instead of can K.

Contributed by FREDERICK REYNOLDS.



Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay \$3.00 prize each month for the best photo. Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S \$3.00 PRIZE WINNER—ELLIOTT C. WOODFORD

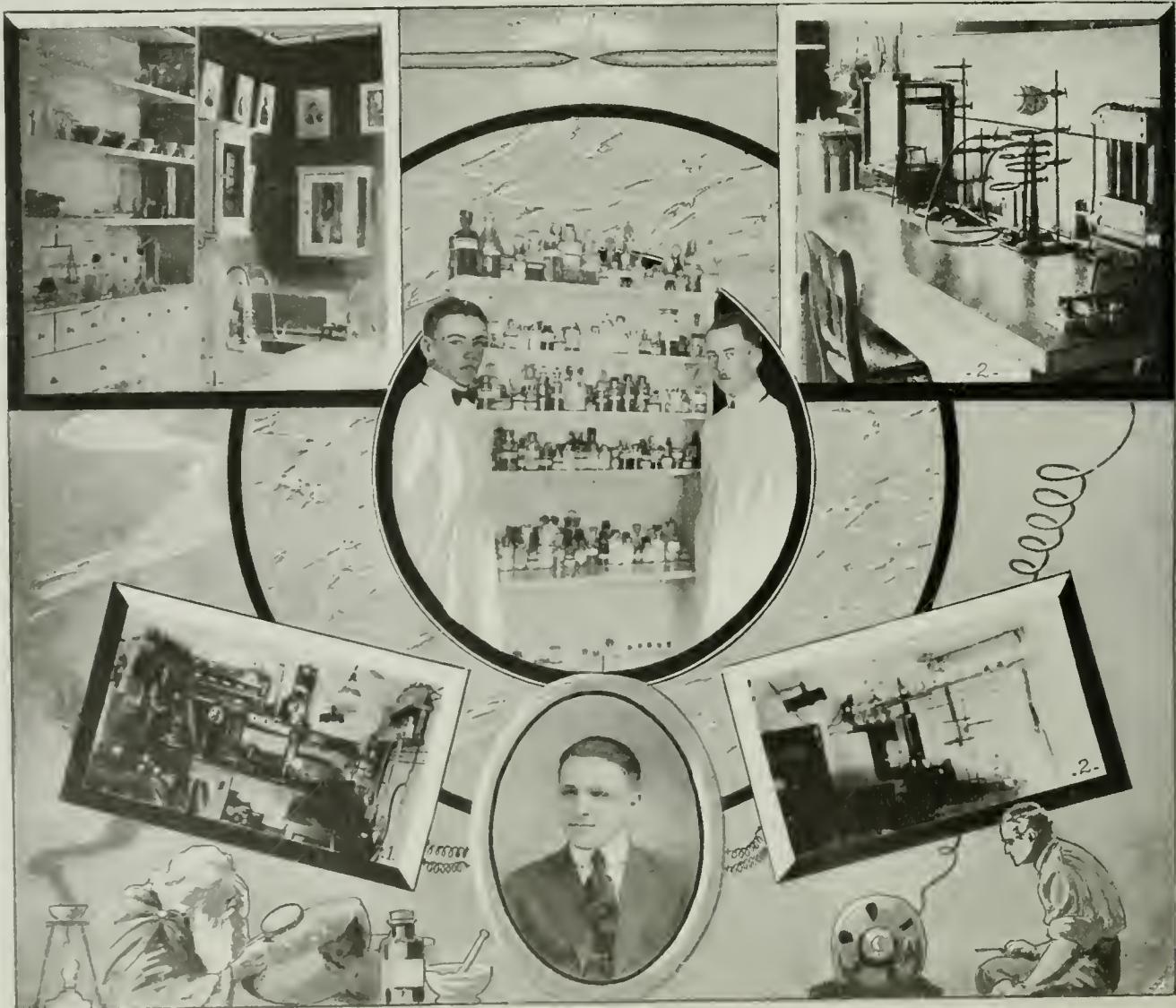
I PRESENT herewith three pictures of the chemical laboratory that Eugene Cortright and myself are using at the present time. One of the photos (top center) shows the chemical cabinet containing over two hundred and fifty chemicals, all labeled and arranged in alphabetical order. This photo shows Eugene Cortright standing at the left of the cabinet, and yours truly at the right. Another photo, figure 1, shows the shelves of chemical apparatus, including burettes, crucibles, evaporating dishes, Florence flasks, Erlenmeyer flasks, funnels, graduates, mortars and pestles, retorts, wash bottles, condensers, hydrometers, beakers, U-tubes, and chemical thermometers. To the right of these shelves is the medicine cabinet, and below the medicine cabinet is a soapstone sink with hot and cold water. Another table contains a ring stand, gas taps, Bunsen burner, rack of test tubes, gas mask, and electric tap. Also a compound microscope. One of the tables contains a chemical balance, a 1/4 K.W. transformer, condenser, and spark gap (part of the wireless station that we had at one time, but which is dismantled now), and which material we intend to use in building an X-ray apparatus. Our stock cabinet contains extra test tubes of different sizes, pipettes, glass tubing, rubber tubing, electrical supplies such as switches, fuses, bulbs, sockets, and adapters, ad lib, ad infinitum.

ELLIOTT C. WOODFORD, Owego, N. Y.

HONORABLE MENTION—MILFORD H. COHEN

ABOUT four years ago, being interested in Electricity, I started a small experimental shop, which I have by the dint of hard work built up to quite an efficient electrical and chemical laboratory. I have an arc light which throws a beam from a mile to a mile and a half. I have constructed many, but this has been my most successful one. A choke coil is used for its resistance which has proven very satisfactory. When battery current is necessary I have a one-eighth horse-power motor, which drives a small fifteen-volt D. C. generator, and this supplies ample current. I also have an old-style graphophone, which plays the cylinder style records; with this graphophone I secured a recorder, and a few blank Dictaphone records. This outfit is excellent in receiving wireless messages coming at a fast rate of speed, for as soon as the message is completed, the reproducer may be changed, instead of the recorder, and in this manner the message may be repeated at a slow rate of speed. This was before the wireless stations were dismantled by our Government, of course. On the side wall of one of the photos (lower group) you will see a very efficient electric furnace, from which a very high degree of heat may be obtained. I am now engaged in making an auto, which is to be driven by a Smith Motor Wheel. My shop is very handy in many other ways, as it allows me to construct various models described in THE ELECTRICAL EXPERIMENTER. In my chemical laboratory I am also doing some very interesting experiments.

MILFORD H. COHEN, Charleston, W. Va.



Phoney Patents

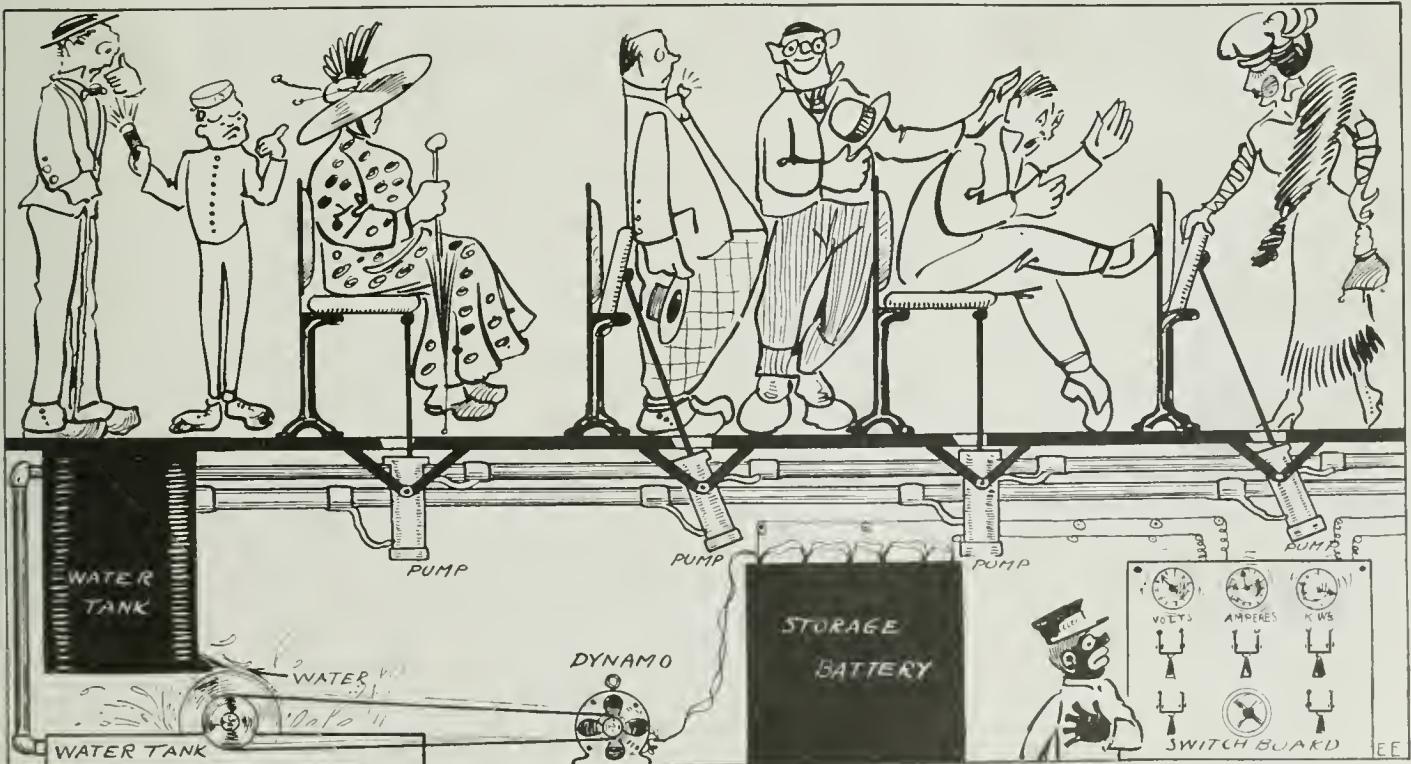
Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS (\$3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you \$20.00 for the initial fee and then

you haven't a smell of a Patent yet. After they have allowed the Patent, you must pay another \$20.00 as a final fee. That's \$40.00! We PAY YOU \$3.00 and grant you a Phoney Patent in the bargain, so you save \$43.00!! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick hat. The daffier, the better. Simple sketches and short descriptions will help our staff of Phoney Patent Examiners to issue a Phoney Patent on your invention in a jiffy.



Prize Winner: THE MOTORMAT BURGLAR EJECTOR. Herewith witness my idea for an electric motormat burglar ejector, guaranteed to work without a hitch in 101 per cent of all cases. Mr. Burglar approaches the stoop and on his first step upward depresses the electric alarm bell button indicated in the S.E. corner of the map. You've got me, Steve! The knight of the black-Jack hits the button—the bell rings—the hero of the family (he, she, or it) arises and sneaks up to the front door—beholds intruder on motormat and does his duty by throwing in the motor switch. The result is illustrated at the right. I said it was 101 per cent efficient—the extra 1 per cent is the time it "gets" you, when wife sees you first as you rise up the front stoop about 3 G. M. in the morning after the night before. Take a tip, Brother Yelps, wear a shock absorber—you know where! Inventor, Wm. A. Fritsch, Brooklyn, N. Y.



THEATER-CHAIN POWER-PLANT. Did you ever stop to think just how many million horsepower of free energy are dissipated every single night by the thousands of theater-goers in such a large city as New York, when they sit down and get up? It amounts to something like 49,580,666½ H. P. per evening for New York City alone, according to my figures. So, hence and thus, I collected my brains together and eventually devised the astonishingly simple chair pump and dynamo plant here shown. Each chair is connected by a lever with a water pump under the floor. The pump sucks water up from the tank below the water-wheel, forces it out thru another pipe back to the supply tank above the water-wheel, etc. The same water is thus used over and over again. The water-wheel drives the dynamo, which charges a storage battery. Thus the electricity required for lighting up the theater, "movie" machine, etc., is all provided by the unsuspecting audience. The manager gets his money's worth and the Public is pleased!!! Inventor, Paul Austin, Phoenixville, Pa.



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

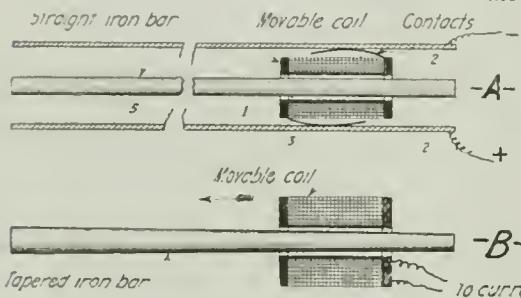
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to this department cannot be answered by mail 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.

MAKING SOLENOID MOVE ALONG IRON BAR.

(959) W. Doherty, New York, N. Y., sends us a proposed scheme for creating axial movement of a solenoid along an iron bar and wishes our advice on it.

A. 1. To our best knowledge, there is no practical way of creating motion or traveling of the solenoid along a straight iron bar in the way you show in your diagram,



Method of Causing a D. C. Solenoid to Move Along an Iron Bar Without Any Commutating Device or Motor.

(see sketch "A"), but it is possible to accomplish this by simply having the iron bar slightly tapered (sketch "B") and you will find a very long treatise on this very subject given in U. S. Patent No. 1,248,273, copy of which we can supply at 10 cents. The ELECTRICAL EXPERIMENTER for February, 1918, page 702, contains a brief digest on this interesting patent.

CAN HIGH VOLTAGE ALONE KILL?

(960) W. A. J., New York, asks:

Q. 1. We ask you to kindly answer the following question, in order to settle a dispute between two friends:

A says that a wire charged with 75,000 volts of electricity, without a fraction of an ampere in it, would kill a person touching it. B says that altho the wire is charged with such a large voltage and there isn't the least part of an ampere in it, that a person touching it would not be killed.

We have asked several persons about this matter but in view of the fact of their varied answers we have decided to let yours be the last word. We would appreciate it very much, therefore, if you would kindly inform us what the effect would be on a person touching the wire. In case it would kill him we would also like to know if the killing would be instantly, gradually, or finally.

A. 1. In the first place it is impossible to have a wire charged to 75,000 volts without a fraction of an ampere in it. You cannot have voltage without amperage and vice versa. In order to kill a person a good many conditions are necessary. It has

happened repeatedly that people who touched wires charged to 100,000 volts were not killed, while others took only a 110 volt current and were killed instantly. The point in contact with the human body makes all the difference. For instance, when the hands are wet, the effect will be much more pronounced than if the hands were dry. Also various people have various thicknesses of skin, and the thicker the skin the more it protects. Thus, workmen using pick and shovel after a while acquire a very thick skin on the inside of their hands which forms a protection against the electrical current. Therefore, you will see that just touching a highly charged wire without knowing all the other surrounding conditions itself is meaningless.

Speaking generally, it is not volts that kill. It is the amperage. High voltage by itself is not dangerous as you can take several hundred thousand volts thru the body by

means of the so-called Tesla high frequency currents without feeling anything whatsoever. Take an ordinary violet ray machine—it gives a voltage usually above 50,000.

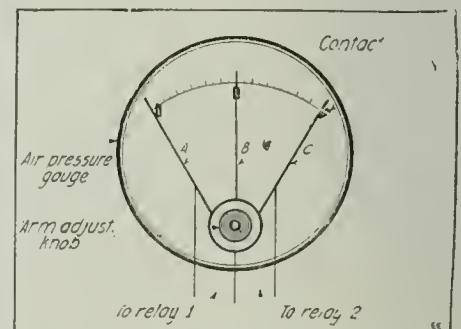
Nor is it necessary to use high frequency currents. Large spark coils which give a tremendous amount of voltage while dangerous are not often fatal to the human system unless a charge is taken into a vital part of the body. The editor has seen a man get a fairly good charge in both hands from an eight-inch spark coil giving somewhat over 300,000 volts (maximum or peak value). While it threw the man down, the effect was not fatal. He recovered in a few minutes without ill effects.

AUTOMATIC AIR PRESSURE REGULATION.

(961) M. B. Pedersen, Tooele City, Utah, writes:

Q. 1. How can I rig up an automatic air compressor regulator so that the electric motor driving the compressor will start and stop at low and high pressure.

A. 1. In the diagram a front view is shown of your air pressure gage. It will be noted that there are two adjustable arms, A and C, which can be regulated for any pressure by means of an adjustable finger, also shown in diagram. These arms, A and C, should be fitted with suitable contact points. They should be insulated from each other, and should be properly connected to external relays for starting and stopping the motor. The pointer (B) should also have a contact point on it and a connection to an external circuit, as shown in diagram. This scheme has been used successfully for more than two years.



How Air Pressure Gage Can Be Rigged Up With Two Electric Contacts, So That Compressor Motor Starts and Stops at Low and High Pressure Respectively.

SPONGY PLATINUM.

(963) Sylvan D. Rolle, Philadelphia, Pa., asks:

Q. 1. Questions on spongy platinum.
A. 1. You are right relative to the matter of spongy platinum. It will only in-
(Continued on page 488)

IN THE DECEMBER "E. E."

How ships are "arc welded" instead of riveted—resulting in better ships and faster production. The latest advance in ship-building science.

Turning Air Into Bread—The Electrical Fixation of Atmospheric Nitrogen, by Robert H. Moulton.

Electrical Testing Engineers Made to Order, by C. M. Ripley, of the General Electric Co.

Flying Across the Atlantic on a 10,000 H.P. Aerial Liner, by W. Edouard Haessler, aviator.

Carbon Lamps versus Tungsten Lamps—The A. B. C. of the economy of Tungsten filaments.

How to Use Electric Fans in the Winter, by Pauline Ginsberg.

How to Make a Seven-inch Reflecting Telescope—For astronomical observations. Details for grinding lenses, etc., by Latimer G. Wilson.

A Practical and Useful Laboratory Switch-board, by H. Danner.

The Edison Storage Battery—Its Operation and Maintenance, by J. F. Springer.

New Wireless Ideas, Rules, Wrinkles and Formulas—Including Description and Drawings for a new vertical type cabinet coupler; also a Rotary Quenched Spark Gap Unit and another cartoon by Burney.

Popular Astronomy—Sixth Paper—"The Total Solar Eclipse of June 8, 1918", with some wonderful photos, by Isabel M. Lewis.

Free Test Lesson in Draftsmanship

TEST LESSON IN DRAFTSMANSHIP

Prepared Expressly for Our Prospective Students to Enable Them to See How Simple and Easy Is Our Method of Home Instruction
The Most Practical Correspondence Course Ever Written on the Subject

Send for this free lesson which explains the Chicago "Tech" method of teaching Draftsmanship by mail. Positions at big salaries are now waiting for competent men. The call of men to the war has left vacancies everywhere. Even draftsmen of limited training and experience are snapped up and paid good salaries. If you are dissatisfied with your opportunities, learn Draftsmanship. Chicago "Tech" will train you in the most practical way in the shortest time. Mail the coupon today and let us tell you about the Chicago "Tech" method. This free lesson will show you how well equipped you are to follow Draftsmanship. Enroll in the course only if you decide that you can take it up to advantage. No cost, no obligation on you to make this investigation.

Send for this free lesson which explains the Chicago "Tech" method of teaching Draftsmanship by mail. Positions at big salaries are now waiting for competent men. The call of men to the war has left vacancies everywhere. Even draftsmen of limited training and experience are snapped up and paid good salaries. If you are dissatisfied with your opportunities, learn Draftsmanship. Chicago "Tech" will train you in the most practical way in the shortest time. Mail the coupon today and let us tell you about the Chicago "Tech" method. This free lesson will show you how well equipped you are to follow Draftsmanship. Enroll in the course only if you decide that you can take it up to advantage. No cost, no obligation on you to make this investigation.

Come to the College or Learn At Home

Hold your present position while training. Our experts will instruct you by mail. Only your spare time is required. You are directly under practical draftsmen and engineers. You are taught exactly the work required in the drafting rooms of big concerns. No time to put in on unnecessary studies. This means thorough instruction and early graduation.

\$25⁰⁰ to \$100⁰⁰ a Week

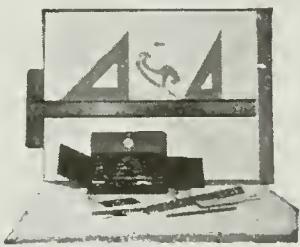
Draftsmen earn good salaries in normal times. They command extra high salaries now—and the tremendous work to be done after the war will bring a permanent and intensive demand for good men. Make your spare time count now for a higher salary and a better position.

Easy Payments

The fees for Chicago "Tech" Courses are very moderate—and you can pay on easy terms. And also—you obtain in a few months what it would take several years to acquire by ordinary methods. You can get an early start. You are soon ready to take a paying position and to quickly get back the cost of your course.

FREE Instruments

Every student of the Chicago "Tech" Course in Draftsmanship receives this set of instruments, or a cash credit in case he already has a set. These instruments are of the same make and sizes as used by high salaried experts in drafting rooms of factories, shops, railroads, etc. You use them while learning—then take them right into your practical work.



Send the Coupon

The sooner you are prepared the sooner you will be holding a job that pays a large salary and opens the way to advancement. Many executives, general managers and superintendents began as draftsmen. Other institutions ask you to pay first—and then to find out later how well qualified you are for this profession. We send the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything. The coupon will bring the Test Lesson, free. Also information about the profession of Draftsmanship and detailed facts about Chicago "Tech" methods, the fees, terms, etc. Mark with X the branch you are interested in—or if in doubt about which course to take, write a letter stating facts about yourself and asking our advice which will be freely given. Mail either the coupon or the letter today.

Chicago Technical College,
1145 Chicago "Tech" Building, Chicago

Without obligation to me, please send me your FREE Test Lesson and other interesting literature covering the subject indicated below. Mark X opposite work in which you are especially interested.

- | | |
|---|--|
| <input type="checkbox"/> Architectural Drafting | <input type="checkbox"/> Plan Reading—Builders |
| <input type="checkbox"/> Machine Drafting | <input type="checkbox"/> Plan-Reading—Shop Men |
| <input type="checkbox"/> Electrical Drafting | <input type="checkbox"/> Estimating |
| <input type="checkbox"/> Structural Drafting | <input type="checkbox"/> Surveying |
| <input type="checkbox"/> Sheet Metal Drafting | <input type="checkbox"/> Map Drafting |
| <input type="checkbox"/> Builders' Course | <input type="checkbox"/> Reinforced Concrete |

Name
Address
City State
College or Home Study? State which.....

Other Mail Courses
Chicago "Tech" not only helps men to success in draftsmanship, but in other important practical professions.

General Builders' Course
Plan Reading, Estimating, Construction, Architecture, etc., are taught in every detail. Intended especially for contractors, bricklayers, stone masons, carpenters and others in the building industry.

Plan Reading
Practical instruction from actual working blue prints, under the direction of experts. Everything made clear. Enables a man to get in a few months what he seldom gets the opportunity to learn well, if at all, at his work. Courses for men in all branches of building and mechanical lines.

Plan Reading for Builders
How to read Blue Print plans for every kind of building construction; how to lay out work; how to know just what the architect means. A course that helps men to become foremen; foremen to become superintendents and superintendents to become contractors.

Plan Reading for Shop Men
How to read Blue Print drawings of machinery, foundry work, sheet metal work, munitions, tools, aeroplanes, structural steel, cars, etc., etc. A mechanic or shop man in any branch of industry can quickly increase his earning power with this information.

FREE Lessons
Test Lesson in either of these Plan Reading Courses sent free. Just mark the coupon to show which you want. Act now. Prepare to take one of the higher jobs which are opening in every industry.

NEW LIFE!

Health-Strength-Beauty

You can have bodily vigor, success-attaining energy— attractive healthful beauty! All yours at *practically no cost*—the great benefits of the famous VIOLET RAY TREATMENTS heretofore only procurable at big expense from Physicians and Beauty Specialists. TREAT YOURSELF at home with

Renulife Violet Ray HIGH FREQUENCY GENERATOR

transforms electricity into the most powerful, effective purifying Health and Beauty giving agency known to science, yet gentle, soothing, perfectly safe—no shock nor pain. Eradicates disease from blood, flesh, bone and nerves; tones and restores. While relieving pains and aches and the manifest results of disorders, it removes the deep seated cause. Saturates the system with invigorating, life-laden violet rays bringing back normal functioning.

- TREATS Successfully**
- Rheumatism
 - Neuritis
 - Lumbago
 - Chest Pains
 - Catarrah
 - Headache
 - Ear Diseases
 - Hardening of Arteries
 - Wrinkles
 - Skin Diseases
 - Falling Hair
 - Etc., Etc.

Painless Electricity

Science has modified electricity that the weakest may stand its force without fear or pain. Every tissue and fibre is saturated, patient experiencing only a sensation of relief, as if standing in a ray of sunshine. Violet Ray high frequency has no comparison with old, crude, electrical batteries and snotkin current. Every jar and shock is removed. The cures are marvelously rapid.

Lowest Priced—Most Effective

Violet Ray For Home Use

Every person would be wonderfully benefited by a few minutes' daily use. Its astonishing low price places it within the reach of all. Write at once for full information regarding uses, benefits, price, etc.

Liberal Trial Plan Proves Value



Treatment for general debility, nervousness, etc.



Quick relief for rheumatism



Inhale ozone for catarrh, throat and lungs. Marvelous local results with general benefit.



USE AT HOME

GET FREE BOOK telling the whole marvelous story of the Violet Ray. Its wonderful successes—its many uses—specified by physicians for rheumatism, neuritis, headache, catarrh, wrinkles, blemishes, falling hair and 100 other bodily ailments and beauty defects, chronic and acute. Get this valuable book by return mail.



RENULIFE ELECTRIC CO. 530 Marquette Bldg. Detroit

Wanted: Representatives to demonstrate to physicians and individuals. Fine money making opportunity.

THE ORACLE.

(Continued from page 486)

candescence when in the presence of two or more gases, which readily combine, and the incandescence is due to the liberation of heat thru the combination of the gases, in which case the action is accelerated due to the presence of the spongy platinum, which acts as a catalytic agent.

EXPERIMENTAL MECHANICS.

(Continued from page 477)

where it is necessary to obtain a central point, irrespective to the character of work. A dog-chuck is one containing independent jaws. Many lathes are supplied by the makers with a four-jaw chuck of this kind.

NOVEL X-RAYS.

(Continued from page 454)

"What are these branch-like marks at the upper and lower side of the skull?"

"Evidently something 'flashed' thru my mind just then—perhaps the birth of an idea. The plate recording the flash, which is just like lightning."

"How is it that your brain does not show at all?"

"As you know the X-ray picture was taken immediately after I concocted next month's cover design. All my brains went into making that, which explains the discrepancy!"

X-RAYS IN TUBERCULOSIS.

In the finished positive photographic print, the lungs of a normal person show white—this representing the air contained in the cells of the lungs. If the lung is diseased—as in pneumonia—it will show dark, i.e., the cells being occluded with matter. Tuberculosis is diagnosed by the spotted, mottled appearance of the affected lungs.

In our illustration which shows a clear case of incipient tuberculosis, the arrows point to the seat of the disease. In this print the patient's right is left, and left is right. The right lung, which is quite dark, except for a small upper portion, shows an advanced stage of pneumonia, as well as tuberculosis. The left lung is comparatively free from pneumonia, but shows traces of tuberculosis as well. In this lung, beginning right under the last lower arrow, we note a semi-circular bulge; this is the lower part of the heart. Right underneath the heart is the *diaphragm*—the part dividing the chest from the abdomen.

Photo courtesy Dr. B. Fidler, N. Y. C.

THE OSCILLOGRAPH—HOW IT WORKS.

(Continued from page 474)

paper be pulled at a known rate (say one inch per second) one can study the history of the moving pencil as regards its motion in time. Similarly if the photographic plate in our imagined experiment be moved at a known speed, we can then study the variation from instant to instant of the current traversing the loop. If the plate be chopt thru the beam when no current passes thru the loop and then, with the test current on, chopt thru again and in the same place as before (using guides to make the plate follow the same path) then upon development of the plate we obtain from the first operation a straight line (the so-called *zero line*) and from the second operation the *curved* line showing the variations occurring in the test current. Where the curved line crosses the straight line the current is zero and is changing direction.

Figure 3 represents a record taken by the writer with a modern type of Duddell

oscillograph. The prominent wavy line shows the variations occurring in a commercial 60 cycle alternating current circuit. Figure 3 is a print from the film negative, the film having moved at the rate of 111 inches per second. Notice how the curve varies from the smooth sine curve usually used to represent the alternating current. Just one cycle is represented. What happened in figure 3 took place in *one-sixteenth of a second*. Certain kinks in the curve do not last longer than 1/2500 of a second. No zero line is recorded. If it were it would lie practically halfway between the upper and lower peaks of the curve.

The other smaller curve or ripple of Fig. 3 represents the current fluctuations in the receiver of a telephone when the receiver is held against the mouthpiece of the transmitter and is thereby made to emit the familiar high-pitched howl, which gives the device its name the—*howler*. Note the broad zero line recorded in this curve. This, too, is an alternating current, tho of very different shape from the 60-cycle one. Further, it has a much higher frequency. Reference to the figure shows that 23 cycles of the high frequency current take place during one cycle of the commercial current. In other words this howling telephone receiver was traversed by an alternating current of 1380 oscillations per second.

THE GYRO ELECTRIC DESTROYER.

(Continued from page 465)

fact that some of my friends here in the office would be likely to subscribe to this fund. I am, therefore, enclosing \$1.00 to be used in this great idea of yours. As you understand, this dollar is not to be credited to me, but to O. H. King, 1422 Hurt Bldg., Atlanta, Ga. I will continue to work for the EXPERIMENTER until I go to the Navy, which I am expecting to do in November."

"A. L. Terry, 1422 Hurt Bldg., Atlanta, Ga."

"INVENTORIALS" AND A "HUMDINGER."

"I have long been a reader of the E. E. and have always managed to maintain a state of mental equilibrium after perusing your sometimes far-fetched 'inventorials,' but I must admit that the September number contained a humdinger in the developments of the Gyro-Electric Destroyer. And in consequence thereof I feel privileged to rise up and say, 'Shake!' both to the originators of the idea and the editor who projected it. Why not a Gyro-Electric Destroyer? It is no more fantastical than the first airplane seemed to us, or the first tank, or the long rang 'Bertha' of the Hun. So, I say, boost for it, write some of those advertisements like you do up for the 'Maggie,' or like your August editorial, which, by the way, was a masterpiece! Keep it up for several months if necessary, appeal to the American idea of patriotism and also of taking a chance, and every man who sees it will send in his dollar. Then you have the winter to build it, and in the spring we will see, what we will see. Here's hoping for the success of the Gyro-Electric 'Teufel-wagen,' and 'hoping' with a dollar bill.

"Arno A. Kluge, 11237Q St., Lincoln, Nebr."

FROM "TOM" REED.

"Good luck, old top! Thomas Reed, 19 Congress St., Boston, Mass."

MORE DOLLARS COMING.

"I will try to interest my friends in this 'Kaiser Killer' and send you some more dollars soon. Milton Ward, Ahron, Iowa."

"GIVE THEM HELL."

"I am enclosing one dollar as my part of the subscription for the building of a Gyro-Electric Destroyer. I am not a subscriber to the ELECTRICAL EXPERIMENTER, but I purchase my copy as soon as it appears on the newsstands and have read with interest your articles relating to this novel but promising idea. Surely subscribers to an 'Electrical Experimenter' organization should have confidence enough to finance one of its experiments, so build away and then roll 'Over the Top' with the best of luck and give them Hell. Karl F. Mayers, Littlestown, Pa."

(Continued on page 490)

U. S. AIRPLANE Mail Service

Started May 15, 1918

marks the real beginning of commercial aviation. Uncle Sam is carrying mail every day between New York, Washington and Philadelphia and the end of the war will make possible the extension of airplane mail delivery to all parts of the country. As fast as machines can be built they will be put to work carrying freight and passengers. But the demands of commerce must wait. Every man who knows, not merely how to make one small part of an airplane, but who has studied and learned the scientific principles of design and construction is needed **RIGHT NOW** to help win the war.



Learn by Mail

in your spare time at home. Our new, practical course has the endorsement of airplane manufacturers, aeronautical experts, aviators and leading aero clubs. Every Lesson, Lecture, Blue Print and Bulletin is self-explanatory, right down to the minute in every detail. No book study; no schooling required. All lessons written in non-technical, easy-to-understand language. You can't fail to learn quickly under our expert direction. We furnish just the kind of practical, scientific training you need to succeed in this wonderful money-making industry. Write today.

More Men Needed Men, Young and Old, to Learn the Mechanics of **AVIATION**

Wonderful salaries are being paid to trained experts in airplane building, airplane assembling, repairing and adjusting. Here is an easy road to promotion or to a splendid paying position in the private employ of one of the scores of airplane manufacturing companies. We have more calls for men than we can supply. Never has any industry offered so many golden opportunities for ambitious men. Make it your business to investigate first before you decide. But don't wait to send for full information.

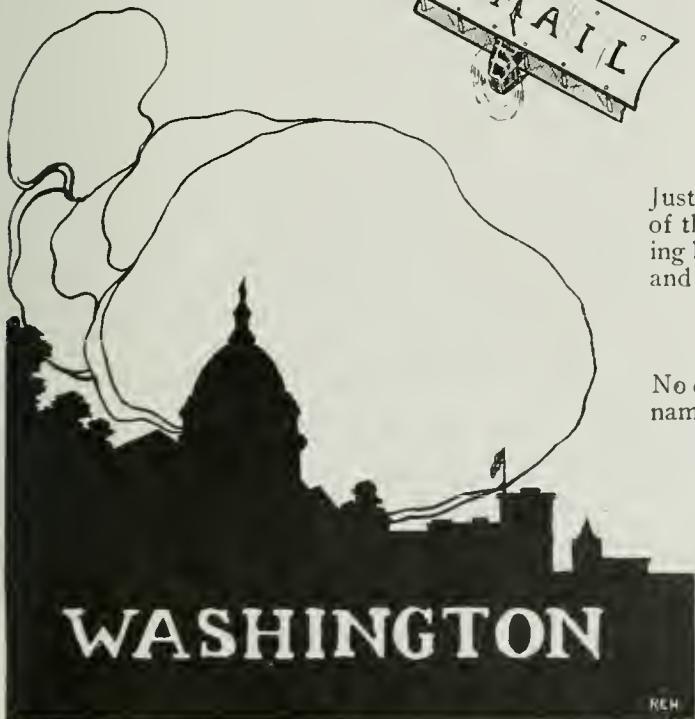


FREE NEW BOOK—"OPPORTUNITIES IN THE AIRPLANE INDUSTRY."

Just published and mailed free on request—the first complete story of the recent remarkable development of the airplane manufacturing business and the wonderful future it holds for you. Get a copy and read it. Let your friends read it.

Mail Coupon--QUICK

No obligation of any kind. But the edition is limited. Send us your name today, before it is too late, and avoid disappointment.



American School of Aviation,
431 S. Dearborn St., Dept. 744 B, Chicago, Ill.

Without any obligations on my part, you may send me full particulars of your course in Practical Aeronautics and your Special LIMITED offer.

Name

Address

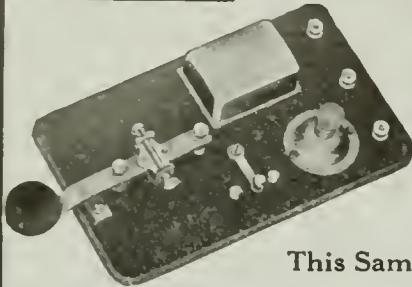
.....

Learn Telegraphy-Wireless

Right In Your Own Home, in your spare time
Your Government is calling for experienced wireless operators and telegraphers to accept positions in the army and navy with advanced rank and increased pay.



Combination Wireless-Telegraphy Outfit



will soon make you an accomplished operator. Teaches Light and Sound Signals, both Radio and Morse. Outfit consists of exceptionally fine Telegraph Key, Buzzer, 3 Binding Posts, Lamp, Lamp Socket and Control Switch—all mounted on a highly finished base. Two outfits can be operated at considerable distance apart for sending and receiving practice.

\$3.00

This Same Outfit Without Lamp \$2.50

Or your dealer can secure it for you. Order to-day. Descriptive circular and catalog of celebrated Knapp Motors and Electrical Specialties from 10c up mailed free on request.

Knapp Electric & Novelty Co., 523 W. 51st St., N. Y.

27 YEARS THE ENEMY OF PAIN

AK

HEADACHE TABLETS



FOR HEADACHES, NEURALGIAS, LAGRIPPE, COLDS,

WOMEN'S ACHES AND ILLS

10 CENTS

ASK YOUR DRUGGIST FOR "A-K" TABLETS
THE ANTIKAMNIA CHEMICAL COMPANY, ST. LOUIS

25 CENTS

CORE WIRE

We have been fortunate in securing thru auction several tons of guaranteed pure, double annealed Norway Iron Core Wire and are selling this wire to "Experimenter" readers

AT PRE-WAR PRICES 20cts LB.

This wire is just the thing for spark coils, transformers, etc., and it is, of course, a very much more superior product than the usual iron wire. We absolutely guarantee the quality.

If you ever thought of building a spark coil, transformer, or similar apparatus, now is the chance to get the right material for it. As far as we know this is the only lot of Iron Norway Core Wire in the hands of any dealer at the present time, and none can be gotten until after the war.

We only have these three sizes:

24 INCHES

26 INCHES

36 INCHES

Thickness about No. 21 B and 8

If either of these sizes should be too long we advise cutting the wire down yourself by means of shears. It will pay you to do so as real Norway Iron Wire, sold by a few dealers last year, brought from 40c to 50c a pound. American core wire now sells for from 30c upwards per pound.

As long as the supply lasts we offer this wire as described above to our customers at the very low price of 20c a pound. Order at once.

ELECTRO IMPORTING CO., 231 Fulton St., New York City

THE GYRO ELECTRIC DESTROYER.

(Continued from page 488)

CONTRIBUTIONS RECEIVED DURING THE MONTH.

\$10.00

Saulsbury, Albert W. Ridgely, Md.

\$3.50

Grube, Earle H. Vallejo, Cal.

\$2.00

Andert, Chas. S. San Diego, Cal.
Barenscher, Paul. Church Ferry, N. D.
Bothwell, Warren. Gothenburg, Nebr.
Cortanzo, Samuel. Linhart, Pa.
Dimick, Chas. E. Skippera, Pa.
Franke, L. K. Walworth, N. Y.
Skiddons, Fred. Deckerville, Mich.
Veen, H. Vander. Kalamazoo, Mich.

\$1.50

Boyce, Harry, Jr. Mt. Vernon, Ind.
Harkness, Chas., Jr. Hays, Kans.
Heller, Frank. McKinley, Ore.
Sindler, Harry. Baltimore, Md.
Van Dyke, Fred. Detroit, Mich.

\$1.00

Accampo, Candido. Amador City, Cal.
Bakey, Clinton. Hamburg, Ark.
Barger, F. A. Wilkes-Barre, Pa.
Bartholomae, Barth. Pittsburg, Pa.
Beech, C. Harry. Wilkinsburg, Pa.
Beeson, Neil F. Marshalltown, Ia.
Bishop, C. E. Sanbornville, N. H.
Blackwell, J. B., Jr. Lometa, Texas
Brittingham, Vertner D. Lexington, Ky.
Brown, W. B. White, Pa.
Buxton, John R. Claremont, Cal.
Cauchon, J. R. Montreal, Ont., Can.
Coleman, Glen E. Muncie, Ind.
Collins, Lee A. Louisville, Ky.
Collins, Theodore. Kewamnia, Ind.
Cooper, Thurman Dallas. Wintonville, N. C.
Decker, Emory. Petersburg, Va.
Ehrlinger, Edward S. Sag. E. S., Mich.
Fairman, Charles L. Victor, N. Y.
Fourcade, Germain A. Boston, Mass.
Francois, T. A. Spalding, Nebr.
Freeman, J. Fisher. Tucson, Ariz.
Frey, G. H. Moundsville, W. Va.
Gersami, John. Brooklyn, N. Y.
Getz, Wm. W. Morton, Ill.
Goleightly, William. Davis, W. Va.
Green, Allen W. Melvin, Mich.
Griffith, Paul E. Milliken, Colo.
Haas, William F. Philadelphia, Pa.
Hayes, John H. Rochester, N. Y.
Hemmerly, Earl S. Philadelphia, Pa.
Hill, John William. Salt Lake City, Utah
Hoagland, Walter E. Mays Landing, N. J.
Hoben, Lindsay. Chicago, Ill.
Hoedemaker, Peter. Paterson, N. J.
Howenstein, Marshall C. Goshen, Ind.
Hoyt, Lowell P. Presque Isle, Me.
Isenberg, John F. Altoona, Pa.
Iversen, Harry. Commerce, Okla.
Jensen, Caleb. Hartford, Conn.
Keen, Royal F. Gernett, Ind.
King, O. H. Atlanta, Ga.
Kluge, A. A. Lincoln, Nebr.
Kratz, J. Lloyd. Norristown, Pa.
La France, A. E. Holyoke, Mass.
Lake, Lawrence. Hammondsport, N. Y.
Lawn, Donald. Milwaukee, Wis.
Lescher, George. Little Rock, Ark.
Maloney, Lucius. Ft. Madison, Iowa
Manhard, Edmond. Waterloo, Iowa
Matson, Leslie. Paulshore, N. J.
Mayers, Karl F. Littlestown, Pa.
Messerly, Henry. Staunton, Ill.
Montano, Warren. Union City, Ind.
Nakamura, Takao. Oloo, Hawaii
Novitsky, Bernard. Pittston, Pa.
Peck, James. Elmira, N. Y.
Pennell, Lawrence W. Brunswick, Me.
Peterson, Peter. Alvarado, Minn.
Polis, Max. Stamford, Conn.
Porch, Albert. Chicago, Ill.
Ransom, Clifford. Carbondale, Pa.
Ransom, Flabel. Carbondale, Pa.
Rasmussen, C. New York, N. Y.
Rasmussen, Albert. El Reno, Okla.
Reed, Thomas. Boston, Mass.
Reitz, R. H. Trevorton, Pa.
Reynal, Nathaniel J. White Plains, N. Y.
Rogers, S. E. Summertown, S. C.
Rosenberger, H. J. Doylestown, Pa.
Saffron, N. J. Akron, O.
Sear, Joseph. Philadelphia, Pa.
Short, Chas. N. Weas. Spgs., S. D.
Skinderviken, J. Chicago, Ill.
Smith, Walter. (No address)
Spadoni, Edward. Summit, Ill.
Stone, Conrad A. McKeesport, Pa.
Stong, A. E. Wartrace, Tenn.
Sullinger, Ferris W. Maryville, Tenn.
Sumudsen, V. T. Sask, Can.
Suthian, Anthony. Butte, Mont.
Taylor, Eric. Toronto, Can.
Taylor, Paul K. Le Roy, N. Y.
Terry, A. L. Atlanta, Ga.

Thunen, Charles.....Hammonon, Cal.
 Tolosana, A.....Glasgow, Mont.
 Trembath, Harold, Jr.....Negaunee, Mich.
 Volak, Walter.....Chicago, Ill.
 Wait, Jay G.....Sturgis, Mich.
 Ward, Milton.....6.....Akron, Iowa
 Wegner, Karl.....Wausau, Wis.
 Westhenser, Ferdinand Leo.....Cincinnati, O.
 Wilkinson, Fred.....Bethany, Ill.
 Winters, T.....Elmira, N. Y.
 Wirig, Joe.....Rock Island, Ill.
 Wirig, John.....Rock Island, Ill.
 Yocum, Chas., Jr.....Pottstown, Pa.

\$0.50

Phillips, Lloyd.....Hall, N. Y.

\$0.25

McGuise, John A.....Ridgewood, N. J.

Total Contributions to date.....\$134.75
 Expenditures to date.....None

EXPERIMENTAL CHEMISTRY.
 (Continued from page 478)

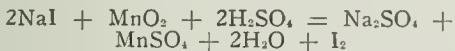
violet vapors on the addition of sulfuric acid to some of the waste liquor. Davy and Gay-Lussac both investigated this new element a year or so later, and Gay-Lussac gave it the name *Iodin* from the violet color of its vapor.

Occurrence.

Iodin does not occur free. Its compounds are widely distributed but are not abundant, being found chiefly in combination with sodium, potassium, calcium, and magnesium, in certain salt springs, and in the sodium nitrat—Chile Saltpeter—deposits of Chile and Peru. Until a short time ago the main source of this element was seaweed, but now the nitrat deposits of Chile furnish by far the largest proportion.

Preparation.

The seaweeds are collected and burned, the ash forming what has been known for a long time, as *kelp*. These seaweeds are burned to a fused mass of carbon and as, this mass being then lixiviated with water, the solution evaporated to remove the excess of chlorides, sulfates and carbonates, and the concentrated mother liquor treated with sulfuric acid, which causes a separation of sulfur due to the sulfides and sulfites present. This sulfur and the crystals of sulfate formed are removed and the remaining acid liquor contained in an iron retort, is treated with manganese dioxide, which, with the free sulfuric acid previously added, liberates iodine according to the reaction:



The temperature is kept at 60 degrees, which causes the iodine to pass off in vapor and condense in a series of earthenware receivers adapted to the retort for that purpose. Fig. 137 depicts such vessels which are known as *Aludels*. Any excess of manganese is avoided in order to prevent bromine and chlorine, which are present in the liquor as salts, from passing over and combining with the iodine.

Preparation of BROMINE from Potassium Bromide, Manganese Dioxide, and Sulfuric Acid.

Experiment No. 147.

Pulverize in a mortar about 5 grams of Potassium bromide (KBr). Put on a paper 2 grams of powdered manganese dioxide, then pour over it the potassium bromide from the mortar, mix them thoroughly together, and, creasing the paper, pour them into a flask of about 125 cc. capacity. Have a one-hole stopper for a thistle, which should extend close to the bottom of the flask. If there is no side neck to the flask, a two-holed stopper must be employed, containing the thistle tube and a delivery tube bent at right-angles. The delivery tube, either directly from the side neck of the flask, if one is used, or from

(Continued on page 498)



Learn Paragon Shorthand in 7 Days

Send No Money - Just The Coupon

We make this flat, positive statement that you—anybody—even a boy or girl of school age, can learn PARAGON Shorthand in 7 days. We will prove this to you beyond the shadow of a doubt by giving you the complete Course of 7 lessons for your own examination, study and approval for 7 days free of cost to you. Use it just as if it were your own, and if, at the end of the 7 days, you are not perfectly satisfied, return it to us and you will owe nothing.

The Simplest in the World

The simplicity and brevity of PARAGON Shorthand is a perfect revelation to everybody who tries it. It eliminates, for instance, all but 26 of the thousand word signs of the least complex systems of shorthand known. It dispenses with intricate theories of "position"; of writing on, or above, or across, or below the line. It requires no "shading" of lines. It goes right down to the very fundamentals of shorthand and teaches you the essentials as logically and as clearly as longhand.

Only \$5 If You Keep It

Instead of the drudgery and awful mental tax experienced in mastering the old-time systems, the study of PARAGON is as fascinating as it is easy. Simple as is the trial lesson shown at the right, and easy as you will find it to write the various words given above, you will already have learned 6 of the 26 characters comprising the Course! If you can learn 6 of these characters during one, two or three hours of an evening, it is conceivable, is it not, that you could learn the remaining 20 in 7 evenings' study? At the end of 7 days you begin practicing for speed, if it is your desire to take a stenographic position. All of this is done during your spare time at home evenings, without interference to your duties during the day! PARAGON Shorthand, being practical for all purposes and easily mastered in 7 days, why devote 5 to 6 months studying the old-time systems at a cost of \$50 to \$75? The complete Course of PARAGON Shorthand will cost you only \$5.00—but only after you are convinced of its merits by free trial.

Convincing Evidence

Wilfred R. M. Diamond, Enid, Okla. "I learned Paragon Shorthand in just seven days. By giving Paragon to the world you are really doing philanthropic work, for you are making it possible for every one to make use of this valuable art."
 J. H. Duncan, Birmingham, Ala. "Two weeks after I started on Paragon I was taking dictation at a very fair rate of speed. I learned Paragon from the home study Course without the aid of a teacher."
 Rev. A. W. Holdar, Preston Hollow, N. Y. "You can use my name at any time in connection with your system of shorthand. It is not only easy to learn, but also to read."

For Every Purpose

PARAGON has been in use for 25 years. It is used by the most highly paid shorthand writers in the offices of the Standard Oil Co., U. S. Steel Corporation, the great Shipbuilding and Munition Works, the offices of the United States Government, etc. Its marked simplicity enables writers to acquire amazing speed. You can use it for dictation, taking down telephone messages, speeches, conferences, sermons, lectures, lessons, court testimony, etc.

PARAGON INSTITUTE HOME STUDY DEPARTMENT

366 Fifth Avenue, Suite 703, New York City

USE THIS FREE EXAMINATION COUPON

Paragon Home Study Department, 366 Fifth Avenue, Suite 703, New York City

You may send me the Complete Course of PARAGON Shorthand with the distinct understanding that I have 7 days after its receipt to either return the Course to you or send you \$5.

Name
 Business
 Address



Elec. Exp. 11-18

It's Fascinating! Try It! See Trial Lesson below for the 6 characters used in writing these words in Paragon.

Paragon Shorthand is written phonetically. For example, the word "Day" is written "Da"—the y being silent. The silent letter in each word on the right has been crossed out.

Send No Money

The complete Course of 7 lessons is now only \$5—the lowest price for a complete Course in Shorthand ever known. But you do not pay for the Course until you have tried it and have satisfied yourself that it is all that is claimed for it. Simply fill out the coupon below and mail it to us. We will immediately forward the Course to you, prepaid. Study it for one, two, or three or seven evenings, just as if it were your own, and if you feel that you can afford to be without this valuable knowledge another day, mail it back to the Institute and you will owe nothing. Send in the coupon or write a letter today.

Men
 Mend
 Mode
 Monday
 May
 Moan
 Ada
 Adam
 Amen
 And
 No
 Nod
 Nome
 Ed
 End
 On
 Ode
 Demon
 Deem
 Dean
 Dome
 Dosh
 Day
 Known

Try This Lesson Now

Take the ordinary longhand letter *d*. Eliminate everything but the long down-stroke and there will remain */*. This is the Paragon symbol for **D**. It is always written downward.

From the longhand letter *e* rub out everything except the upper part—the circle—and you will have the Paragon **E** o

Write this circle at the beginning of */* and you will have **Ed** */*

By letting the circle remain open it will be a **hook**, and this **hook** stands for **A**. Thus */* will be **Ad**. Add another **A** at the end thus */* and you will have a girl's name, **Ada**

From *o* eliminate the initial and final strokes and *o* will remain which is the Paragon symbol for **O**.

For the longhand *m* which is made of 7 strokes, you use this one horizontal stroke —

Therefore, — would be **Me**.

Now continue the **E** across the **M**, so as to add **D**—thus */* and you will have **Med**. Now add the large circle **O** and you will have */* (medo), which is **meadow**, with the silent **A** and **W** omitted.

The longhand letter *n* which has 5 strokes, is written in Paragon with one stroke, thus — (same as the letter **M**, but shorter)

You now have 6 of the characters. There are only 26 in all. Then you memorize 26 simple word signs, 6 prefixes, contractions and one natural rule for abbreviations. That is all.



Nature and Science WILL HELP YOU

THE Therapeutic White Rays of the Magic Pain Relieving Lamp bring back health and vigor. Everybody knows the sun's rays possess positive health-giving properties. Following Nature's law and with the aid of science you can now possess these marvelous healing properties in your own home with the

Magic Pain Relieving Lamp "The Light that Heals"

RELIEVES pain without destroying vitality. Absolutely safe. Does away with harmful drugs. You will be amazed and delighted by this Magic Lamp whose Therapeutic White Rays penetrates, heal and soothe sore spots. Relief from pain results the moment you snap the electric light switch. Rheumatism, neuralgia, sore throat, earache, goitre and a long list of ailments are instantly eased and relieved. It is invaluable in the treatment of skin diseases. Men famous in the world of medicine endorse and recommend Therapeutic Light. Let the Magic Lamp save you pain.

Send for FREE BOOKLET today! Learn what the Magic Lamp has done for others in hospitals, sanitariums and thousands of private homes. Don't suffer another needless headache. Send at once.

Magic Pain Relieving Lamp Co.

Dept. 264B

546 Garfield Avenue

Chicago, Ill.

Write NOW for our big money making proposition. Learn how to turn Spare Hours into Spare Cash.



WHY IS A BLIMP?

(Continued from page 453)

end of the horizontal "worms". The fins and rudder lie flat against the sides of the balloon when it is not in the air. Upon ascent the wind blows into the rudder thru wind scoops, inflates it, and passing upward thru two small pipes, inflates the fins in turn. The time that it takes for this inflation depends entirely upon the strength of the wind.

There is an opening between the ballonnet and the air-rudder, and consequently, when the wind blows into this rudder, it flows thru it and into the ballonnet. This air not being able to escape, it is put under a pressure equivalent to the pressure of the wind that is forcing it into the ballonnet, and which is directly governed by the wind velocity in miles per hour on the outside of the bag.

The pressure of this air in the ballonnet causes it to expand upward, and this upward expansion in turn presses on the gas above until the internal pressure of the air strikes a state of equilibrium with that of the gas. Upon the occurrence of any atmospheric change, the ballonnet action takes place as previously outlined, and causes the balloon proper to retain its original shape. This maintenance of shape is a very necessary element, for upon its remaining constant depends the ability of the balloon to fly accurately and safely.

The basket is made of rattan that has been interwoven by following the over and underlapping method which insures rigidity and strength. Its capacity is two observers. One of these acts as a pilot and is responsible for the action of the balloon, while the other is known as the observer, and he is especially trained for this very important post. Instruments contained in the basket are of highest sensitivity for determining height, direction of wind, speed of wind in miles per hour, etc. A telescope is mounted on the cross-arm over the heads of the occupants, and due to its universally jointed swivel, it has a range of 360 degrees in any plane. Two parachutes also figure as part of the equipment, as also do a telephone, consisting of transmitter and receiving instrument, a camera, an additional pair of binoculars, and last, but not least, a means of protection against enemy air attack in the shape of a modern light-weight machine gun.

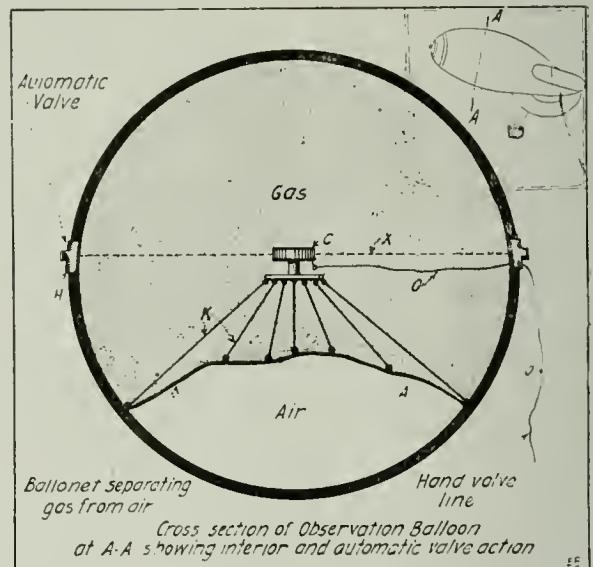
Of especial interest is the way in which the basket is attached to the balloon. This method of cross-lacing minimizes the swing of the basket to nil, and gives an increased stability, beside absolutely preventing rotary motion of any sort by the basket.

The "Blimp", in reality a dirigible balloon, navigating under its own power, is shown in cross-section for the benefit of the reader. By referring to the symbols in the picture, and then finding their corresponding definition in the caption below it, the writer hopes for a thoro understanding of the actions of the various means and methods employed to conquer the air in this particular type of machine.

The chances of enemy artillery making a direct hit and destroying one of these blimps or even observation balloons, is remote. One would casually think that hitting a balloon by shell fire would be the easiest thing in the world. Exactly the contrary is the case. The main difficulty is caused by the fact that there is nothing to

judge the bursts of the shell by. From its position where the enemy artillery is firing, nothing can be judged except whether the shells are going straight toward the balloon or not, and nothing is known as to whether these shells burst in front or behind the balloon. Observation from the enemy's flank will tell this, but flank observation will not tell the truth about the accuracy of the line. Cross-observation is the only method by which it can be made an easy target, but as this type of artillery observing takes probably about twenty minutes, the balloon can be moved about by means of the automobile or locomotive on the ground below, and thereby causing the enemy to take another observation, and just about the time that they are ready to fire a shot at the balloon, it is again moved, and thus plays a game of hide and seek with the enemy artillerists.

The most dangerous position of the kite balloon, is at the period of time when it is just leaving the earth, and until it arrives at a height of about twenty-four hundred feet. After once attaining this altitude, it is comparatively safe from attack from any source upon the ground. But this immunity is not perfect once an enemy airplane arrives upon the scene of action.



This View Shows a Cross-Section of an Observation Balloon, and the Arrangement of Air and Gas Chambers, with Automatic Valve Action Provided.

At the base where the cable and the wires from the balloon reach the ground, are stationed twelve men, constantly sweeping the sky with powerful glasses. Enemy airplanes are sighted, an alarm is immediately sounded, the automobile or locomotive winch begins to wind up the cable, which moors the balloon to the earth, and powerful anti-aircraft guns squirt out their fire at the Boches that are trying to swoop down upon their prey. The guns crash, nearer and nearer comes the balloon to the ground, the automobile or locomotive to which it is moored, starts to move, and gently draws the balloon to its nest, where it is concealed until another and better opportunity for ascending arrives.

The duty of the observers when they are up above the shell-torn lands "somewhere in France," along the American sectors, is to be ever watchful for unusual activities behind the enemy's lines, to take careful note of the positions of guns, trenches and men, likewise to carefully check up reports of cavalry reconnoissance, to be watchful for the bringing up of reserves, and spot field works.



YOUR knowledge will always be the greatest factor in your success. No investment in the world will pay you bigger dividends than money invested in increasing your knowledge. And you can now do it in spare time, in your own home, for only 50c a week!

The pay-raising books described below were written by greatest authorities in their fields. Written in plain every-day language so anyone can understand and use the vast amount of knowledge contained in each set. Thousands of full page plates, photographs, diagrams, etc. Handsomely and durably bound in half Morocco or flexible bindings and stamped in gold. Select the set in line with your ambition, and examine it free. Mail coupon. If satisfied pay the Bargain Price, on terms of only 50c a week. Select your set NOW.

<p>1.—Automobile Repairing 5 Volumes; 2500 Pages, 5 3/4 x 8 1/4 inches; 2100 Illustrations. Prepares for Garage Foreman, Automobile Mechanic or Chauffeur. Regular price \$25. Special price \$17.80. Terms, 50c a week.</p>	<p>man. Regular price \$35. Special price \$21.80. Terms, 50c a week.</p>	<p>6.—Accountancy and Business Management 10 Volumes; 3680 Pages, 7 x 10 inches; 1987 Illustrations. Prepares for Certified Public Accountant, Auditor, Office Manager, Accountant, Credit Man or Bookkeeper. Regular price \$50.00. Special price \$24.80. Terms, 50c a week.</p>	<p>Engineer, Master Plumber or Plumber. Regular price \$20.00. Special price \$15.80. Terms, 50c a week.</p>	<p>Regular price \$20.00. Special price \$12.80. Terms, 50c a week.</p>
<p>2.—Law and Practice (with Reading Course) 13 Volumes; 6000 Pages, 7 x 10 inches; 24 Illustrations. Prepares for all Bar Examinations. Regular price \$72. Special price \$39.80. Terms, 50c a week.</p>	<p>4.—Civil Engineering 9 Volumes; 3900 Pages, 7 x 10 inches; 3000 Illustrations. Prepares for Civil or Structural Engineer, Transitman, Estimator, Designer or Chief Draftsman. Regular price \$45.00. Special price \$29.80. Terms, 50c a week.</p>	<p>7.—Telephony and Telegraphy 4 Volumes; 1728 Pages, 7 x 10 inches; 2000 Illustrations. Prepares for Telephone Engineer, Wire Chief, Exchange Manager, Trouble Man or Telegrapher. Regular price \$20.00. Special price \$12.80. Terms, 50c a week.</p>	<p>9.—Mechanical and Architectural Drawing 4 Volumes; 1720 Pages, 7 x 10 inches; 1037 Illustrations. Prepares for Architectural or Mechanical Draftsman. Regular price \$20.00. Special price \$12.00. Terms, 50c a week.</p>	<p>12.—Modern Shop Practice 6 Volumes; 2300 Pages, 5 3/4 x 8 1/4 inches; 2500 Illustrations. Prepares for Machine Shop Superintendent or Foreman, Foundryman, Pattern Maker, Tool Designer or Tool Maker. Regular price \$30.00. Special price \$19.80. Terms, 50c a week.</p>
<p>3.—Steam and Gas Engineering 7 Volumes; 3300 Pages, 5 3/4 x 8 1/4 inches; 2500 Illustrations. Prepares for Stationary, Marine or Locomotive Engineer or Fire-</p>	<p>5.—Architecture, Carpentry and Building 10 Volumes; 4760 Pages, 7 x 10 inches; 4000 Illustrations. Prepares for Architect, Contractor, Construction Superintendent, Carpenter Foreman, Designer or Chief Draftsman. Regular Price \$50.00. Special Price \$24.80. Terms, 50c a week.</p>	<p>8.—Sanitary Heating and Ventilation Engineering 4 Volumes; 1454 Pages, 5 1/2 x 8 1/4 inches. Prepares for Sanitary Engineer, Heating and Ventilating</p>	<p>10.—Fire Prevention and Insurance 4 Volumes; 1500 Pages, 7 x 10 inches; 600 Illustrations. Prepares for Countermao, Rate Clerk, Inspector or Agent. Regular price \$20.00. Special price \$15.80. Terms, 50c a week.</p>	<p>13.—Electrical Engineering 7 Volumes; 3000 Pages, 7 x 10 inches; 2600 Illustrations. Prepares for electrical Engineer, Power Plant Superintendent, Substation Operator or Electrician. Regular price \$35.00. Special price \$19.80. Terms, 50c a week. Carpentry and Contracting 5 Volumes, 2138 Pages, 5 1/2 x 8 1/4 inches. Regular price, \$25.00. Special price \$17.80.</p>

Not One Cent in Advance

Examine Any Set for 7 Days Free

Do not let doubt or delay deprive you of this opportunity to invest in your own self improvement. Mail the coupon today—right now—without sending a penny. You take no risk. If, after examination, you feel that spare time reading of these books will bring you a better, bigger paying job—if you are convinced that these books will pay you enormous dividends, send only the small payment each month, which amounts to less than 50c a week. You fritter more than 50c a week with no return on your investment. Why not make that 50c work for you?

Mail Coupon Now

The increasing cost of paper and binding may force us to withdraw this offer when the present stock is exhausted. We urge those interested to mail the coupon at once and get the special price and easy terms. Mail the coupon and the books will come at once. Simply pay the small shipping charge, then return the set at our expense if you do not care to buy after examination. For a limited time, as a special inducement for prompt action, we offer with every set a Consulting Membership Free. This gives you the privilege of submitting your perplexing problems to a corps of experts for an entire year. This consulting membership ordinarily sells for \$12.00. It is yours free if you act promptly. Mail the coupon before you turn this page. This offer may never appear here again.

SPECIAL DISCOUNT COUPON
American Technical Society, Dept. X-3388-A,
Chicago, U. S. A.

Please send me set of

for 7 Days' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send \$2 within 7 days and \$2 each month until I have paid the special price of If I decide not to keep the books I will return them within 7 days. Title not to pass to me until the set is fully paid for.

Name

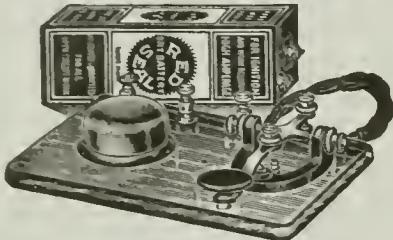
Home Address

Reference

Employer

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

Mesco Telegraph Practice Set For Learning Telegraph Codes

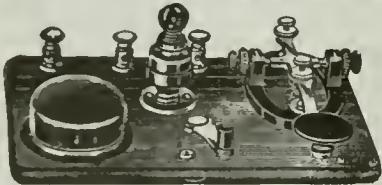


The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No. Price
342 Telegraph Practice Set, with Battery and Cord.....\$3.24
Weights 4 lbs. packed.
Price does not include postage.

MESCO Combination Practice Set for learning the Morse and Continental Visual and Audible Codes



This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.
List No. 52—Practice Set with Red Seal Battery and Cord.....\$4.06
Weights 4 lbs. packed. Price does not include postage.

Send for the New Edition of Our Catalog W28

It is pocket size, contains 248 pages, with over 1,000 illustrations and describes in plain, clear language all about Belts, Push Buttons, Batteries, Telephone and Telegraph Material, Electric Toys, Burglar and Fire Alarm Contrivances, Electric Call Belts, Electric Alarm Clocks, Electrical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Send for the Catalog Now

Manhattan Electrical Supply Co., Inc.

NEW YORK: CHICAGO: ST. LOUIS
17 Park Place 114 B. Wells St. 1106 Pine St.
San Francisco Office: 604 Mission St.

MECHANICALLY RIGHT — A REAL LATHE A Regular lathe, not a toy



Swing 4 inches, 11 inches between centers, 17 inches total length. Net weight 9 lbs. Shipping weight 13 lbs.
The bed of this lathe is machined. Workmanship is first class throughout. Lathe comes equipped with wood turning chuck. Lathe can be fitted with 3 inch face plate and drill chuck as special equipment. Order now today. Price \$4.50 cash with order.

SYMPHER MFG. CO., DEPT. C, TOLEDO, OHIO

Feldman's "Geyser" Electric Water Heater

Instantaneous Hot Water

FELDMAN MFG. CO.

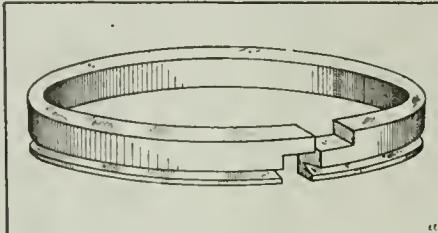
1500 Times Bldg. New York City

A NEW "OIL SEALING" PISTON RING

This ring is made from a special formula of close-grained, tough gray iron, a few points softer than proper cylinder metal. Individually cast, retaining on the inside the skin of the casting, which insures long life and lasting resiliency.

A groove is cut around the ring at right angles with the face sloping at an angle of about 45 degrees, the groove passing between the sliding face, forming the lap and the side of the ring.

In one direction the square edge gathers the surplus oil. In the opposite direction the oil is distributed again, from the sloping face, pulsating as it were, preventing the groove from clogging. Not only this, but to-day, when "gas" is 20 per cent ker-



New Grooved Form of Piston Ring.

osene, the danger of passing this coal oil down into the oil (lubricating pit) with consequent weakening of the lubrication and harm to the bearings, is readily overcome by reversing the top ring of this type, when applying them to the piston.

The power of the motor is thus increased because of the oil seal provided by trapping the oil in the groove, and the coal oil trapped in the upper ring groove is drawn back in the firing chamber on the power stroke and either exploded into power or sent out the exhaust pipe.

WHY AIRPLANES DON'T FEAR ANTI-AIRCRAFT GUNS.

(Continued from page 447)

hundred meters. (A little over 4/10 milc.) This condition is clearly shown in the accompanying illustration.

Hence, the great problem of the anti-aircraft gunner is to accurately determine in advance the position in space where the enemy airplane and the projectile will meet, after both have followed their respective trajectories for an equal period of time. This forms a problem which has been called by the British, "the problem of prediction." In general and considering that the target is an animated one, and having, as we might say, its own will-power, it is quite obvious that no absolute and definite solution can be applied to the problem unless we can refine our intellects to the point of knowing what direction the enemy aviator is going to take each successive second! During twenty seconds, the average time period during which the anti-aircraft projectile is in the air, a flying machine has time to change its course in various sudden and unexpected ways, both as to altitude and as to direction. Colonel Reille outlines, however, a number of interesting methods of determining by certain laws, just where the target is liable to be after the lapse of such a period as this, and as he states, "The problem, altho appearing almost impossible of solution, nevertheless has a probable solution, and this belongs to the domain of mathematical extrapolation, based on the laws of continuity."

In general the solution of the problem of accurate anti-aircraft firing depends on the measurement either of the angular velocity of the target, i. e., the space in degrees that it covers in a certain period of time, or the measurement of the target's linear velocity, i. e., its speed in feet per second, etc. Now

it was found that the angular velocity of a flying machine moving with a uniform linear velocity, changes value every minute in practically all cases. Supposing even that the angular velocity measured at the very moment of the shot could be applied to extrapolate for the point in the air which the projectile ought to reach, and this is questionable owing to the relatively long duration of the flight, any measurement taken at a moment somewhat prior to the firing of the shot is evidently out of date and has no value whatever regarding the extrapolation desired.

This is the reason why, after the trials made with instruments capable of giving from time to time discontinuous measurements of angular velocities, it has been felt necessary to substitute for them instruments capable of giving continuous measurements, and this instrument is illustrated herewith. It is called a galvanometric cinematometer.

The instrument works on an ingenious electrical principle as follows: A steel armature which turns inside of a magnetic solenoid (coil of wire) develops a current of induction, the intensity of which is a measure of the velocity of rotation. If the steel armature is secured on the axis of a sighting telescope pointed at the airplane, a galvanometer properly graduated will enable the range-finding officer to read constantly instead of periodically, the angular velocity of the moving target. As the illustration of the measuring instrument shows, there are two steel armatures and two solenoids provided; one measures the angular velocity when the telescope is moved across the horizon, the other solenoid and armature indicating the angular velocity when the telescope is moved up or down vertically. A mean value is obtained from both instruments when the telescope is moved diagonally or up and sidewise for instance. The problem of aiming and firing an anti-aircraft gun is thus a considerable one, and moreover highly scientific in its solution, for among other things, the officers having to do with the range-finding, have to determine the altitude or height of the enemy plane; its orientation, and its velocity, either angular or linear; the extrapolation or prediction of the point to be aimed at, wherefrom the knowledge of the azimuth* is determined. The altitude is measured by triangulation from a large observation base. In all these calculations and their various ramifications, both applied and suggested, the use of the well-known plotting board, familiar to all artillerymen, is recommended.

In determining the azimuth when the angular velocity of the target is determined by the aid of the instrument here shown, the extrapolated azimuth is obtained by the plotting of the horizontal angular velocity and this in starting from the last azimuth in which the target has been observed, prior to the firing of the shot. In the same way the angle of sight is extrapolated or plotted from the angular velocity taken in the plane of sight where the target has been observed, prior to the firing of the shot.

Consider once more the fact, as aforementioned, that an enemy aircraft may traverse a distance of about seven hundred meters or .434 mile during the flight of the projectile thru the air. The shell proceeds on its way and clings helplessly to its trajectory, and will inevitably burst once the combustion of its fuse has come to an end. In the words of Colonel Reille—"During this period the race is surely most unequal, for the moving aerial target under the guidance of a quick-witted aviator, has maintained the full power of her free will,

*Azimuth: An arc of the horizon intercepted between the meridian of a place and the vertical circle passing through the center of a celestial body.

(Continued on page 496)



10 LEARN PUBLIC SPEAKING LESSONS FREE

Write—quick—for particulars of this extraordinary offer; an opportunity you will never forget if you take advantage of it. Ten lessons in effective public speaking absolutely FREE to those who act promptly, to introduce our course in localities where it is not already known.

WHAT THE COURSE TEACHES YOU

- How to talk before your club or lodge.
- How to address board meetings.
- How to propose and respond to toasts.
- How to make a political speech.
- How to tell entertaining stories.
- How to make after-dinner speeches.
- How to converse interestingly.
- How to write better letters.
- How to sell more goods.
- How to train your memory.
- How to enlarge your vocabulary.
- How to develop self-confidence.
- How to acquire a winning personality.
- How to strengthen your will power and ambition.
- How to become a clear, accurate thinker.
- How to develop your power of concentration.
- How to be the master of any situation.

We Teach You By Mail

We teach you by mail to become a powerful and convincing speaker—to influence and dominate the decisions of one man or an audience of a thousand. We have trained hundreds and helped them to increase their earnings and their popularity. Learn in your spare time at home how to overcome “stage fright” and conquer fear of others; how to enlarge your vocabulary; how to develop self-confidence and the qualities of leadership; how to RULE others by the power of your speech alone; how to train your memory. Our

NEW, EASY METHOD

perfected and taught only by Prof. R. E. Pattison Kline, former dean of the Public Speaking Department of the Columbia College of Expression, can be learned in 15 minutes a day. Prof. Kline is one of the foremost authorities in the country on public speaking and mental development. Do not let this chance escape you.

FREE LESSON COUPON

North American Institute
9818 Manhattan Building,
Chicago, Ill.

I am interested in your course in Effective Public Speaking and your offer of 10 lessons free. Please send full particulars. This request places me under no obligation of any kind.

Mail This Free Coupon **Offer Limited! Send no Money**

This Special Offer of TEN LESSONS FREE is made strictly for advertising purposes and will be withdrawn without notice. Write now, before it expires, and receive full particulars with enrollment blank by return mail. No obligations of any kind. Just tear off and mail this free coupon—or a postal will do.

NORTH AMERICAN INSTITUTE
984B Manhattan Building - - - - - Chicago, Ill.

Name
Street
City State

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

414 PAGES
145 ILLUSTRATIONS

I. C. S.
ELECTRICAL ENGINEER'S
HANDBOOK
\$1
ELECTRICITY!

HERE'S just the book on Electricity that you need to answer your many questions—to solve your knotty problems, to teach your new kinks, to be your memory for tables, rules, formulas and other Electrical and Mechanical facts that some people try to carry in their heads—and fail.

With this "Little Giant" I. C. S. Electrical Engineer's Handbook in your pocket, toolchest, on your work bench, drawing table or desk, an hour or a day need not be lost "digging up" some forgotten rule, some unfamiliar fact; you'll just turn to the very complete index and get it "in a jiffy." Just a few of the subjects treated are:

- Electricity and Magnetism; Electrical Symbols; Batteries; Circuits; Magnets; Direct and Alternating Currents; Dynamos and Motors; Belts; Shafting; Electroplating; Electrical Measurements; Meters; Arc and Incandescent Lamp; Mercury Arc Rectifiers; Transformers; Insulation; Electric Cars; Single and Multiple-Unit Control; Transmission; Rail Welding; Tables of Wires—Sizes, Capacities, etc.—Mathematical Rules, Formulas, Symbols; Tables of Constants, Equivalents, Roots, Powers, Reciprocals, Areas, Weights and Measures; Chemistry; Properties of Metals; Principles of Mechanics; First Aid, etc.

The Electrical Engineer's Handbook is one of 22 I. C. S. Handbooks covering 22 Technical, Scientific and Commercial subjects. (See titles in coupon below.) They have the contents of a full-size book condensed into pocket size ready to go with you anywhere and be at your instant command. Substantially bound in cloth, red edges, goldleaf stamping, printed from new, clear, readable type on good quality book paper and illustrated wherever a picture will help.

No Risk Money-Back Offer!

The price of the famous I. C. S. Handbooks, of which more than 2,000,000 have been sold and are in practical everyday use, is \$1 per copy. So confident are we that you will find them exactly what you need for ready reference in your work, that we stand ready to promptly and cheerfully refund your money if for any reason you are not fully satisfied with their value. Simply send a letter or the coupon below, enclosing \$1 for each book wanted. If at any time within 10 days you wish to return the books, your money will be refunded.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6164 Scranton, Pa.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6164, SCRANTON, PA.

I enclose \$_____ for which send me postpaid the Handbooks marked X, at \$1.00 each. I may return any or all and get my money back within ten days from receipt:

- | | |
|---|---|
| <input type="checkbox"/> Electrical Engineer's | <input type="checkbox"/> Advertiser's |
| <input type="checkbox"/> Telephone and Telegraph Engineer's | <input type="checkbox"/> Business Man's |
| <input type="checkbox"/> Mechanic's | <input type="checkbox"/> Bookkeeper's |
| <input type="checkbox"/> Steam Engineer's | <input type="checkbox"/> Sign and Correspondent's |
| <input type="checkbox"/> Westinghouse Air Brake | <input type="checkbox"/> Salesman's |
| <input type="checkbox"/> Civil Engineer's | <input type="checkbox"/> Window Trimmer's |
| <input type="checkbox"/> Coal Miner's | <input type="checkbox"/> Cotton Textile Worker's |
| <input type="checkbox"/> Concrete Engineer's | <input type="checkbox"/> Farmer's |
| <input type="checkbox"/> Building Trades | <input type="checkbox"/> Poultryman's |
| <input type="checkbox"/> Plumber's and Fitter's | <input type="checkbox"/> Marine's |
| <input type="checkbox"/> Chemist's | <input type="checkbox"/> Automobile's |

Name _____
Street and No. _____
City _____ State _____



or choice of 44 styles, colors and sizes in the famous Ranger line of bicycles for you to keep and use a month as your own. **Would You** then agree to show your bicycle to ten or more of your friends and tell them the ridiculously low factory price, easy terms, unusual conditions and exceptional offers I would make, all of which I will explain to you if within ten days of seeing this you will say in a letter or on a postal, "Send particulars of Bicycle Offer" and address your postal card or letter: Personal for G. L. LEWIS, Manager MEAD CYCLE CO., 107 Mead Block, Chicago

WHY AIRPLANES DON'T FEAR ANTI-AIRCRAFT GUNS.

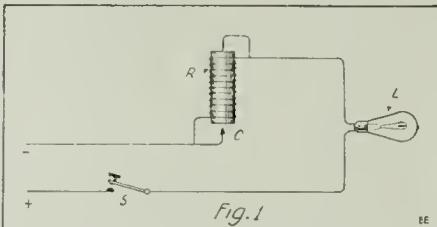
(Continued from page 494)

gle projectile from the ground burst anywhere near the plane, and at once she is in a position to thoroughly baffle all the calculations that have been wasted on the aiming and firing of this projectile. Due to the foregoing facts, it is clearly evident that the systems of anti-aircraft firing based solely on ranging must be condemned as being ineffective and excessively expensive." "Also," as this authority, who is Chief of Artillery in the French Advisory Mission concludes—"are they not sufficient to show that, so long as we do not have a gun of a fantastic muzzle velocity, and capable of pouring into space projectiles of a speed infinitely superior to that of the flying machine, then the anti-aircraft gunner must concentrate all his attention and ingenuity in throwing skyward, sudden and dense barrages on the points in the air determined by extrapolation, silently calculated by measurements as accurate as possible."

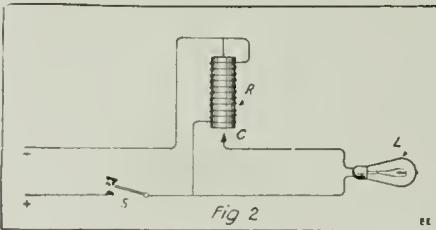
A THERMOSTATIC TIME SWITCH.

(Continued from page 475)

This device will afford considerable amusement and mystery to the uninitiated who see the lights flash on apparently by themselves, as the operator has ample time to move away from the push-button before the lights light.



Principle of the Thermostatic Time Switch, in Which a Coil Heats a Rod R, Expanding It and Closing the Lamp Circuit.



Theoretically Workable Thermostat Switch for Controlling Lamp But Impractical for Obvious Reasons, Such as Heating and Deterioration of the Heating Coil.

MAGNETIC AND OTHER FOOL WAR DREAMS.

(Continued from page 451)

whale of an idea. I think I will take half a day off, inject a hypodermic syringe full of Prof. Kammerlingh Onnes' liquid helium, and try that stunt myself. It sounds almost good.

In another corner of the editor's desk, what did I pick up but another spasm from a fly-by-night inventor (mostly vent) residing in Ogosh, Minnehaha. Gaze on Fig. 3 of the accompanying illustration, and you will see one of the greatest pests of the Naval Ins—, excuse me, Consulting Board, viz: the magnetic compass mine. This disturber of the Patent Office peace gets my goat. "It's easy," sez he, "just take a spark coil, some batteries and a compass needle,



The Electric Safety razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current. All users of the **Lek-Tro-Shav** speak well of it. A barber says—"Have shaved for years and have never used any shaving device near its equal." A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor." No. 1 Made for use from Light Socket. No. 2 Made for use from Dry Battery. Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully. **VIBRATING ELECTRIC RAZOR CO** Dept. 122. Omaha, Nebr.

Hotel St. James
Times Square, New York City
Just off Broadway at 100-113 West 45th St. 1 1/2 Blocks from 45th Street Entrance to Grand Central Station.

Women will find here a home atmosphere and absence of objectionable features of ordinary hotel life.

40 Theatres, all principal shops, 3 to 5 minutes' walk.

2 minutes of all subways, "L" roads, surface cars, bus lines.

An excellent Restaurant, at moderate prices.

Write for "What's Going On In New York."

All Outside Rooms
With adjoining bath..... from \$1.50
With private bath..... from \$2.00
Sitting room, bedroom, bath, from \$4.00
Furnished Apartments by the year, month or week, at special rates.

RAYMOND L. CARROLL, Pres. and Mgr.

DO YOU WANT A Wonderful Muscular Development, with perfect health, abundance of vitality and great strength? You can get all the above, if you want them, and I can show you how. The results of my system are shown on my own person, and that is recommended enough. I have prepared a booklet, illustrated with photographs of myself, which will tell you how you can obtain a development the same as I did. The name of it is "Muscular Development" GET IT—it will interest and benefit you. A copy of this instructive and illustrated booklet will be sent you upon receipt of 10c—stamps or coin.

EARLE B. LIEDERMAN
Why not look as healthy and be as strong as I am?

EARLE LIEDERMAN, Dept. 202, 203 Broadway, New York City

SHORTHAND IN 30 DAYS

Boyd Syllable System—written with only nine characters. No "positions"—no "ruled lines"—no "shading"—no "word-signs"—no "Code-notes." Speedy, practical system that can be learned in 30 days of home study, utilizing spare time. For full descriptive matter, free, address, Chicago Correspondence Schools, 989 Unity Bldg., Chicago, Ill.

and place them in the mine. In another compartment of the mine place a ton or so of gun-cotton or T. N. T." "Now," sez he, "when all is ready, and the compass needle duly fitted with an electrical contact, it will swing around and close the spark coil circuit, thus detonating the high explosive as soon as a steel ship draws near. Fine—but how in blazes am I going to tell enemy ships from my own?!* I should worry!

GADZOOKS!!! Lads, but look at war dream No. 4! What do our eyes behold, my Lords? Nothing less than the evil eye and titanic grin of the terrible *Electromagnetic torpedo*. "Why should so many torpedoes be wasted by missing the mark, when such an invisible and omnipotent force as that of magnetism is available," writes this "also-ran" inventor. No sooner said than done, and down he sat and penned this drawing and specification. I would assure you friends that if I were as big as the biggest torpedo, with a girth of twenty feet and a length of ten yards, and just bubbling over with magnetic molecules, I would not be attracted by the biggest steel boat you ever saw at a distance exceeding a few inches at most. If you do not believe it, just go down to the nearest steel foundry where they have an electro-magnet capable of lifting several tons, and see for yourself how far my magnetic influence extends.

The "electrification" experts had been at it again when I ran across Phoney Patent No. 5. "Take some ten thousand of your electrical experts" sed this inventor in his spessyficashion for a patent to *end the war* instantly, and address to no less a personage than General Pershing himself—"send them down to the sunny shores of the Mediterranean, and let them improve each shining hour by gathering thousands of No. 1 electric eels. Ship said eels to the Western Front in plate-glass trunks, so that they cannot shock anyone while in transit, and at the psychological moment, liberate fifty thousand for luck from airplanes flying along the Rhine into that German holy of holies, and the war will be ended. I commission that budding genius with the rank—I sure think it's rank!—Brigadier-General of the Electric Eel Division, and he can have full charge of that Department any time he wants it!

I momentarily lost my equilibrium and nearly forgot to hold my magnetic molecules in line, while old "H. P." nearly fainted, when my gaze fell on War Patent No. 6. CARAMBA!!! What do you think of this *magnetic conceit*? The chap that promulgated and otherwise foisted this brainy (?) idea on a long-suffering War Board was a Count—Count of No-account, I guess, for he wrote—"Why not build a VERY POWERFUL ELECTRO-MAGNET and submerge it in the shoal waters about the North Sea, so that the enemy battleships will be attracted from the deep channels into the shoals, where our sea forces can knock them to smithereens." Well, boys, I am glad I am here to speak for myself, and take a tip from father, that if that bird could build an iron core large enough for me to live in, and surround it with a coil of copper wire, big enough to use all the kilowatts developed in Europe, well even then I could not cause any of the mighty steel-plated dread-naughts of the German Navy to move one-thousandth of one millionth part of an inch from their chosen path. Of course, if a nosy submarine tried to pass me at a distance of a few feet, and provided I had several thousand kilowatts of magnetized molecules tuned up to a state of saturation, I *might* hold him a while. But none of that five-mile or ten-mile stuff, or quarter mile either.

I have often wondered how it would feel to have several million of my best trained molecules concentrated on the nose of a



LIONEL STRONGFORT

"Dr. Sargent, of Harvard, declared that Strongfort is unquestionably the finest specimen of physical development ever seen."

Oh! You Unfit!

Unfit, flabby, weak, useless—doing nothing for yourself, your family or your country, at the one time in the whole history of America when the Nation expects EVERY man either to FIGHT or WORK. What good are you to anyone, in these stirring times, if you are dragging yourself about with your physical system a wreck, your mentality cobwebbed and your spirit gone? Brace up!—take hold of yourself—

BECOME A MAN

Don't think you can't—YOU CAN, if you go about it right. And when you do a place will be awaiting you. America needs men here at home as well as on the fighting lines; men to carry on the gigantic war work of the Government; men to run the industries of our great country; men to take the places of our soldiers over there, to care for the families left behind; *men fit to be the fathers of Americans to come.*

YOU CAN MAKE YOURSELF FIT IF YOU WILL DO IT

You can add to the duration of your own life, and make every year of your life more useful, more pleasurable, more worth while living, by taking yourself in hand and become fit. What's the use of living, if you don't enjoy life? Where's the good in waking up at all, if you wake up tired out before you begin the day? What fun is there in going about suffering all the time from youthful errors, vital losses, de-vitalizing habits, poor memory, constipation, rheumatism, dyspepsia, indigestion, biliousness, headaches; with a fevered brain, a rotten temper, a muddled intellect—unable to DO anything worth while or to enjoy an hour of your day?

DON'T BREAK DOWN IN THE PRIME OF LIFE

Vital statistics prove that the average American dies ten or fifteen years before his time, *usually from preventable disease*, simply because he does not take care of his body and live in accordance with Nature's laws. Nature is the universal, all-powerful Healer; give her half a chance and she'll get to work on you, no matter how much of a mental and physical wreck you feel yourself to be.

WHY DON'T YOU BETTER YOURSELF?

Place yourself in my hands and I will show you how every organ in your body will be brought to normal function; you will fairly tingle with vigorous life. My system and method will vitalize you, rebuild you, rejuvenate you.

I can bring your forces of Nature into play; make your success certain. No matter what your present condition, my method is restorative, rejuvenating. You will be vitalized; the glands of your body that store secretions necessary to robust health will be invigorated; your mental activity will be increased, your energy augmented; you will be a live factor in whatever sphere you may be.

I'll Show You Nature's Way

The ONLY safe, sure, simple way to really build yourself up and get rid of the ills that are hampering your progress, making you of no account in the world and eating up your years of life. No patent medicine preparations or druggist's dope in Nature's way or mine. No over-exercise, strengthening your muscles at the expense of vital organs. Just Nature's way—the Army way—the Strongfort way—the way that has led thousands of my pupils back to health and strength and the enjoyment of living life. Note opposite coupon. Check your main ailment and you will receive a practical talk without obligation.

Send for a copy of my free book, "Promotion and Conservation of Health, Strength and Mental Energy." IT'S FREE. I will send you a copy by return on receipt of three two-cent stamps to cover postage and packing.

LIONEL STRONGFORT
Physical and Health Specialist
706 Park Building NEWARK, N. J.
Personal Consultation by Appointment Only

FREE CONSULTATION COUPON

Mr. Lionel Strongfort, Newark, N. J.—Please send me your book—"PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY," for postage of which I enclose three 2c stamps. I have marked (X) before the subject in which I am interested.

- | | | |
|-------------------------|----------------------|---------------------|
| .. Colic | .. Insomnia | .. Youthful Errors |
| .. Catarrh | .. Short Wind | .. Vital Losses |
| .. Asthma | .. Flat Feet | .. Gastritis |
| .. Obesity | .. Stomach Disorders | .. Heartweakness |
| .. Headache | .. Constipation | .. Poor Circulation |
| .. Thinness | .. Biliousness | .. Skin Disorders |
| .. Rupture | .. Torpid Liver | .. Despondency |
| .. Lumbago | .. Indigestion | .. Round Shoulders |
| .. Neuritis | .. Nervousness | .. Lung Troubles |
| .. Neuralgia | .. Poor Memory | .. Increased Height |
| .. Flat Chest | .. Rheumatism | .. Stoop Shoulders |
| .. Deformity (describe) | .. Impotency | |

(706)

Name

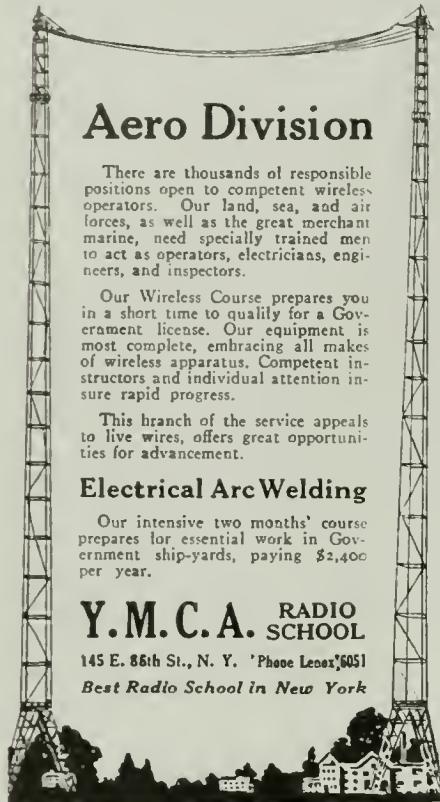
Street

City State

Write Plainly

WIRELESS

Prepare while you can for this branch of government service in which there is exceptional opportunity for better pay and rapid promotion. Our courses qualify men 18 to 45 as expert Wireless Operators.



Aero Division

There are thousands of responsible positions open to competent wireless operators. Our land, sea, and air forces, as well as the great merchant marine, need specially trained men to act as operators, electricians, engineers, and inspectors.

Our Wireless Course prepares you in a short time to qualify for a Government license. Our equipment is most complete, embracing all makes of wireless apparatus. Competent instructors and individual attention insure rapid progress.

This branch of the service appeals to live wires, offers great opportunities for advancement.

Electrical Arc Welding

Our intensive two months' course prepares for essential work in Government ship-yards, paying \$2,400 per year.

Y.M.C.A. RADIO SCHOOL

145 E. 86th St., N. Y. Phone Lenox 6051
Best Radio School in New York

WANTED

50 Young Men to Learn Electricity

In the great factory of "KNAPP," celebrated manufacturer of electric motors, dynamos, specialties, etc.

You Don't Pay Us— WE PAY YOU!

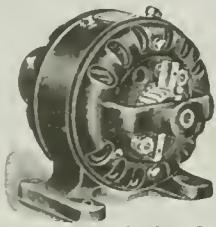
To young men with ambition to succeed, we will pay regular weekly wages (\$10 to \$16 a week) and teach them the business thoroughly.

New York is the city of opportunities and an ideal place in which to live. Here is your chance to establish yourself in the big city. We will help you find good living quarters and start you on your way to a responsible position at big salary.

Seize this opportunity—write immediately for full particulars. First applications will receive preference.

Knapp Elect. & Nov. Co., 523 W. 51 St. N.Y.

110 VOLT A. C. GENERATORS ONLY \$5.00



Good hand generators, while stock lasts, \$5.00.
Order today.

Battery charger, 6 v. 6 amp. \$10.00; 7 v. 11 amp. (like cut) \$27.00; Hydro-Electric Generator complete, giving up to 25 v. 3 1/2 amp. D. C. \$25.00. Immediate shipment while stock lasts. Order from this ad.

Watson Electric Co., Dept. 11, Gas Bldg., Chicago

fast-traveling bullet, so that when approaching the steel helmets of the Kaiser's *finest*, they would immediately yank the bullet out of its wonted course, and cause it to slam mightily against Fritz's steel sky-piece, and by this sudden concussion cause the bullet to explode with most disastrous results!

A budding genius from Whatsundermyhat, Nil, proposes that the Naval engineers shall equip all sea-going vessels with a series of (always) "large and powerful" magnetizing coils, placed in belt lines entirely around the hull of the ship, and excite my magnetizing coils with several hundred kilowatts of *alternating current*. Now, altho you might not know it, when an alternating current is past thru my magnetizing coil, I can repel certain bodies with extreme speed, but not for any great distance, usually not exceeding a few inches. You can imagine then what chance I would have repelling a modern automobile torpedo traveling at the rate of fifty miles an hour, and with a momentum of many thousand foot-pounds.

Boys, Howdy! Take off your hat to war spasm No. 9, specially invented to hasten peace, so its inventor states, and he makes my bones weary, for I'll be dinged if he doesn't pack up a bunch of my best trained Maxwellian molecules into an iron lifting magnet measuring ten feet in diameter, and whirl it along over the enemy positions suspended from an airplane. You ought to hear that boy rave. I can see the boche on a dead run for Berlin, can't you? Yes, you can't! No wonder the Sun wears such a pleasant smile in Fig. 9—it must be a warm day in Ju-ly—lie is right!

EXPERIMENTAL CHEMISTRY.

(Continued from page 491)

the right angle bend, is connected to a medium size test tube, which is immersed in a vessel filled with water. Pour in 5 or 10 cc. of sulfuric acid thru the thistle tube, and apply gentle heat after mixing the substances together by rotating the flask a moment. The apparatus depicted in figure 138 utilizing a retort may be used by those who prefer this mode of preparation. The apparatus depicted in Fig. 139 may also be used in place of either of the above.

Avoid getting the gas into the room by applying only gentle heat. As was the case of chlorin, the best antidote for an overdose of bromin is alcohol or ammonia, inhaled from a handkerchief. Collect 3 or 4 cc. of bromin then clean the apparatus with water, or if necessary, hydrochloric acid, and finally rinse with water.

Preparation of IODIN from Potassium Iodid, Manganese Dioxid, and Sulfuric Acid.

Experiment No. 148

Take a small glass retort or a tube and arrange it as in Figs. 138 or 139.

Grind up in a mortar 5 grams of potassium iodid and mix with it on paper 2 grams of fine manganese dioxid; then transfer the mixture from the paper to the retort, exercising care not to get any into the neck of the retort.

Pour thru a funnel of 5 cc. of sulfuric acid. Mix the substances together by rotation, then put the retort in place and apply *gentle heat only*. Do not continue the process over five minutes! Then remove the stopper from the flask and thrust a cold stirring rod halfway down the bulb for two minutes while the contents cool.

How Can We Tell "Real" Death?

(Continued from page 457)

which is usually injected into the jugular vein in the neck after the blood is withdrawn, is composed of a certain chemical solution which tends to prevent rapid decay of the tissue. Once the body is embalmed, it is impossible for a person to come to life again (as, for instance, from a state of suspended animation). So it becomes all the more important to know an exact test for determining *when life absolutely ceases to exist*, even before embalming as becomes obvious.

USUAL TESTS FOR CESSATION OF LIFE

1. Pulse and Heart Beat: The pulse, as the end of life approaches, grows weaker and weaker, and this is felt by grasping the wrist so that the index and second finger bear against the radial artery. As life approaches the end, the heart beat frequently may drop to as low as 20 to 30 per minute. It is usual for the physician to listen to the heart beat with the stethoscope. There is also available what is known as the *microphone-stethoscope*, which is supposed to be extra sensitive, for the purpose of listening to the faintest heart beat. Some physicians, however, state that the most sensitive and reliable test for the heart beat is to rest the ear against the breast, upon which a piece of gauze has been placed for ethical reasons and which does not interfere with the transmission of sound from the heart cavity to the ear. The stethoscope in such cases is liable to amplify or localize other slight sounds occurring in the breast due to movements of air in the lungs, or due to congestion in the lung passages, especially where the patient has been afflicted with what is known as *death rattle*. If the heart has to all intents and purposes stopt, when listened to at the breast over a period of five minutes and then for another period of five minutes, it is safe to assume that the patient is actually dead, for in practically all ordinary cases where *syncope* or *suspended animation* has occurred, the persons so affected have come to life again in a period not exceeding three minutes. Finally the radial artery may be opened at the wrist. If *no blood appears*, it indicates that life has past from the body and that the heart is not functioning even in a slight manner, as is the case in *suspended animation*. It is the opinion among medical men that in the case of *syncope* *life does not entirely depart from the body*, and no authentic case is on

record where such a condition has occurred, as Dr. John B. Huber has pointed out.

2. The Respiration Test: Respiration normally occurs at the rate of sixteen to eighteen per minute, but this may drop to as low as three or four per minute as life approaches its finality. An old fashioned test which is a fairly good one and extensively used at the present time is that of the cold mirror—the mirror being held over the mouth. In the case of syncope, any slight action of the lungs may cause the expulsion of breath, which forms a mist on the mirror. This test, however, will not indicate the condition of syncope. No ordinary test will indicate this condition, excepting that of cutting the radial artery at the wrist.

Even slight breathing can be heard by the ear applied to the breast, especially by the trained ear of an experienced physician. The *death rattle* is one phase of the respiration action which sometimes persists after life has ceased to exist, apparently.

3. Body Temperature: When life ceases to exist the temperature of the human body invariably drops rapidly, or at the rate of approximately 1.6 degrees Fahrenheit per hour. The living body has a temperature of 98.6 degrees, but a person may die with a fever and have a temperature as high as 106 to 108 degrees. The living body temperature, however, may fall below 95 degrees temporarily, in some serious cases of cholera or yellow fever. About 95 degrees is usually considered the minimum temperature at which life can exist. Sometimes the temperature will rise several degrees after death, but this is purely a chemical reaction in the different parts of the body. The body will become cold, and room temperature may follow in from three to twenty hours. In some cases a slight warmth of the body has been noted after a period of as long as twenty-four hours.

4. Color of Skin: To all intents and purposes, when the circulation of the blood has practically ceased, the skin of the body becomes ashy pale, and there is absence of the pink color when examined under a strong light, as from a reflector. The tissues of the body lose their elasticity, and irritants placed on the skin do not give any vital reaction.

Skin Signs: Scarification of the skin and use of a cupping glass fails to draw blood. Injection under the skin of a solution of ammonia is followed only in life by a port wine colored congestion. Reddish color of the finger tips when approximated toward a light if there is circulating blood.

(Continued on page 502)



In Which Line Will You Do Your Bit

YOU have got to do your bit in the big task facing America. How will you do it? Will you be able to sell your services at big pay as a skilled worker, or will you have to put in your time in uncongenial work and get little for it **BECAUSE YOU LACK TRAINING?** America is faced with the problem of finding men who can think and act for themselves. It is a big problem. Trained men were never scarcer, and yet think what this scarcity will be like when America jumps into the work of reconstruction. Skilled workers in every trade and profession will be at a premium. There will be work for you, for every man, for years to come. The choice of what you do and how much you earn is up to you. What are you going to do?

Prepare NOW Profit Later! The fact that trained men are the money makers, that they are always in big demand, that their training is insurance against lack of employment, should make any man see the wisdom of training. You can't get anywhere without it—but you can go a long way with it. You have to work for a living. Why not get the most for your efforts?

will well repay you. Systematic home study will make it easy for you to master any of the Courses below. Nor is the cost of such training out of your reach, no matter how little you may be earning.

At our risk— **Take 10 Lessons** not yours— you can take **at OUR Expense!** ten examinations in the Course you select. After the tenth lesson, if you feel you are not getting thorough, practical training, you simply notify us—you are not out one cent. There are no strings to that offer. What we have done for thousands of students in twenty-five years we can do for you. Our money-back guarantee is proof of our confidence to train you successfully. It is also your protection.

Training Decides Your Pay

There is no sentiment in determining your salary. You get paid for what you do. What you do depends on what you *know*. The difference between \$15 a week and \$50 is the result of training—knowing **HOW**. Training alone gives you the power to satisfy your ambition. The way is clear for you to acquire a good, practical training without interfering with your present work. Check and mail the coupon below. We will promptly send you Free Bulletin of the Course you are interested in, and full details of our methods, easy payments and guarantee. Send **TODAY**.

AMERICAN SCHOOL OF CORRESPONDENCE, Dept. G7448, Chicago, U. S. A.

TRAINING-THE KEY TO SUCCESS

- High School Graduate
- Gen. Education Course
- Com. School Branches
- Electrical Engineer
- Elect. Light and Power Superintendent
- Hydroelectric Engineer
- Telephone Engineer
- Telegraph Engineer
- Wireless Operator
- Architect
- Building Contractor
- Civil Engineer
- Structural Engineer
- Mechanical Engineer
- Shop Superintendent
- Steam Engineer
- Draftsman and Designer
- Lawyer
- Business Manager
- Cert. Public Accountant
- Accountant and Auditor
- Bookkeeper
- Stenographer
- Fire Insurance Expert
- Sanitary Engineer
- Heating and Ventilating Engineer
- Master Plumber
- Automobile Engineer
- Automobile Repairman
- Airplane Mechanic



Check Course you are interested in and mail the Coupon

Name

Address

U.S. PATENTS



SEND FOR THIS FORM

Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception", sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.



255 OURAY BLDG.,
WASHINGTON, D. C.

PATENTS
and
Trade Marks

Send sketch or model for actual search and report. Write for Booklet of instructions on patent practice and procedure. Prompt personal service. . . .

Geo. P. Kimmel
Patent Lawyer

88K, Oriental Bldg., Washington, D. C.

PATENTS COPYRIGHTS TRADE MARKS DESIGNS

U.S. PATENTS MAKE IDEAS PAY

Hundreds of inventions are sold yearly. We will help you sell yours without cost.

Before sending your inventions to anyone send for our "Blank Form of Disclosures" that will Protect you until your application is filed in the Patent Office.

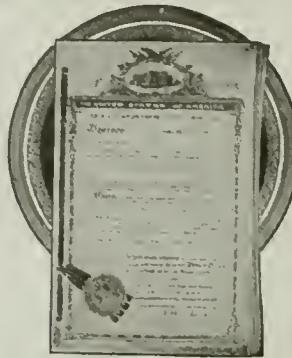
Our book "Making Ideas Pay" gives full information relative to securing Patent Protection. Manufacturers are writing us continuously for new inventions.

Send for Book and Blank Form of Disclosure today. Prompt service. Best results.

A. M. BUCK & CO.
Patent Attorneys

205 Second National Bank Bldg., Washington, D. C.

PATENT ADVICE



Edited by H. GERNSBACK

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 address to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge 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.

Readers' attention is called to the fact that due to the great amount of letters to this department it is quite impossible to answer them all thru these columns. The inquiries answered in this issue date as far back as May, and if readers wish speedy service they should carefully note the announcement appearing in the preceding paragraph.

Spring Handle.

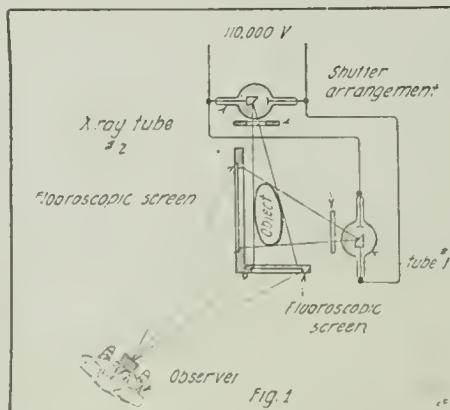
(270) Fred A. Shearer, Centralia, Wash., has an idea to prevent handles attached to tool chests, etc., from being broken in transit. They are often broken when thrown off trains. His idea is to place a small wire spring in the handle to keep it closed, thus preventing damage. Our advice is asked.

A. Spring handles are not new, and there have been a great many styles on the market. Any first class hardware store carries such handles.

Stereoscopic X-Ray.

(271) Robert J. McGill, Washington, D. C., submits a plan of X-ray work for quickly locating a foreign object in a human body by throwing two shadow images upon fluoroscopic screens which are at right angles to each other and at a stereoscopic angle to each other, so that the observer, (see illustration) can get an idea of the depth of the object as well as the location laterally. By using a stereoscope, the observer may combine the two views so as to give the appearance of solidity to the resulting image in the "mind's eye." This principle may be used for observation and diagnosis of cases other than those where foreign bodies are lodged in the patient's body. Our advice is asked.

A. This seems to be a particularly clever idea, and altho stereoscopic X-ray pictures have been taken before, we do not think that we have come across a scheme whereby the object can be seen stereoscopically direct by means of a fluoroscope. Heretofore pictures were taken on regular photographic plates, and these pictures were then in turn viewed by means of a stereoscope. We think this idea is patentable but as a precautionary measure, we would ask our correspondent to get in touch with a patent attorney to have him make a search.



Stereoscopic X-Ray Scheme Involving the Use of Two X-Ray Bulbs.

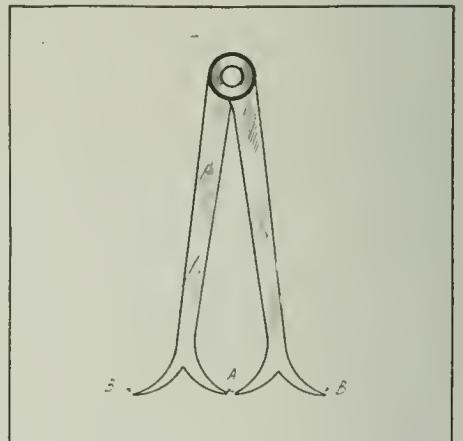
Sub-Aquatic Wireless.

(272) H. K. Skinner, Oxford, Ohio, wishes to know if he could get a patent on underground wireless by applying same to a submarine. Our advice is asked.

A. The sketch which our correspondent submits outlines the idea, but he evidently forgets that salt water being a fairly good conductor, prevents wireless waves from being propagated under water for any appreciable distance. For this reason the idea can hardly be called practical.

Double Caliper.

(273) Lawrence Byrne, La Salle, Ill., submits a double caliper as shown by attached diagram. As



A Calliper Which Measures Inside or Outside Diameters.

will be noted points A A are used for calipering the outside, and points B B are used for measuring the inside of the work. Our advice is asked.

A. This is a particularly clever idea, and we are quite certain that a patent can be obtained upon it. We do not think a caliper of this sort exists at the present time. We advise our correspondent to get in touch with a patent attorney.

Miscellaneous Patent Questions.

(274) M. A. Levins, Pueblo, Colo., submits several ideas. We answer them as follows:

1. The use of selenium in connection with measuring the candle power of various light courses is not new, having been often described in text books.
2. The idea of having a speech record on a moving picture film, so as to make so-called speaking pictures is not new. This idea was described a long while back by us and is the so-called Hartmann process. It is patented.
3. The use of selenium as resistance in connection with moving pictures is not practical as outlined by our correspondent.

Aerial Torpedo.

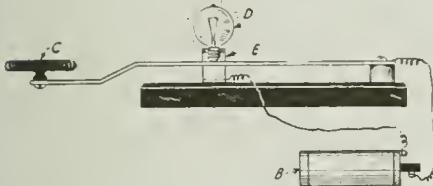
(275) H. Reinhart, Edmonton, Alta., Can., has invented an aerial torpedo propelled by the escaping gases, on the principle of the sky-rocket, with a small explosive charge in the war head. The torpedo is supposed to be used from aeroplanes

only, and weighs a few pounds, but is destructive enough to damage an enemy plane or dirigible balloon. The torpedo could be started from a sort of small cannon which would ignite the powder and propel it until it was traveling under its own power. Tho the distance it would travel would not be far and a steep angle for firing would be necessary, it probably would have a destructive effect.

A. An idea of this kind, while it is good and while it might work in practise has the great drawback that, like all other devices to combat aeroplanes, it will be ineffective, for the reason that aeroplanes travel too fast, and even if it were possible to make the flying torpedo self-propelling and self-steering, how could it overtake an aeroplane manned with a thinking pilot who changes his course at will. A mechanical device, of course, could do nothing of the sort, as you could not make it follow an aeroplane. Mechanisms of this kind, while interesting, are not very practical, even if, they should be controlled by wireless.

CODE PRACTISE INSTRUMENT

(276) A. E. Kopp, New Middletown, Ind., sends in a drawing and description of a code prac-



Code Practising Key In Which Lamp Flashes Signals.

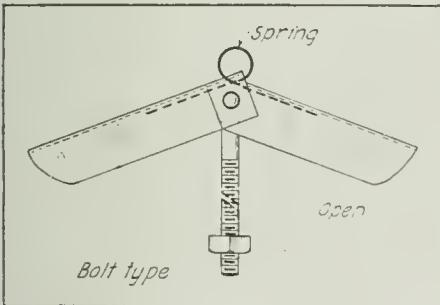
tise set, and the illustration which we reproduce herewith is practically self-explanatory. As will be noted the bulb D is mounted on the cross piece, while the key C makes contact with the bottom of the bulb thru battery B. It will, therefore, flash every time the current is "made."

A. This is a very clever idea, but there is one thing we do not like about it, and that is the current is broken on the downward stroke. As a rule such outfits are not liked very much, and if our correspondent can devise an instrument where the current is made on the downward stroke, we believe he would have a much better apparatus. However, even in the illustrated state we believe a patent can be obtained.

Expansion Toggle.

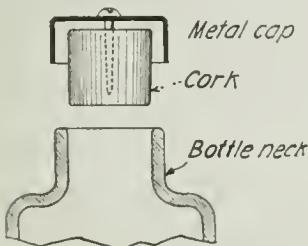
(277) D. W. Booth, Montreal, Que., Can., submits an idea on an expansion toggle which we illustrate. Our advice is asked as to patentability and practicability.

A. This seems to be a good idea which seems patentable, altho we would not vouch for it without making a search in the patent office. Off hand it seems that a toggle of this kind would be more expensive to manufacture than the old style.



Novel Form of Expansion Toggle Proposed By Inventor.

(278) Paul B. Kingsley, Cheyenne Wells, Colo., submits the following: "Just recently I purchased a bottle of Le Pages' glue. After removing the metal screw cap I found a cork. I was immediately confronted with the problem: How shall I remove the cork without a corkscrew? I finally succeeded in prying the cork out with a knife, and sat down and thought. An idea came to me. I secured a screw of the rounded-headed variety, and



Improved Cork and Cap Idea for Glue Bottles.

Patent Office and Working Drawings
Mechanical, Electrical, Automatic and Special Machinery Designed and Built
References Furnished
American Drafting Bureau
327 S. La Salle St. Chicago, Ill.

PATENTS
Promptness Assured
HIGHEST REFERENCES BEST RESULTS
WATSON E. COLEMAN
Patent Lawyer
624 F Street, N. W. Washington, D. C.

PATENTS
LACEY & LACEY

Attorneys-at-Law—Patent Practice Exclusively
Solicitors of
U. S. and Foreign Patents
Trade-Marks, Copyrights
642 F Street, N. W., Washington, D. C.
Write Us for Our Inventors' Book
PATENT-SENSE
ESTABLISHED 1869



E. M. TALBERT

Invent Something

YOUR IDEAS MAY BRING WEALTH IF PATENTED

Now is the time to patent a meritorious invention. We are constantly receiving letters from manufacturers and investors interested in new inventions protected by patents secured through us and which can be turned into money through proper handling.

Labor shortage has increased the demand for inventions in all lines. Uncle Sam Wants New Inventions to Help Win the War.

Write us today for free copy of our 104 page book, "How to Obtain a Patent and What to Invent." At the same time send us a sketch, model or photograph with written description of your invention for our Free Opinion and Evidence of Conception Certificate. If your invention is proper subject matter for a patent we will send you our Certificate to that effect

PATENTS

and our Evidence of Conception and Disclosure Certificate which may prove of value and assistance to you. Our Credit System will enable you to file your application and proceed without delay. Patents secured by us are advertised at our expense in Popular Mechanics Magazine. To protect yourself write for our free book and submit your invention to us today.

TALBERT & TALBERT, 4287 Talbert Building, Wash., D. C.
Patent Lawyers—Successors to Talbert & Parker



PATENTS WANTED

TRADE-MARKS and COPYRIGHTS

Largest Patent Firm in the World



Victor J. Evans.

Before sending your invention to any attorney or manufacturer or disclosing your invention, write for our free blank form **PROOF OF CONCEPTION** in order to protect your invention and secure your rights. This should be signed and witnessed and returned to us, together with a model or sketch and description of your invention, and we will give a **FREE OPINION** as to the patentability of the invention. If we report the invention patentable we will furnish a Certificate of Patentability.

SPECIAL OFFER

This Certificate of Patentability, together with our blank form Proof of Conception will protect the inventor and serve as proof of the invention until the case can be filed in the U. S. Patent Office.

OBTAINING ASSISTANCE FOR INVENTORS—Our certificate is of great assistance to inventors who require financial aid to obtain patents

OUR FIVE BOOKS MAILED FREE

(See Coupon Below)

to any address. Send for these books—the finest publications ever issued for free distribution.

HOW TO OBTAIN A PATENT

Our illustrated eighty-page Guide Book is a Book of reference for inventors and contains 100 mechanical movements, illustrated and described. Tells how to invent for profit.

WHAT TO INVENT

Contains a valuable list of inventions wanted and suggestions concerning profitable fields of invention; also information regarding prizes offered for inventions amounting to **ONE MILLION DOLLARS**

LIST OF PATENT BUYERS

Contains requests from manufacturers, mail order houses and promoters for patents secured by us and suggestions as to New Ideas they wish to purchase. We place our clients in touch with capital free of charge. We have recently received over 300 requests from manufacturers.

MILLIONS IN TRADE-MARKS

Shows the value of Trade-Marks and information regarding unfair competition

We advertise Our Clients' Inventions Free in a list of Sunday newspapers, in manufacturers' journals and in World's Progress. Sample Copy Free. We save you time and money in securing patents. After the patent is granted we assist you to sell your patent.

WANTED NEW IDEAS

FREE COUPON!

VICTOR J. EVANS & CO.
PATENT ATTORNEYS

New York Office: 1001 to 1007 Woolworth Bldg. Pittsburgh Office: 514 Empire Bldg. Philadelphia Office: 1429 Chestnut St.
Main Offices: 779 Ninth Street, N.W., Washington, D. C.

Name.....Address.....

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

AMERICA NEEDS YOUR IDEAS

MILLIONS OF DOLLARS

are being spent NOW for new ideas of all kinds. Never before has the demand for good things PROTECTED BY OWEN PATENTS been so great—or profitable to the man who will but use his brains. Send for my four free books and find out what inventions are needed.

THESE ARE FREE! SUCCESSFUL PATENTS—
 STEPPING STONES—hundreds of hints of ideas wanted, truth about prizes for inventions;
 PATENT BUYERS—contains over 400 requests for OWEN PATENTS, with ideas desired;
 PATENT PROMOTION—tells how to sell your patent, etc.

I'll help without charge to sell your ideas by advertising it and otherwise putting you in touch with prospective buyers. Send sketch or model for free opinion as to patentability, cost of patent, etc. Advice costs nothing. Write today for my books. A postal request will do.

RICHARD B. OWEN, Patent Lawyer
 164 Owen Building 2275-B Woodworth Bldg.
 Washington, D. C. New York City

after punching a hole thru the metal cap I thrust it thru and turned it into the cork. Then I could remove the cork easily with the metal cap, and replace the two with one operation. See illustration. Why not make corks along similar lines, to be used on such bottles with a labor saving view? Various modifications of this idea may be made from a manufacturing standpoint. Particularly to keep the screw (or swivel pin) from pulling out of the cork. Would like your opinion on the subject."

A. While the idea is clever and no doubt patentable, we are of the opinion that glue bottles—once opened—need no cork. When in use they are at best a nuisance because they stick to the bottle, and for that reason the metal cap as a rule is used, which presenting little surface does not stick as strongly as the large surface cork would. Our opinion is that from a practical standpoint, an invention of this kind would not be very satisfactory.

THE DUNWOODY INSTITUTE.

The William Hood Dunwoody Industrial Institute, a school with an endowment of five and one-half million dollars "for training in industrial and mechanical arts," is now training a large number of men under contract with the Government for both Army and Navy. One of the interesting departments in connection with this training is the Radio Department, in which at the present time there are under training over 200 Navy Radio students and fifty Army Radio students.

The men enlisted in the Navy or inducted into the Army or Navy are sent to the Institute for an eight to ten weeks' course of instruction in both operating and theory. The Institute is now considering a material increase in the quota of Radio students under training for the Government and needs additional instructors both for class theory and laboratory as well as operating. Any men having proper qualifications, if interested, should write to The Dunwoody Institute, Minneapolis, Minn., for further particulars.

HOW CAN WE TELL "REAL" DEATH?

(Continued from page 498)

Muscle Signs: In death the muscles show an ACID in lieu of an ALKALINE reaction during life. Needles thrust into living muscles become oxidized. A living muscle responds by contraction when a faradic current is applied to it. The response diminishes after death and is lost in 3 hours. If 20 minutes have elapsed after presumable death and the muscular contractility is unaltered—the subject is NOT dead. By this method (electro-bioscopy) a woman who lay for 32 hours deprived of apparent vitality was saved from burial.

Icards' Fluorescein Sign: This is probably one of the BEST signs of death. It is simple, reliable and the drug is innocuous. A solution of 15 grains of fluorescein, 15 grains of carbonate of soda and 120 grains of water is injected under the skin. As long as the circulation has not ceased, the injected fluid spreads rapidly, and in this case the body acquires a greenish-yellow coloration within 2 or 3 minutes. The eyes simultaneously become emerald green. With a slow circulation the phenomenon may be delayed 20 minutes. NO COLORATION shows that life is extinct.

5. Eyeball Test: In death the patient's eyes are invariably open, but they may appear to be closed for the reason that the upper and lower lids both droop, the upper lid drooping about half way over the eyeball and covering the pupil; the sinking of the lower lid causing the white of the eye to be noticed, and hence it is generally thought that the eyeballs are pointed upward, but they invariably point straight ahead. The eyes are closed by skillful manipulation on the part of the undertaker. In real death the eyeballs lose their extreme tenseness which invariably occurs in cases of syncope or suspended animation. A flashlight thrown in the eye causes no reaction, this test being known as the *light test*.

The corneal test is made by scratching the cornea of the eyeball with the finger nail—in real death no movement of the eyeball or reflex should occur. With regard to the face, the mouth invariably drops open when life ceases, and this must be closed by the undertaker, preferably before the body has become cold and the muscles set.

6. Rigidity of Body: The rigidity of the limbs and the rest of the body does not always indicate real death, for it has been found that this condition can also occur in cases of syncope or suspended animation; hypnotic subjects can also simulate a cataleptic or rigid state.

NEW AND PROPOSED TESTS FOR CESSATION OF LIFE

1. The Litmus Paper Test: As is well known, litmus paper is used to determine whether a solution or secretion is alkaline or acid, the paper changing color accordingly. In applying this test for the purpose in question, a small piece of paper is employed, one end of which is placed

NEW BOOK ON ROPE SPLICING

Useful Knots, Hitches, Splices, etc. How Different Knots Are Made and What They Are Used For INDISPENSABLE TO EVERY MECHANIC AND RICGER

PRICE 20c. A most practical handbook giving complete and simple directions for making all the most useful knots, hitches, rig-



ging, splices, etc. Over 100 illustrations. All about wire rope attachments, lashing, blocks, tackles, etc. 37 Heraldic Knots Illustrated. Of great value to mechanics, riggers, campers, boatmen. Price 20 cents postpaid. Johnson Smith & Co., Dept. 833, 84 W. Lake St., Chicago

"The Baby" Double Action Revolver

A Handmade and Most Effective Weapon, Measures But 4 1/2 inches Long. Takes Regular .22 Calibre Cartridges \$4.50

The new Baby Double Action Hammerless Revolver has been designed to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of Efficiency and Practicality. It is just as effective and serviceable as the larger size revolver you can buy. Everyone should have a "Baby" in his pocket. How to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard .22-calibre cartridge obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable. It will shoot a bullet in less than a second. The revolver is very well constructed, with first nickel plated fluted barrel of cylinder, and it weighs only 1 1/2 pounds. The price of the "Baby" revolver is only \$4.50, postpaid. Write for literature containing sufficient to cost, send for literature. Price 25c. Large sizes \$10 and \$12 postpaid. Johnson Smith & Co., Dept. 833, 84 W. Lake St., Chicago



LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night

The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of an article, emits rays of white light, rendering it perfectly visible in the dark. THE DARK IS THE NIGHT, THE MORE YOU SHINE, THE MORE YOU SHINE. Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the peak stations or switch plates of your electric lights, match boxes, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. Bottle containing sufficient to coat several articles. Price 25c. Large sizes \$10 and \$12 postpaid. Johnson Smith & Co., Dept. 833, 84 W. Lake St., Chicago

Build Your Own PHONOGRAPH,

It's Easy With Our Help

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motor, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

Write Today for Our Free Blue Print Offer. Agents wanted for our ready built Choralcons.

CHORALEON CO.
 711 Meager Bldg., Elkhart, Ind.



"Electrical Worker's Friend"

An electrical book of 66 motor drawings with complete instructions for re-winding and reconnecting.

PRICE, ONLY \$3.50

Write for full particulars

J. SMITH & SON
 1524 Lowrie Street, N. S. Pittsburgh, Pa.

NEW SCIENTIFIC WONDER "X-RAY" CURIO

PRICE 21c. SILVER ONLY. BIG FUN BOYS

You apparently see thru Clothes, Wood, Stone, any object. See Bones in Flesh. A Magic Trick Novelty given FREE with each X-Ray MARVEL MFG. CO., Dept. 52, New Haven, Conn.

ZIP-ZIP (THE LITTLE GIANT)

The prong is made of beautiful metal, the rubbers are elastic and lasting with plenty of pep and force; scientifically made and best workmanship. Zip-Zip complete only 50c, prepaid. Shipped same day ordered right from factory. Thousands sold and orders pouring in every day. Order from us or your Sporting Goods Store.

AUTOMATIC RUBBER CO.
 Columbia, S. C.

WHY "FLUNK"?

To Latin students! "CAESAR"—FIRST 8 BOOKS—"CICERO," OR "VIRGIL"—and others, translated, word for word into ENGLISH. Complete, clothbound, \$1.00 each, postpaid. MONONGAHELA NOVELTY CO., BOX 299, MONONGAHELA, PA

EVERY INVENTOR

should have this book, "PATENTS AND PATENT POSSIBILITIES." It is chock full of ideas and practical advice, telling what to invent and where to sell. Write for your copy today. IT IS FREE. I have requests for patents upon sound inventions of all kinds. Can you help supply the demand?

My service is individual, prompt and efficient. 14 years experience. Every expedient is employed to secure patents at least possible cost.

H. S. HILL, 804 McLachle Bldg., Washington, D. C.

BARBAIN

\$3 Cash with order buys this BENCH LATHE

Swing 8 in. Slip. C. to C. Shipping Wt. 10 Lbs. Peter Austin 930 W. First E.E. Muncie, Ind

THE MIDGET SLIDE RULE

will add, subtract, multiply, divide; solve problems involving even and uneven roots and powers. Also gives the logarithms of numbers and the Sines and Cosines, Tangents and Cotangents of all angles. Its operation is very simple; quickly solves any mathematical problem. Durable made of metal. Adapted for shop and office use. Fits the pocket. 3 1/2 inches diameter. Price with instructions \$1.00

Your money back if you are not satisfied

Gilson Slide Rule Co., Niles Mich.

SMALL ENGINES

Perfected Gasoline Engines—
 1/2, 1 and 1 1/2 h. p.—for Farm and Shop use. Price \$10.50 and up. Also WASHING MACHINES

We ship on trial. Send for Booklet and Special Offer.

STIEVERKROPP ENGINE CO.
 1401—18th St., Racine, Wis.

STARTER FOR FORD CARS

ART BIG PROFITS

Learn NOW

at home in spare time by our new instruction method. Commercial Art, Cartooning, Illustrating, Designing. Delightful, fascinating work in big demand. \$50 paid for one drawing. Handsome free booklet explains everything. Write for it now. Get our special Free Outline Offer at once.

Washington School of Art, Inc.
 1379 H St. N. W., Wash., D. C.

MOTORCYCLES

and BICYCLES at cut prices. Singles and twins \$25 to \$100. New Motorcycle Tires \$3. Automobile Tires \$3. Best Motorcycle Belts \$5. Carburetors \$6. Spark coils \$8. Second-hand Bicycles \$5. Tandems \$16. New Bicycles at Factory Prices.

Deninger, The Price Cutter, Rochester, New York



LEARN MUSIC WITHOUT A TEACHER

New way. Any instrument you like now made easy. Piano, Organ, Violin, Banjo, Mandolin, Cornet, Harp, Cello, Ukulele, Saxophone, Piccolo, Clarinet, Flute, Trombone, Guitar, or Singing, all by note. Don't even need to know one note from another to begin. Lessons by mail in simplified chart and picture form take you step by step, and make every step as simple and clear as A B C. Prepared by foremost musicians. Over 225,000 people, from seven years old to seventy, have learned through these simple lessons. Many have become teachers. This new method succeeds even after old methods of personal instruction fail. Entire course on trial—you to be the judge and jury; averages only a few cents a week if satisfied and nothing whatever if not.

Free book shows how simple and easy it is and gives full information. Special introductory offer if you answer at once. Write today, then judge for yourself. No obligation. Address

U. S. SCHOOL OF MUSIC
13311 Brunswick Bldg. New York



Hear Ye!

what Mr. Robinson of Planhamson Telephone Co., Plantersville, Tex., says about the

SKINDERVIKEN Transmitter Button

Plantersville, Tex., Sept. 6, 1918.
Skinderviken Telo. Equipment Co.,
Rec'd the Transmitter Button and it's fine Biz. Send me three (3) more quick.

It makes an old phone talk better than a new one. I don't see how the little button beats a transmitter, but it sure does.

R. J. ROBINSON, Jr.

Above recommendation letter received today, Sept. 9th. Recommendation letters, new and repeat orders are pouring in every day.

Over 500 Telephone Companies in the United States and abroad are now using the Skinderviken Transmitter Button.

Booklet No. 3 free for the asking

Skinderviken Telephone Equipment Co.

For your convenience in writing us, address

STECO, 2134 Clark St.

Chicago, Ill.

DUCK'S

BIG 300 pp. ELECTRICAL and WIRELESS CATALOG

Mailed upon receipt of 8c in stamps or coin which may be deducted on first dollar purchase. Catalog contains 160 pages of wireless instruments and 140 pages of electrical supplies. No bigger or better values are obtainable elsewhere. We have a complete stock of everything listed in this catalog. Wireless orders promptly filled.

BLINKER SETS with key, bulb and socket, \$2.50 mounted on mahogany base

THE WILLIAM B. DUCK CO.

230-232 Superior St. Toledo, Ohio

Learn Watchwork, Jewelrywork and Engraving

A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog

on the eyeball or on the under side of the lid, and if it does not change color it may indicate a syncope condition. This is the reason: In life the skin and flesh exudations are alkaline, while when death occurs bodily decomposition and its various chemical reactions set in; therefore these exudations become acid. Hence we obtain the acid reaction on the litmus paper in this test, if the person is really dead. This is one of the best and newest tests available, says Dr. Sinclair Tousey. A similar test is one employing a solution (ether or chloroform), a few drops of which are placed on the eyeball, and the solution, due to the actions just mentioned, will cause the eyeball to turn red and slightly swell, if life still exists in the body, even tho all other tests indicate differently. If no coloration or enlargement of the eyeball occurs, then death can be considered to have taken place, says Dr. Albert Abrams.

2. The Electro-cardiograph Test (proposed by the writer): From the fact that the very minute electric currents produced by the pulsations of the human heart, as explained in an article on the Electro-cardiograph which appeared in the May, 1917, issue of this Journal, it would seem that by applying the extremely sensitive Einthoven string galvanometer or an equally sensitive instrument to the body, then the slightest action of the heart would produce a measurable electric current, which would register on the photographic recorder of the apparatus. It would also seem possible for every physician to be equipt with a special portable instrument of this type for the purpose in question.

3. X-Ray Test (proposed by Mr. H. Gernsback): Suggested on the strength of the fact that with the improved high-power X-ray apparatus available today various diseased conditions of the lungs can be established with the aid of the X-ray photograph, including tuberculosis of the lungs, which, owing to the absence of air in the diseased lung, photographs black in the skiagraph.

4. Abrams' Test: This is based on the fact that a beating heart has a specific radio-activity and yields a characteristic reflex. As long as the heart beats, this reflex can be elicited. A detailed description of this reflex is too technical for the average layman.

5. Weighing the "Soul": This is probably a rather far-fetched and mythical proposition, but according to reports current some time ago, it was claimed that tests were made with a specially sensitive bed-scale, on which a patient was placed and later died. The physicians claim that after making every conceivable and known allowance for bodily decomposition, both organic and gaseous, there was still a discrepancy of about four and one-half ounces which the medical savants could in no way account for, and they attributed it to the soul departing from the body.

(We print this statement for what it is worth.—Editor.)

Conclusion: "The danger of premature burial has no doubt been exaggerated, but the diagnosis of death by a competent physician should be made obligatory by law," says Dr. Albert Abrams, the well-known medical authority. "A period that must elapse before burial should be fixed by law. In France, it is 24 hours; in Germany, 48 hours, and in England, it is customary to await putrefaction, thus emulating the traditions of Greece and Rome, where 6 to 11 days were allowed between death and the funeral."

WESTINGHOUSE ENGINEERS GET NEW RESEARCH LABORATORY.

(Continued from page 459)

materials laboratory, the ceramic laboratory and the research laboratory. The latter is housed in what is commonly known as the "new research building." The growing demands for more fundamental work made it desirable to provide a special building where advanced and new research problems could be better separated from the more insistent works problems. A location about a mile distant from the works was selected, partly on account of the crowded condition in the vicinity of the works, but more especially to secure a site relatively free from vibration, dirt and noise and which would afford a certain amount of isolation.

The power house contains motor-generator sets for supplying single-phase, two-phase and three-phase current at 220 volts, and direct current at 250 volts (three-wire circuit). A motor-driven air compressor supplies compress air at 125 lb. pressure, and a large motor-driven vacuum pump supplies the necessary house vacuum. A liquid air machine capable of supplying 1½ to 2 liters of liquid air per hour is also installed in the main power house. The storage battery is in a separate room in the basement of the power house and consists of a total of 218 cells, so divided that various groupings and combinations may be obtained.



Everything About FLYING

Everything about flying can be found in Hayward's new book just published on **Practical Aviation**. The latest book on the market. Covers the theory and practice of aviation—the design and construction of aeroplanes—the aerial propeller— aeronautical motors, and military uses of the aeroplane. 700 pages, 8¼ x 5¾, flexibly bound, gold stamped.

Pilots, Observers and Mechanics are badly needed in the aviation section of the army. To the man who wants to take up the fascinating work of flying, **Practical Aviation** will prove of untold value. This book has been ordered by the war department for use in military and naval camp libraries.

What the Book Covers—

Dirigible Balloons—Simple Balloons—Elements of the Dirigible—French, British and German Dirigibles, etc. Early Days of Aviation—U. S. Government Requirements—Elementary Aerodynamics—Internal Work of the Wind—Features of Design—Aerial Propeller—Factors in Propeller Action—Calculating Stresses—Laying Out Propeller—Propeller Construction, etc. Stability—Design and Construction of Aeroplanes—Methods of Design—Assembly of Aeroplane—Testing—Standard Types of Aeroplanes—Special Types, Both American and Foreign—Hydroaeroplanes—Explosion Motors—General Specifications—American Types—Foreign Types—Military Uses of Aeroplanes—Functions—American, French, British, Italian and German Machines—Scouting Service—Aerial Photography—Photo Scouting—Reconnaissance—Wireless—Artillery Observation—Bombing Expeditions, etc. Building Aeroplane Models—Building a Glider—Building a Curtiss—Building a Bleriot, etc.

Shipped Postpaid for Seven Days' Examination

Just send us a money order or check for \$3.75 attached to the coupon below, and a copy of **Practical Aviation** will come to you, prepaid. Examine it carefully—read it—use it for seven full days. If at the end of that time you feel the book is not suited to your needs, send it back to us and we will refund your money.

This offer is open to every man within the boundaries of the United States and Canada. Fill in and mail the coupon now and secure a copy of the very latest and most up-to-date book on the important subject of aviation.



AMERICAN TECHNICAL SOCIETY, Dept. EE 11-18, Chicago, U. S. A.

Please send me, postage prepaid, for seven days' examination, a copy of **Practical Aviation**. Enclosed find \$3.75 which is to be returned to me if I return the book to you after seven days.

Name.....
Address.....

Learn Aviation Mechanics

*"Supremacy
in the air
the Key to
Victory!"*

Train yourself for the Aviation Service by availing yourself of the Preparatory Ground Course in Aviation Mechanics, affording preparation prior to entering Government Ground School, covering aero-dynamics, aero-engines, rigging and Lewis gunnery. Previous experience unnecessary.

COMPLETE COURSE including aero engine course, taken in six weeks (three hours daily) or three weeks (six hours daily)..... **\$60**

Special Aero-Engine Course (three weeks) **\$35**

Wireless Course (four weeks) **\$25**

Day and Night Classes Begin Every Monday
Write for our Illustrated Booklet "H"—"A Message to You on Aviation"

(Members of Aeronautical Society of America)



Telephone Brysnt 9078
110-114 West 42d STREET, NEW YORK

MAGNETIC RECTIFIER

Patented April 18, 1916

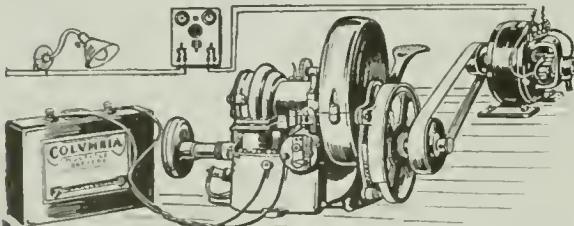


The F.F. Battery Booster

For Home Charging of Storage Batteries

Call up your dealer and ask the price of a new starting and lighting battery to fit your car. Then let us tell you how to prolong indefinitely the life of your old battery at minimum expense. Fire Departments the country over require positive battery service. They are our best customers. Write for bulletin No. 12

The France Manufacturing Company
Cleveland, Ohio.



THE "LITTLE PET"

is unquestionably the engine you have always wanted. Ideal to run small electric power plants, for charging storage batteries, electro-plating for the laboratory, for the workshop, drive bench lathe, grinder, saw, washing machine, etc.

Operated on either gasoline or City gas

Coil built into engine, countershaft and all gears safely housed. Ready to run when you unpack it, only battery to be connected. Any speed from 500 to 1400 R.P.M. can be had instantly, while engine is running. Step on foot pedal to start engine. Automatic oiling, no grease cups, an ideal home motor safe and dependable, will last for years. Cost to run 1½ cents per hour. Engine has 2" bore and 2" stroke. Gives over ½ H.P. Weight 60 lbs.

Price complete \$40.00 | Send for free catalog E. ELGIN GAS MOTOR CO., Elgin, Ill.

The House of Taylor



HOTEL MARTINIQUE

BROADWAY, 33D STREET, NEW YORK
One Block from Pennsylvania Station.

Equally Convenient for Amusements, Shopping or Business

157 Pleasant Rooms, with Private Bath, \$2.50 PER DAY.

257 Excellent Rooms, with Private Bath, facing street, southern exposure, \$3.00 PER DAY.

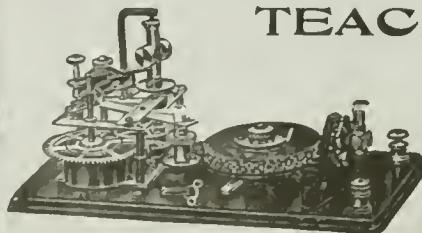
Also Attractive Rooms from \$1.50.
The Restaurant Prices Are Most Moderate.

400 Baths
600 Rooms

"THERE'S MONEY IN IT"

AT HOME LEARN TELEGRAPHY AT HOME MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter, THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
39L Cortlandt St. New York

A GYRO ELECTRIC "MOVIE" CAMERA FOR THE BATTLEFIELD.

(Continued from page 460.)

projector would be hopelessly out of place amongst the efficiency of the war camps, not from any detrimental standpoint as to the quality of the projector, but that where everything must be as compact as possible it became necessary to evolve one that would occupy but little space, be easy to operate and still fill the bill in all particulars.

Apparently all these requirements have been fulfilled in a new portable projector evolved by a Chicago concern. It will project a 12-foot picture at any distance from 50 feet to 80 feet, according to the focal length of lens.

A 4-inch lens, which is the standard equipment on all projectors, will give any size picture up to 12 feet in diameter, and throw up to 50 feet. Proportionately smaller size pictures at throws less than 50 feet.

A 6-inch lens will give any size picture up to 12 feet at any throw up to 80 feet. Proportionately smaller size pictures at throws less than 80 feet. This does not prevent the use of the projector in a small room where there is but a 6 or 8-foot throw for a 2 to 4-foot picture can be obtained, according to whether a 6-inch or 4-inch lens is used.

A WATER-JET BLAST APPARATUS.

(Continued from page 476)

the water outlet, it should be stopt by tightening the water outlet pinch-cock. By regulating both pinch cocks a place is reached where the water remains at a constant level, all air going out to the air delivery tube, and all water going out the water outlet tube.

An apparatus such as just described was made by the writer and has been in constant use in his laboratory. It supplies sufficient air for two blast lamps, and will give at least five pounds of air pressure for injection purposes, etc. If more air is needed then three injectors may be used, or if not as much is required, only one injector is necessary.

If a combination blast and vacuum apparatus is wanted then one, or both of the injectors may be made into a water-jet vacuum pump by the addition of a "T" fused on to the air inlet hole. If both are thus equipt, a blast and suction cannot be obtained at the same time unless one air-opening is left free. One injector may be left open for the air supply and the other used for suction. But in doing this the supply of air is cut in half. Usually therefore it is better to leave both air inlets open and make a vacuum pump separately, then both may be used at the same time without loss of air.

In this way, and with a minimum of expense, and with a very little knowledge of glass blowing, an efficient suction and air-blast apparatus run by water pressure may be constructed so that they will be in every way as satisfactory as the factory-made product.

ELECTRICITY AIDS HUN "MOVIE" SPIES.

(Continued from page 455)

The final episode of this series is brought to a dramatic climax by showing the final efforts of the Kaiser's spies to wreak their hatred on America up to the very moment war was declared.

Harrison Grant and Dixie Mason know that Ambassador von Bernstorff will not leave the country without making a supreme effort to cause damage to American resources. Ceaseless vigilance directs their

attention to one of the greatest railroads in the country, and they discover that two German spies employed as dispatchers have planned to wreck the whole system by mixing the train dispatch orders. (See Fig. 3.)

The episode abounds with dramatic and patriotic thrills. Mrs. Blank Blank has the satisfaction of telling von Bernstorff what a dupe he has been in her hands, and how he has betrayed to the Secret Service, thru her, many of the plots of the Imperial German Government.

Heinric von Lertz at last meets justice. He is locked in the hold of a vessel by accident, in which he has opened the sea-cocks to sink it for the purpose of keeping it from falling into the hands of the Americans. He is drowned like a "rat in a trap" as the crime of his own doing is accomplished.

TALKING THRU LAND AND WATER.

AContinued from page 450)

in Fig. 1. As the operator speaks, changes in the microphone resistance will occur, corresponding to the fluctuations of the voice, and these resistance variations will cause differing strengths of battery current to reach the electro-magnetic oscillator, which in turn will radiate powerful sonorous vibrations or sound waves corresponding to the spoken voice. These telephonic sound waves transmitted thru the earth or water, are picked up by a microphone (or by an oscillator) and caused to affect the telephone receiver in the same way as the telegraphic dot-and-dash signals do. Telegraphic signals have been transmitted to a distance of twenty miles by this method, and telephonic speech has been transmitted and received over distances exceeding twelve miles.

One of the most interesting phases of this recently patented invention (U. S. Patent 1,270,398) is that by means of a compound microphone arrangement (mounted in one of these liquid tanks or ground pits so as to be revolved thru any desired angle) it becomes possible to very accurately determine to the fraction of a degree, *from just what direction a sound wave is propagated!* A practical application of this remarkable principle involved in the new Fessenden sound-transmitting and receiving apparatus, is shown in Fig. 3, where, by means of two observation points fitted with the special "sound direction detecting apparatus," it is possible to quickly and accurately locate any activities on the part of enemy "sappers," who may be engaged in digging a mine.

The principal feature of the whole arrangement here outlined, is that the signal-producing or receiving instrument is not in direct contact with the earth, and does not vibrate with the same phase or amplitude as the earth itself at the transmitting or receiving point, thereby avoiding losses from refraction, bending, or irregular travel of the sound waves, and enabling the true direction of the sound to be rapidly ascertained, and permitting amplification by mechanical resonance, et cetera; as will become evident.

Referring to Fig. 3 and the detail illustration at the right showing a close-up view of one of these "sound direction" detectors, we see that a large pail-shaped tank of water is sunk in the ground to start with. *The ground around the pail is preferably wetted* so as to make good physical contact between the pail and the ground. A three-legged metal spider rests at the bottom of the pail, and this is surmounted by a sound-insulating pedestal made of lead. In this sound-insulator is placed a vertical and revolvable metal rod which carries a pivoted cross-arm supporting a sensitive microphone

(Continued on page 507)



In War or Industry

K. I. Shorthand Will Help You On

The New Easy Shorthand You Can Learn in 5 Evenings

Do not imagine that K. I. Shorthand is needed only by the professional stenographer or court reporter.

You, no matter what you are doing, will find it a tremendous help in getting on to a bigger job and bigger pay.

A knowledge of shorthand has proved for many the entering wedge to the main office, to the intimate association of superiors, to preference and promotion.

In our Army and Navy, officers are glad to rely on the young man in the service who is able to take dictation verbatim. It means promotion, easier work, better pay. You need K. I. Shorthand whether you remain on the job in America or go over-seas. When you return it may be the means of opening opportunities for you that you would be unfitted for otherwise.

30 Days' Approval

K. I. Shorthand is immensely different and far ahead of any other system. Experts in the old systems are amazed at its simplicity. **But prove it for yourself!** Get the course and see how you can master it in five evenings.

Numerous professional stenographers who have spent months in learning one of the old systems, write us that they have changed to K. I. Shorthand because it is a more natural method — easier to read and to write.

From a Teacher
"I learned K. I. Shorthand principles in five hours and after not quite two weeks' practice I can write almost as fast as anyone would dictate. It is easier to read than any other system I have seen." — A. Rudolph Allen.

Yes, you can learn it all, thoroughly and well, in that amazingly short space of time. And it costs such a trifle that you need not deny yourself anything in order to possess this helpful accomplishment. Think what a saving in time, money and effort.

Wherever you go, you will find K. I. Shorthand helping men and women along. It is practical and meets all usual requirements. It covers a great range of service. Not only stenographers use it, but business men, merchants, lawyers, doctors, clergymen, newspaper men, soldiers, sailors and U. S. radio men. K. I. Shorthand is taught in business schools, and practiced by court officials; used by reporters. Put it to work in your service. It will give you, too, a lift in your life's progress.

Wouldn't the ability to save time; to record instantly facts, thoughts, ideas and instructions, give you an advantage over others not similarly equipped?

Free Lessons

Mail the coupon to-day, or write, mentioning "Electrical Experimenter." We will send you the first lesson FREE. If interested, the complete course will be dispatched promptly to you on approval for thirty days. That gives you ample time, more time than you really need, to acquire real stenographic proficiency in the K. I. System. If not convinced, you will not be put to any bother or expense.

Learn at Home

K. I. Shorthand is shorthand made shorter, simpler, clearer, easier to learn, wonderfully easy to read and never forgettable. You learn so quickly because it omits all the intricate, perplexing and brain-fagging special rules, positions, shadings, etc., that make other systems a nightmare for the student.

What Others Say

A Soldier from "Over There"
"You are right. The principles of K. I. Shorthand can be learned in five hours. For the past three years I have been in France with the Canadian forces and a knowledge of K. I. Shorthand would have proved of great value to me in taking down orders at the front." — H. C. Cannon, Late Sergt. 121st Battalion C. O. F.

In learning K. I. Shorthand you write complete words and sentences from the start. You do not feel that you are studying, as you go pleasantly through the lessons; it is more like a game, full of fascinating interest, that grips you and makes you want to get on to the next lesson and the next.

From a Court Clerk
"K. I. Shorthand is easy to learn and meets all requirements. Have been using it in court already." — Clark L. Bouton.

Mail the Coupon

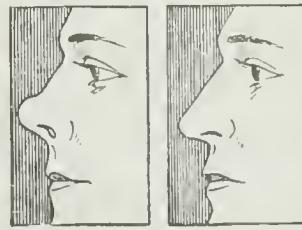
Please send me the first lesson in K. I. Shorthand, FREE.

KING INSTITUTE INC.

154 E. 32nd Street New York, N. Y. 8 So. Wabash Avenue Chicago, Ill.

Name Address EF-300

YOU HAVE A BEAUTIFUL FACE BUT YOUR NOSE?



IN THIS DAY AND AGE attention to your appearance is an absolute necessity if you expect to make the most out of life. Not only should you wish to appear as attractive as possible, for your own self-satisfaction, which is alone well worth your efforts, but you will find the world in general judging you greatly, if not wholly, by your "looks," therefore it pays to "look your best" at all times.

Permit no one to see you looking otherwise; it will injure your welfare! Upon the impression you constantly make rests the failure or success of your life. Which is to be your ultimate destiny? My new *Nose-Shaper*, "TRABOS" (Model 24) corrects now ill-shaped noses without operation, quickly, safely and permanently. Is pleasant and does not interfere with one's daily occupation, being worn at night.

Write today for free booklet, which tells you how to correct ill-shaped noses without cost if not satisfactory.

M. TRILETY, Face Specialist

1038 Ackerman Bldg., Binghamton, N. Y.

?

CHEMISTRY!

DO YOU KNOW?

Do you know how to make chemical tricks?
 Do you know how cloth is bleached?
 Do you know how to test soil?
 Do you want to make invisible ink?
 Do you know how to test flour?
 Do you know how Chlorine Smoke and Chlorine Gas (German War Gas), is made?
 What do you know about chemistry in general?

These and hundred other interesting questions are answered and demonstrated with our Chemistry Laboratory which we present herewith.

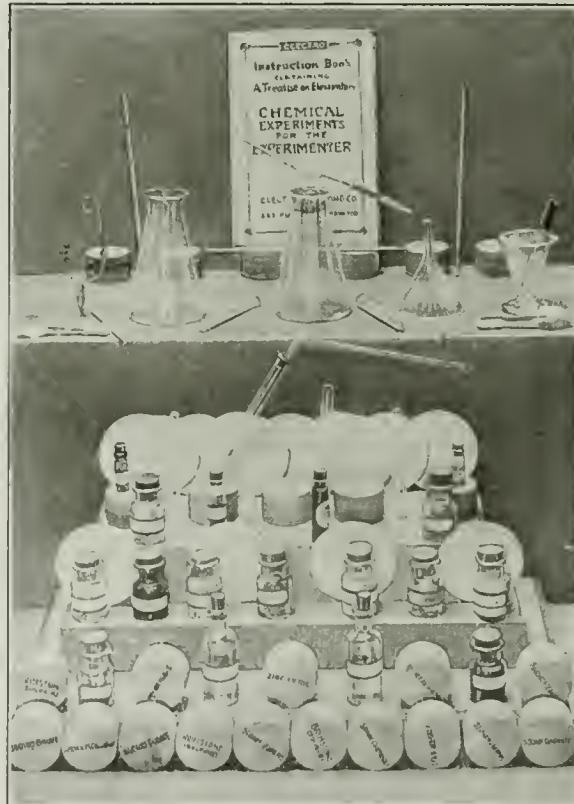
The chemicals furnished are all technically pure and put up in appropriate wooden boxes and glass bottles, and there is a sufficient quantity to make dozens of experiments with each. The apparatus are of standard laboratory size and quality.

Altho all chemicals have nearly doubled in price, we have decided not to raise the price for this outfit for the present.

Read the list of chemicals and apparatus and look at the actual photograph of the outfit at your right.

And order one today!

We present herewith to our friends our new E. I. Co. Chemical Laboratory which contains real chemicals and apparatus to perform real chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparatus and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry**, useful data and recipes, and **100 instructive and amusing experiments.**



44
Chemicals
17
Apparata
1
Instruction
Book with
100 Ex-
periments

PRICE
\$5.00

Shipping
 Weight 10 lbs

CAN BE SHIPPED
 BY EXPRESS ONLY

THE E. I. Co. CHEMICAL LABORATORY

DESCRIPTION OF THE OUTFIT

It contains the following 44 chemicals:

Ammonium Chloride
 Alum
 Antimony
 Boracic Acid
 Charcoal
 Sodium Nitrate
 Sodium Carbonate
 Sodium Borate
 Sodium Sulphite
 Manganese Dioxide
 Oxalic Acid

Brimstone
 Iron Oxide
 Sulphate of Zinc
 Magnesia Carbonate
 Zinc, Metallic
 Sodium Bicarbonate
 Sodium Sulphate
 Sodium Chloride
 Calcium Sulphate
 Barium Chloride
 Lead Acetate

Ferrous Sulphate
 Nickel Sulphate
 Sodium Phosphate
 Zinc Carbonate
 Ammonium Sulphate
 Ammonium Carbonate
 Ammonium Aqua
 Calcium Chloride
 Chloride of Zinc
 Copper Sulphate
 Glycerol

Iron Chloride
 Calcium Oxide
 Stannous Chloride
 Nickel Chloride
 Hydrochloric Acid
 Sulphuric Acid
 Iodine
 Mercury, Metallic
 Tin, Metallic
 Litmus Paper
 Ferrous Sulphide

The following apparatus are furnished:

One Standard Washbottle
 One Conical Glass Measure
 One Erlenmeyer Flask
 One Glass Funnel
 One Delivery Tube

Six Assorted Test-Tubes
 One Test-Tube Holder
 Ten Sheets of Filter Paper
 One Glass Dropper
 One Spoon Measure

Glass Tubing
 One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.

THE ELECTRO IMPORTING Co., NEW YORK, 231 FULTON STREET
 SEE OUR FULL PAGE AD ON PAGE 514 FOR FREE CYCLOPEDIA

TALKING THRU LAND AND WATER.

(Continued from page 505)

at either end. The two microphones face each other and are connected in series-parallel with a battery and a differentially wound telephone receiver. Suitable angle index dials are fitted to the apparatus, which instantly indicate the angle, both vertical and horizontal, at which the instrument happens to rest when a certain measurement is being taken.

Considering that the two differential windings of the telephone receiver are connected so as to oppose each other, any sound waves traveling thru the ground and reaching both microphones exactly at the same instant, will cause a total cessation of sound in the receiver, when the bar carrying the two microphones is exactly at right-angles to the direction from which the sound proceeds. The position in which the microphone bar indicator points toward the enemy's trench will be the one to be attacked, either by counter-mining or by a direct raid on the enemy trenches. This measurement gives the horizontal direction or angle from which the sound is emanating.

To determine the vertical angle or the dip of the direction from which the sound waves emanate, the central vertical rod is rotated thru 90 degrees of the pivoted microphone bar, and is tilted until the sound is minimized again, at which point the angle or dip is indicated on the vertical index dial of the instrument. By taking another observation at a point thirty to forty feet down the trench, the location from which the sound proceeds may be determined in the same manner, and its point of origin will be that point at which the two lines of direction, so determined, meet, and its distance can then be instantly calculated (or computed on a slide rule) by trigonometrical means, with which all military men are thoroly familiar.

POPULAR ASTRONOMY.

(Continued from page 463)

globular cluster is composed of thousands if not hundreds of thousands of individual suns surpassing our own sun in size and brilliancy. They appear to be systems that have reached the height of development in which a comparatively settled and stable condition of affairs has been attained. They resemble the spirals in having exceptionally high velocities of translation thru space, but they are comparatively few in number, about seventy being catalogued up to the present time as against thousands of the spiral nebulae. Now these globular systems show a symmetrical distribution with reference to the plane of the Milky Way which appears to form an equatorial belt that the globular clusters and the spiral nebulae avoid. The width of this equatorial belt wherein lie the vast majority of all the stars, including our own sun, and the great irregular gaseous nebulae is about ten thousand light years, while its diameter appears to be fully three hundred thousand light years. Symmetrically distributed above and below this belt in spheroidal form lie the globular star clusters. The fact that these clusters are distributed symmetrically with reference to this belt seems to be evidence that they are units in one great universe in which the Milky Way occupies the equatorial position. This has a direct bearing on the island universe theory of the spiral nebulae. The spirals as well as the globular star clusters lie at great distances outside the equatorial belt but they show signs, as we said before, of being affected by it since they tend to cluster in greatest profusion in the vicinity of its poles as if avoiding the strong gravi-

tational attractions existing in the equatorial region.

It would appear then that the spiral nebulae are not "island universes" in the sense that they are Galaxies similar to and independent of our own Galaxy, but are rather secondary formations in a universe in which the Milky Way occupies the position of an equatorial belt. The spiral nebulae are possibly conglomerations of stars and nebulae that have at some time broken away from or past thru the equatorial region of dense star clouds and gaseous nebulae and are moving rapidly away from the central plane since the antapex of their radial velocities is the center of the equatorial region.

According to Dr. Shapley of the Mt. Wilson Observatory, who has recently made extended investigations of the globular star clusters, computations based on the radial velocities and distances of these objects from the central plane show that within one hundred and twenty-five million years, if the velocities remain unaccelerated, more than half of the globular clusters will have penetrated this equatorial region occupied by our Galaxy while the Great Cluster in Hercules, one of the nearest, will reach the plane in less than thirty million years. These intervals of time are very short in the history of a sidereal universe and he concludes that the central region has been penetrated by the globular star clusters many times in the past and that the moving star groups that are found within this equatorial region such as the Hyades and the Ursa Major star group may be remnants of clusters that attempted to cross the plane of the Milky Way.

The most acceptable theory advanced up to the present time in explanation of the spiral nebulae therefore assumes that they are not "island universes" that resemble our Galaxy in size and extent but rather subordinate units in one vast universe in which the Milky Way, the majority of all the stars, the planetary nebulae, and the great irregular nebulae from which the stars are formed, occupy the central belt. At great distances beyond this region lie the globular star clusters and the spiral nebulae.

Tho the origin of the spiral nebulae and the cause of their peculiar structure is still unexplained they are generally believed to be enormous conglomerations of stars and nebulosities having a motion of rotation as well as a velocity of translation thru space that is tremendously high.

(Next installment will appear in November issue)

THE HOW AND WHY OF RADIO APPARATUS.

(Continued from page 472)

metal cover on the transmitter, and placing the wireless receiver diafram (with its cap removed, of course) up against the "Detection" transmitter diafram. In fact the two may be glued together so as to have a practically single period of vibration, similar to the method utilized in building telephone relays. After doing this, and taking care not to spill the carbon granules out of the microphone, the receiver and transmitter should be bound together firmly with tape. The same directions hold, of course, for the second receiver and transmitter, stage D. At Fig. 4 there is shown a simple method of supporting the sound-proof wooden boxes, containing units C and D; by suspending them on 1/4 inch rubber bands from an arm. This prevents extraneous vibrations from affecting the ultra-sensitive



Big Money in Electricity

The electrical industries offer wonderful opportunities to boys with a liking for Electricity. The salaries paid to trained men are large, promotion comes rapidly and, best of all, the work is fascinating.

The discovery and development of new lines (such as wireless telegraphy and telephony), from time to time, promise attractive and paying fields to those who wish to specialize. The will to do and Special Training will bring success to you.

The International Correspondence Schools can help you to become an expert in electrical work, no matter what branch you like best. Thousands of young men have already won success through I. C. S. help. You can do as well as anybody, if you try. Everything is made so clear that you can learn in your spare time, regardless of where you live or what your work. No books to buy.

There's big money in Electricity. Get after it by marking and mailing the Coupon today. Finding out costs you nothing.

INTERNATIONAL CORRESPONDENCE SCHOOLS BOX 6163, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ELECTRICAL ENGINEER
- Electric Lighting and Ins.
- Electric Wiring
- Telegraph Engineer
- Telephone Work
- MECHANICAL ENGINEER
- Mechanical Draftsman
- Machine Shop Practice
- Toolmaker
- Gas Engine Operating
- CIVIL ENGINEER
- Surveying and Mapping
- WARE HOUSEMAN or ENGINEER
- STATIONARY ENGINEER
- Marine Engineer
- Ship Draftsman
- ARCHITECT
- Contractor and Builder
- Architectural Draftsman
- Concrete Builder
- Structural Engineer
- PLUMBING AND HEATING
- Sheet Metal Worker
- Textile Operator or Supt.
- CHEMIST
- SALESMANSHIP
- ADVERTISING
- Window Trimmer
- Show Card Writer
- Sign Painter
- Railroad Trainman
- ILLUSTRATING
- Cartooning
- BOOKKEEPER
- Stenographer and Trust
- Cert. Pub. Accountant
- TRAFFIC MANAGER
- RAILWAY ACCOUNTANT
- Commercial Law
- GOOD ENGLISH
- Teacher
- Common School Subjects
- Mathematics
- CIVIL SERVICE
- Railway Mail Clerk
- AUTOMOBILE OPERATING
- Auto Repairing
- Navigation
- AGRICULTURE
- Spanish
- French
- Italian
- Penmanship

Name _____
 Present Occupation _____
 Street and No. _____
 City _____ State _____

Stop Forgetting

Memory the Basis of All Knowledge

The Key To Success

The secret of business and social success is the ability to remember. I can make your mind an infallible classified index from which you can instantly select thoughts, facts, figures, names, faces. Enables you to concentrate, develop self-control, overcome bashfulness, think on your feet, address an audience, Easy, Simple. The result of 20 years' experience developing memories of thousands.

Write Today for free booklet "How to Remember" and Copy-righted Memory Test, also how to obtain my FREE book, "How to Speak in Public."

Prof. Henry Dickson, Principal

Dickson School of Memory, 101 Hearst Bldg., Chicago, Ill.



Mystify Your Friends with Chemical Magic!

Pour ten different colored liquids from the same pitcher of clear water! Make disappearing ink, magic writing paper, and chemical fire. You can do all these and many more weird, puzzling chemical tricks with "CHEMCRAFT." Learn the Science of Chemistry, test foods, water, air and earth; make dyes, ink and soap and perform lots of other useful, fascinating and instructive chemical experiments.

"CHEMCRAFT" is Absolutely Harmless—No Dangerous, Explosive or Poisonous Chemicals. Outfits contain all chemicals and supplies needed to perform each experiment many times. Also Manual of Instruction. Get "CHEMCRAFT" and have real fun.

Chemcraft No. 1—\$1.25
West of Mississippi River and in Canada—\$1.50
Chemcraft No. 2—\$2.50
West of Mississippi River and in Canada—\$3.00
Chemcraft No. 3—\$5.00
West of Mississippi River and in Canada—\$6.00

Be sure you get "CHEMCRAFT," the original and most complete and scientific chemical outfit. Ask for it by name at your Toy Store, or send price and we will deliver direct prepaid. Write for more information.

The Porter Chemical Company
Industrial Bldg., W. Washington St.
Hagerstown Maryland

Do Your Christmas Buying Now!
Waiting will mean inconvenience, delay and perhaps absolute disappointment.



TELEGRAPHY and RADIO FOR MEN IN DRAFT

Send for our latest folder on Land Wire Telegraphy. Day and Evening classes for Men and Women. Prepares for all branches.

Day and Evening classes in Radio for Naval Reserve, Aviation, Tank Service, Signal Corps and Merchant Marine. Beginners admitted every Monday in both branches.



EASTERN RADIO INSTITUTE
899 B Boylston St.
BOSTON, MASS

Every Electrical Man

Should be in possession of a Mansfield's Automatic Electric Water Finding Apparatus to enable him to act as adviser on water supply.

A remunerative business can be rapidly acquired.

Particulars from

EDWIN A. MANSFIELD
Electrical Engineer
New Brighton, England

transmitters. This system has been applied commercially, and an amplification value of 15 times the initial received strength of signal has been obtained.

The "Helmholtz" acoustic resonator has been successfully used to boost the strength of signals as heard in the radio receiver, the glass bell of the resonator being placed close up to the receiver opening as shown in Fig. 5-A. It is particularly suited to use on regenerative valve sets, where a variable capacity is employed to vary the number of beats. The receiver used is preferably a standard 1,000 or 1,500 ohm type. The large opening of the resonator should fit over the opening in the telephone receiver cap. This type of pure acoustic resonator responds only to a certain frequency for each size of bulb; therefore the resonator used should approximate the beat frequency used. Also the variable capacity in the audio circuit should be varied until the beat frequency created permits the Helmholtz resonator to be in resonance with the receiver. On spark signals and a crystal detector a resonator corresponding to the pitch of the incoming signals should be selected in each case.

Fig. 5-B illustrates an adjustable resonance amplifier which has been used with beneficial results, it is said. The resonance tube comprises two tight-fitting brass tubes, one sliding within the other, and the complete tube member joining a microphone and receiver, for example. The resonant frequency to which the tube will respond may be changed by sliding the inner tube in or out. The law of frequency for these tubes can be found in any good text-book on physics. Various sizes of tubes should be tried.

The "comprest air" amplifier. A new and extremely simple form of intensifier for telephonic, telegraphic and phonographic signals or sounds in the *Parsons comprest air valve*, shown in Fig. 6. A radio or telephone receiver, R, is connected by a rod, as seen, to an air piston or other form of valve. Whenever the receiver diaphragm moves, or signals are being received, it actuates or moves the air valve controlling the flow of compressed air to a loud talking diaphragm chamber, L, connected to a suitably large horn. This is only a general description of this most interesting amplifier, and further information can be gained from the phonograph companies using it, also by consulting the records of the Patent Office or back files of the **ELECTRICAL EXPERIMENTER** (October, 1915, issue, page 265).

The "Lowenstein" Electro-magnetic Amplifier. This apparatus as designed by Fritz Lowenstein, of New York, will operate on any receiving detector and is recognized as the most sensitive detecting device for electric current of this particular type ever constructed for commercial use, as it will be deflected by a current of 1 micro-ampere (1 millionth of an ampere).

This super-sensitive relay is illustrated in Fig. 7. The moving element C is wound with a coil of extremely fine wire and carries a contact D which makes connection with a small pool of mercury E, when the armature is deflected. The moving part is supported on two jewel bearings to eliminate friction and the connections to the moving coil consist of two very fine helical copper springs suspended at both ends. Two small discs, F, F, are provided to regulate the swing of the coil, which is mounted between two pole-pieces, BB, that are energized by the massive coils shown at A, A, A, A. The coils are so connected that the two pole-pieces will have different polarities, thus forming a N. and S. pole. The current for these magnets is obtained from a 110 volt direct current supply and is led in thru the wires G.



Stop!!

If you are aiming for New York, why not strike the center? This is where the **HERMITAGE** is located.

In the middle of the Times Square district. The **HERMITAGE** touches elbows at once with the great amusement and business centers of the metropolis.

Thoroughly modern and fireproof.
Rates: \$2.00 to \$3.50

The Management of the **HERMITAGE** is now under the personal supervision of its proprietor—

FRANK C. HURLEY,

Formerly with Auditorium and Chicago Athletic Club, Chicago, the Denison Hotel and Columbia Club, Indianapolis.

BOYS Build and Fly Your Own Training Plane



Train yourself in Aviation. Be an Amateur Aviator with an Aeroplane of your own. Learn how Aeroplanes are built; learn the principles of construction, operation and control. With **IDEAL** Accurate Scale Drawings, and Building and Flying Instructions, you can build a perfect Model Aeroplane, 3 ft. size, that will rise from the ground by its own power and fly like a big one. Send now for the Plans for the one you want to build.

Drawings and Instructions for
Curtiss Military Tractor
Blériot Monoplane
Nieuport Monoplane
Taube Monoplane
Curtiss Flying Boat
Wright Biplane
Cecil Peell Racer (7 for \$1.50)

25c EACH

Send for Our New **Aeroplane Catalog**. Tells about Model Aeroplanes, Racing Aeroplanes, Flying Toys, and parts and supplies to build them with. 48 pages. Send 5 cents for it today.
IDEAL AEROPLANE & SUPPLY COMPANY
76-82 West Broadway New York City

Convert Your Bicycle Into a Motor-Cycle



We sell you the motor complete or furnish you with the finished parts from which you can build the motor yourself with few tools.

We send you the printed instructions with true prints of the drawings for \$2.50 or full particulars for 3-cent stamp.

STEFFY MFG. CO., 5025 Brown St., Phila., Pa.

Bliss Electrical School

ELECTRICAL ENGINEERING
Condensed Course—Complete in One Year.
Sound, scientific, practical—without frills.
For young men of energy and character.
26th year opens September 25th. Write for new catalogue.
260 Takoma Avenue, Washington, D. C.

The operation of this remarkably sensitive relay is as follows: The powerful electro-magnets are first excited and the moving coil is connected to the receiving outfit in place of the regular 'phones thru terminals H, and a calling device, such as a bell, at the terminals I. When the coil C is excited by the feeble current produced by the detector, which, of course, is received by the other instruments from the radio transmitting station, it will turn, and its lever D will make contact with the pool of mercury E, thereby completing the circuit which causes the calling device to operate. The bell can be replaced with a tape register by which messages can be readily copied. This, of course, must be operated at a slow speed, as the moving coil has an oscillation period of .1 of a second. The oscillating frequency period can be changed by varying the distance of the levers F, F, and the coil. The ivory or bone cup in which the mercury is kept can be moved either forward or backward by operating a small thumb screw located at the end of the container.

The complete relay is supported on a table that can be rotated to offset any detrimental effects of the earth's magnetic field. A suitable cover with a glass top is placed over the instrument to prevent any dust settling on the delicate moving parts. This device is capable of withstanding shocks and will work even when slightly tilted, for it has been tested on moving vessels and the results were entirely satisfactory.

Altho the relay is adopted for radio work, it will be very useful in a laboratory where it is necessary to detect very minute or feeble currents. By mounting a sensitive microphone to make connection with the winding on the moving element this apparatus might then be used as a telephone relay, second only to the Audion in sensitivity.

The "Selenium" Relay. Until recently the most sensitive relay was the Siemens polarized relay, which would close its contacts with about 0.00005 ampere.

The new selenium relay invented by Mr. G. Allstrom is said to respond to less than 0.0000000001 (one hundred billionth) ampere. See Fig. 8. This would make it even more sensitive than a telephone receiver, and experiments have shown that for wireless work it is well adapted for signalings and calling purposes, etc. The instrument has been used in connection with electrolytic detectors, which were always thought successful only in connection with telephone receivers. Loud, audible signals were never obtained so far with such detectors, but the Allstrom selenium relay makes it possible to use a sounder or tape register with any kind of detector, no matter how sensitive.

An extremely light piece of sheet iron, A, is hung between two platinum wires of the minute diameter of 0.0001 inch, etc. In the center of the iron sheet a small, very light mirror is cemented. An electro-magnet, M, which may have a resistance as high as 10,000 ohms, is placed immediately behind the iron foil, so that the magnet core almost touches the iron.

Some distance away a sensitive selenium cell, S, is stationed. The cell itself is enclosed in a box, which at the front has a narrow slot. A source of light, O, is placed behind and directly over the selenium cell, and the room must, of course, be dark. By means of a parabolic mirror a beam of light, R, is thrown upon the small suspended mirror on A.

This beam is reflected towards S, but as long as the foil A, is motionless, the beam of light does not fall thru the slot of S.

However, a minute current—such as a wireless wave—passing thru the windings of M, will magnetize its core sufficiently to turn the very light mirror on A, and the

FREE

\$20

Violin, Hawaiian Guitar
 Ukulele, Guitar, Mandolin, Cornet or Banjo
 Wonderful new system of teaching note music by mail. To first pupils in each locality, we'll give a \$20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiian Guitar, Cornet or Banjo absolutely free. Very small charge for lessons only expense. We guarantee success or no charge. Complete outfit free. Write at once—no obligation.
 SLINGERLAND SCHOOL OF MUSIC, Dept. 422, CHICAGO, ILL.

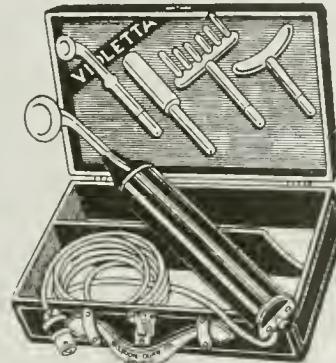
35 MILES PER HOUR
 Is Record Of This Car

 Built by a boy from Junior parts furnished by us. Any boy can build this car. Parts very cheap. Send 26 cents for blue prints and price list of parts showing how to build this speedy little car.
 SYPHER MFG. CO.
 156 Warren Street
 TOLEDO, OHIO.

High Frequency Bargains

In taking our inventory we found over 200 Violet-Ray machines of all makes. We selected 100 of the best machines, which we thoroughly overhauled in our factory making them better than new. Many of these machines cost over \$40.00.

We have placed all these instruments in two groups and are disposing of them for the ridiculously low price of **\$9.75** and **\$12.50**.



How to secure one of these machines

Send only 50 cents to pay express charges and we shall send you one of these instruments by express for your examination. This amount will be deducted from total cost of machine. You need not accept if not satisfactory.

Send at once for we shall send the best machines out first and the quicker you send in your order, the better machine you will get.

We shall also send our beautiful booklet "Violetta" describing the many uses for the high-frequency current. Write us before purchasing any kind of Violet-Ray Machine.

BLEADON-DUN CO., 11-17 S. DESPLAINES ST. CHICAGO
 Dept. 2A



Pay-Raising Books at Reduced Prices

Here's your chance to get—at bargain price—a set of books that will fit you for a better job and bigger pay. Yes, and you may pay the bargain price at the rate of only 50c a week. But you must act now! The rising cost of paper and binding materials won't permit us to continue this offer indefinitely.

No matter what your occupation, one of the sets listed below is bound to suit your needs. They are written in easily-understood language by recognized authorities, and contain thousands of photographs, full-page plates, diagrams, etc., that make difficult points as simple as A-B-C. Handsomely and durably bound in Half Morocco Leather or flexible bindings. Gold Stamped.

Shipped for 7 Days' Examination

We'll gladly send any set of books to you for seven days' examination, shipping charges collect. Examine them carefully—use them at your work for an entire week. If, at the end of that time, you feel they aren't worth many times what we ask, send them back to us. If you keep them, pay the specially reduced price on the easy terms explained below.

Practical Home Study Books

	Vols.	Pages	Size of Page	Illus.	Reg. Price	Spec. Price
Civil Engineering	9	3900	7x10	3000	\$45.00	\$29.80
Architecture, Carpentry and Building	10	4760	7x10	4000	50.00	24.80
Accountancy and Business	10	3680	7x10	1987	50.00	24.80
Steam Engineering	7	3300	7x10	2500	35.00	21.80
Applied Electricity	7	3000	7x10	2600	35.00	19.80
Automobile Engineering	5	2400	5 1/2 x 8 3/4	2000	25.00	17.80
Telephony and Telegraphy	4	1728	7x10	2000	20.00	12.80
Modern Shop Practice	6	2300	5 1/2 x 8 3/4	2500	30.00	19.80
Sanitary, Heating & Ventilation Engineer	4	1454	5 1/2 x 8 3/4		20.00	15.80
Carpentry and Contracting	5	2138	5 1/2 x 8 3/4		25.00	17.80
Mechanical and Architectural Drawing	4	1720	7x10	1037	20.00	12.00
Law and Practice (with Reading Course)	13	6000	7x10	24	72.00	39.80

Only 50c a Week

If, after seven days' examination, you decide to keep the set you have selected, send us \$2 and then \$2 a month until the present low price has been paid.

Don't wait. This means money in your pocket if you act now. Remember, you take no chances whatever. This offer is open to every man living within the boundaries of the U. S. and Canada. Mail the coupon now.

AMERICAN TECHNICAL SOCIETY
 Dept. X338-8, Chicago, U. S. A.

"SPECIAL DISCOUNT COUPON"

AMERICAN TECHNICAL SOCIETY, Dept. X338-8 Chicago, U.S.A.

Please send me set of.....

for 7 DAYS' examination. I will pay small shipping charge. I will examine the books thoroughly and, if satisfied, will send \$2 within 7 days and \$2 each month until I have paid the special price of..... If I decide not to keep the books, I will notify you at once and hold them subject to your order. Title not to pass to me until the set is fully paid for.

NAME
 ADDRESS
 REFERENCE

"Humanize"

Your Talking Machine

The Ellis Music Master Reproducer

brings to life all there is in the record. It brings out the beautiful overtones which musicians listen for—and which are invariably lost with ordinary reproducers. As one enthusiastic user says—

"There is more music in my records than I imagined possible until I discovered it by means of your Reproducer."

Another user says—

"The 'Music Master' Reproducer brings out the musical and tone coloring true to life."

And another says—

"The reproduction of the human voice is wonderful and the rendition of violin or true to the artist's performance as when making the record, even to the down touch of the bow."

Still another says—

"I would not sell my Ellis 'Music Master' for a thousand dollars unless I first got another equally good."

Words cannot convey to you an adequate idea of how much this wonderful little device will do to improve the playing of records. You must see it—hear it—compare the effect with any and all other reproducers you know of; then you will understand why every music-lover owner of a phonograph who hears the Music Master Reproducer wants to own one.

The Music Master Reproducer is made for all machines using disc records. Write today for circular E—which gives full details.

J. H. ELLIS
P. O. Box 882, Milwaukee, Wis.



ray can now fall thru the slot of S, which reduces the resistance of the selenium cell. This is sufficient to operate relay R, which in turn will actuate the signal bell.

With suitable means the oscillations of A can be dampened so that it will return in its original position immediately after the current had past thru M.

In further detail it may be said that a magnet coil having 7,000 to 8,000 ohms resistance will be sufficient for the etheric wave relay coil M. Such a coil may have a very soft iron core about $\frac{5}{8}$ inch in diameter and 5 inches long. Two fiber or hard rubber end discs are mounted at either end, whose diameter is roughly $\frac{2}{4}$ by $\frac{1}{4}$ inch thick. The iron core is insulated with a couple of layers of heavy waxed paper. The coil can then receive about 11 ounces of No. 36 B. & S. gage enameled copper magnet wire. This gives approximately 7,284 ohms resistance for the magnet M, which adapts it nicely to the minute radio currents.

Further, the damping of the iron vane A, can be magnetic in character, so as to leave the vane free of an unbalanced weight. A permanent steel magnet, placed several inches from the iron vane, will have the desired effect in causing the moving member to come to rest quickly. Other methods are also applicable.

The "Audion" Amplifier. The vacuum valve or Audion amplifier is one of the best known and most widely used at this time. Fig. 9 shows the circuits for a cascade arrangement of three oscillation valves. The current fluctuations in the detector circuit are progressively impressed upon the grids of a second and third valve, and these valves, by virtue of their relaying action, result in a progressive amplification being attained. The loose coupler, LC, transfers the aerial circuit oscillations to the first oscillation valve, No. 1; the plate of this first valve is connected up with the usual high voltage battery and the primary, P, of a one-to-one iron wire core transformer. This transformer may be an auto-transformer, the winding having about 9,000 ohms resistance. A spark coil secondary is often used for the purpose, placing a soft iron wire core thru the center of the winding. The secondary winding is connected to the grid and filament of the second valve. Three to four valves are usually all that can well be employed in a cascade amplifier, as the oscillations in the third or fourth stage become so strong as to paralyze the valve. A high resistance (half a million to one and one-half million ohms) is best connected across the grid and filament at R, to prevent excessive potentials accumulating on the grids of the second and third valves. The plate circuit of audion No. 3 is connected to a loud-speaking receiver, which may be fitted with a horn. Coupling transformer T₂, is of the same dimensions as transformer T₁. Bulbs Nos. 2 and 3 should be larger than bulb No. 1. According to Eccles, the three stage cascade amplifier, using ordinary sized bulbs, will yield an amplification of about 120 times; the third Audion will operate a sensitive magnetic type relay connected to a tape register.

The "Lieben-Reisz" Gas Relay. The newer gas or ionic stream relay, designed by Lieben and Reisz, the German investigators, is similar to the Audion, but possesses distinctive features of its own which render it particularly efficient as an amplifier for weak radio currents, which vary from 1 to 50 micro-amperes usually for fair signals. Their gas relay is shown diagrammatically in Fig. 10. Here a regular radio receiving circuit is represented with aerial A, ground G, coupling transformer L C, detector D of the mineral type, variable condenser V C, and a special transformer T₁. The primary

TELEGRAPH PICTURES



This unique set of improved Leishman Picture Telegraphing Machines will telegraph pictures, maps, drawings, and handwriting. The inventor of the Leishman systems recently telegraphed a picture of President Wilson as far as from Paris to Chicago.

This set is highly recommended for experimenters and thoroughly illustrates the system.

Only \$15⁰⁰ for a complete set of two machines
L. J. Leishman Co., Dept. T, Ogden, Utah

Wireless Taught By Mail

DRAFT MEN—THIS IS YOUR OPPORTUNITY

40,000 Wireless Operators, Men and Women, urgently needed for Army, Navy and Aviation Service. Excellent opportunities to win promotion to commissioned and non-commissioned grades with Advanced Pay. Wireless work trains you for position as Commercial Operator, after the war, with pay up to \$200 a month.



Complete Course by Mail in Ten Weeks

Start studying NOW in spare time at home. Complete practice apparatus sent with first lessons. We help you enter any branch of Radio Service you select. Write TODAY for full particulars. A Postal will do.

NATIONAL RADIO INSTITUTE

Dept. 63

Washington, D. C.

Monuments—Mausoleums—Statuary

No matter what your needs, we can serve you most advantageously. Estimates and designs submitted. Mail orders as carefully executed as though you had called in person. Write for particulars.

J. L. Wegenaar Co., 299 B'way, N. Y.
SPECIALISTS IN DESIGN AND CONSTRUCTION

of transformer T₁ takes the place of the telephone receivers usually employed. The secondary of the transformer acts on the valve tube shown at A H K.

The glass tube is exhausted of air and filled with attenuated vapor of mercury at a pressure of 0.001 mm. (20°C.), and this vapor rises from a small portion of mercury amalgam placed at the bottom of the tube. The cathode electrode at K is a platinum strip 1 mm. wide, 0.5 mm. thick and 1 meter long wound on a glass supporting stem, zigzag fashion. This strip is coated also with a thin layer of barium and calcium oxides. The anode electrode A consists of an aluminum wire spiral, while the auxiliary electrode H is made of a thin aluminum plate extending across the tube inside, between anode and cathode. It is punctured thru with many holes about 3½ mm. in diameter.

Also, in general, the cathode K is brought to a bright red heat by an electric current from the potentiometer R, attached to a 30-volt battery. Across the cathode and anode is impressed 220 volts D. C. from a dynamo, etc. The voltages must be kept quite steady. A high resistance W, shunted by a condenser C, is in series with the anode, as also the primary coil of a transformer (step-up) T₂. The secondary S connects with telephone receivers P.

It was discovered by Wehnelt that heated metallic oxides emit electrons; so in the Lieben-Reisz relay the heated cathode K gives off a stream of cathode rays or electrons (cathions), which pass thru the holes in the grid H connected to the radio circuit thru transformer T₁. The strength of the cation discharge thru H will depend on the potential of H. Hence it will be seen that varying grid H potentials are constantly produced by the received Hertzian wave signals acting thru the circuit and transformer T₁. As the cathode stream is varied, so will the 220-volt current vary in proportion, and these variations will be heard as strong signals in 'phones P.

This valve tube acts therefore as a true relay, and it is said that one tube, as here shown, boosts the received currents to 33 times their original amplitude. Of course two or more tubes can be connected in cascade to give any amplification desired. This gas relay was supposed to be much superior to the Fleming valve and de Forest Audion in sensitivity, but as Eccles points out the de Forest patents cover similar devices of equal sensitivity, size for size. Reisz claims that with four of these relays connected in cascade it has been possible to attain a magnification of 20,000.

The "Pliotron" Amplifier. This is a form of vacuum valve devised by Irving Langmuir of the General Electric Company research laboratory, and is claimed to differ from the Fleming valve and the Audion in that the instrument depends for its action on a pure electron discharge. In a pure electron discharge, as the temperature is raised, a point is always reached where the current becomes limited by the space charge between the electrodes. When this stage occurs but a small fraction of the electrons escaping from the cathode manage to reach the anode, whereas the majority of them are repelled by the electrons in the space and, therefore, return to and are absorbed by the cathode. Hence, if a negatively charged body is brought into the space between the anode and cathode, the number of electrons which then return to the cathode will increase, so that the current to the anode will decrease. If a positively charged body is brought near the cathode, either inside or outside the tube, it will largely neutralize the electrons in the space, and will, therefore, allow a larger current to flow from the cathode. By thus placing a variable potential electrode between the anode and cathode the current

1918 ATLAS WITH NEW FREE WAR MAPS

To the readers of the *Electrical Experimenter* who take advantage of this offer now made in connection with

Webster's New International

The Only Grand Prize

(Highest Award) given to dictionaries at the Panama-Pacific International Exposition was granted to Webster's New International and the Merriam Series for superiority of educational merit.

Words of Recent Interest

Anzac, ace, barrage, Bertha, blighty, Boche, Bolshevik, camouflage, Lewis gun, Liberty bond, Sammy, soviet, tank, war bride. These are but a few of the thousands of late words—all clearly defined in this great work.



"The Supreme Authority" The Merriam Webster

A Complete Reference Library in Dictionary Form—with nearly 3,000 pages and type matter equivalent to a 15-Volume Encyclopedia, all in a single volume, in Rich, Full Red Leather, or Library Buckram Bindings, can now be secured on the following remarkably easy terms:

THE ENTIRE WORK WITH 1918 ATLAS

DELIVERED for \$1.00

and easy payments thereafter of only a few cents a week (In the U. S. and Canada) ON SUPERIOR INDIA PAPER

Reduced About One-Half in Thickness and Weight
India-Paper Edition

Printed on thin, opaque, strong, superior India paper. This edition is only about one-half the thickness and weight of the regular edition. Size 12½ in. x 9¼ in. x 2¼ in. Weight 3½ lbs.

Regular Paper Edition
Printed on strong book paper of the highest quality. Size 12½ in. x 9¼ in. x 2¼ in. Weight 15¼ lbs. Both editions are printed from the same plates and indexed.

Over 400,000 Vocabulary Terms, and in addition, 12,000 Biographical Names, nearly 30,000 Geographical Subjects, besides thousands of other references. Nearly 3,000 Pages. Over 6,000 Illustrations.

The only dictionary with the New Divided Page, characterized as "A Stroke of Genius."

To those who mail this Coupon at once!

G. & C. MERRIAM CO.
Home Office, Dept. S, Springfield, Mass.
(Publishers of Genuine Webster's Dictionaries for over 70 years.)

Please send me free of all obligation or expense a copy of "Dictionary Wrinkles," containing an amusing "Test in Pronunciation" (with key) entitled "The Americanization of 'Carver';" also "125 Interesting Questions" with references to their answers, and striking "Facsimile Color-Plate" of the new bindings. Please include specimen pages of India and Regular paper with terms of your *Electrical Experimenter* free Atlas offer on Webster's New International Dictionary.

Name
Address

"To have this work in the home is like sending the whole family to college!"

The ATLAS is the 1918 "New Reference Atlas of the World," containing nearly 200 pages, with 128 pages of maps beautifully printed in colors with marginal reference indexes, late Census Figures, Parcel-Post Guide, New War Maps, etc., all handsomely bound in red cloth, size 10¼x13½.

Let Me Train YOU In AVIATION

I want you to take up Aviation. Positions at good pay are going begging, because there are not enough trained men to fill them. LET ME TRAIN YOU for some of these big positions that pay big wages. I know the game, for I have been flying for years. My advice to you is to decide right now to take a

Home Course in Aviation

in your spare time. Send today for our **FREE BOOK** and I will write you a personal letter along with it. I will tell you some **INSIDE facts** about this great industry. You'll want to get right in. Address as follows:



Captain George Frederick Campbell, Formerly Third Ace of the Royal Flying Corps. Chief Instructor of National Aero Institute.

Capt. Geo. F. Campbell, Chief Instructor, NATIONAL AERO INSTITUTE, DEPT. 744B, Morton Building, Chicago, Illinois.

Two Airplane Concerns agree to take every one of our students who have mastered our course for the big paying positions of Mechanics, Inspectors, Assemblers, Engineers, etc.

Why don't YOU qualify?

Fill Out This Coupon and Mail Today

Capt. George F. Campbell, Chief Instructor
National Aero Institute, Dept. 744B,
Morton Building, Chicago, Ill.
Dear Sir: Please send me without obligation, copy of "The Science of Aviation," also particulars of Mail Course in the Principles of Aviation.

Name
Address

LEARN TELEGRAPHY QUICKER—EASIER

Morse or Wireless Code

Adjustable Buzzer Practice Set

Quickly Gives You Speed—No Tools Needed—A Touch of Your Finger Adjusts It

This practice set with its adjustable BUZZER enables you to learn telegraphy, Morse or Wireless Code, in shorter time than ever before thought possible. A touch of your finger to a thumb screw gives any pitch desired to the BUZZER. Especially designed to give very clear sound of exceptionally high pitch even on ONE DRY CELL. The adjustment of the BUZZER to any pitch is made without the aid of any tools—simply by the thumb screw. The greatest improvement in practice sets ever made—superior to any on the market. Beautifully made; mounted on substantial base.

AS SHOWN WITH BATTERY \$2.90



Price \$3.50 WITH BATTERY AND WIRE

Complete Ready for Use. Immediate Delivery. Money Refunded if not satisfactory. Send for Illustrated Folder.
The TEWNO CO., 41 Park Row, N. Y. C.

Not Enough Men for These \$5,000 Positions

An Important Letter

From the President of the American Commerce Association

I am writing this letter as a last resort to see if we cannot secure more men willing to qualify for traffic positions paying \$2,500 to \$10,000 a year.

How important is the trained traffic man's work can be seen by these few cases out of thousands which occur every day. A concern in South Chicago had been shipping about 200 cars of coke from Connellsville to their smelters. Some time ago a traffic expert succeeded in getting a rate adjustment which resulted in a saving of about \$5.00 on each car. Thus on this one item alone a saving of over \$360,000 a year was effected.

In St. Louis, through misrouting of freight, errors in reconsigning cars and undercharges on shipments, a railroad lost over \$27,000.

A traffic expert discovered that freight rates paid by the Meeker Coal Co. were legal, but exorbitant. A ruling secured from the Interstate Commission resulted in a refund of \$120,000.

There are about 50,000 large business corporations and about 400,000 small shippers which must be protected by competent traffic men. These concerns have freight expenses running from a few thousand dollars to many thousands of dollars monthly. Yet in the entire country there are only a few hundred men actually competent to save the money now being wasted through lack of efficiency in applying the Government Freight Rate System.

Realizing the crying demand for trained traffic experts, and seeking relief, the American Commerce Association—a national organization OF traffic men, FOR traffic men, BY traffic men—offers to give men the training required to make them competent to handle the problems of most economical distribution. This instruction is given by mail and can be studied in spare time at home. The most complete and thorough training is given, and, through the Association, costs but a few cents a day.

Through its Advisory Council, every member of the American Commerce Association receives the help of the most prominent traffic men in America.

It is impossible to go into details in this letter, but the Association has published a remarkable book for free distribution which explains everything in detail and tells how any one may quickly learn the new profession of traffic management. If you are at all interested in getting into this highly profitable field, paying salaries of \$2,500 to \$10,000 and more, write for the remarkable free book. Please state whether you are a beginner or whether you have had previous traffic experience, and give your present age and occupation, also your telephone number. Address American Commerce Association, Dept. 5011, 206 S. Wabash Avenue, Chicago, Ill. (American Commerce Bldg.)

flowing between the anode and cathode may be controlled. This controlling member is usually in the form of a fine wire mesh or grid, as Fig. 11 shows.

The illustration, Fig. 11, shows the construction of the pliotron. A glass frame is used on which to wind the fine wire grid. In the figure the filament is mounted in the center of a glass rod frame, on which the fine grid wire is wound by means of a lathe; the grid often consisting of tungsten wires as small as .01 mm., spaced as close as 100 turns to the centimeter. The operating characteristics of the "pliotron" depend upon the length of filament used, the distance between filament and grid, the spacing between grid wires, the diameter of the grid wires, the distance between grid and anode, and the size and shape of the anode. A circuit for using the "pliotron" as an amplifier is given in Fig. 11, in which case the high frequency currents received from the grid may be amplified one hundred to six hundred-fold. Here it is the radio and not the audio frequency that is amplified; thus the detector circuit can be tuned to the same frequency as the amplifier circuit, with marked advantages in the matter of selectivity.

The "Alexanderson" magnetic amplifier. Referring to the accompanying diagrams, Fig. 12, we have two magnetic windings, A and B, related to one another magnetically and grouped on a laminated core structure in the peculiar fashion shown, there being a slot left in the central leg of the iron core. It is apparent that there can be no direct transformation of energy from one winding to the other for the reason that each turn in the exciting winding B, includes both the positive and the negative branches of the flux produced by the alternating current winding A, which is connected in series (or parallel) with the high frequency alternator or other source of oscillating current. Hence there is no voltage induced in the winding B. However, the current in either of the windings A or B influences the permeability of the common iron core, and therefore changes the inductance value of the other winding. Should the current flow in either winding be sufficient to saturate the iron core, it is therefore rendered practically non-magnetic and the inductance of the second winding is reduced to the value it would have, if the coil included only air. When, however, a current flows in the other winding which gives a magneto-motive force equal and opposite to the first, the iron core is rendered magnetic again. As the two divisions of the A winding are wound relatively opposite to the B winding, the one branch will oppose the ampere turns of B on one-half cycle and the other branch during the successive one-half cycle.

The opposing ampere turns must be at least equal to the ampere turns in the winding B in order to have any flux variation in winding A.

The relations of currents in these windings is substantially the same as between the primary and secondary current in a transformer, altho in this case one is an alternating and the other a direct current, or a current of a different frequency. It is thus obvious how the current flow in winding A can be regulated in proportion to the controlling current in winding B.

Short-circuited condensers are connected to each of the radio frequency coils. A shunt condenser, C_1 , across both coils and their short-circuiting condensers, C_2 and C_3 , increase the sensitiveness. Another condenser, C_4 , inserted in series with the entire amplifier is employed to obtain linear proportionality of amplification and increased sensitiveness. The ratio of amplification is found to be proportional to the ratio of

the frequency of the radio current to that of the controlling current. For telephone control the amplification ratio varies from 100 to 1 up to 350 to 1. It has been successfully used to control the out-put of a 75 kilowatt radio frequency alternator. With this amplifier it has been possible to effect a variation in the antenna energy from 5.8 to 42.7 kilowatts with a variation of control current of but 0.2 ampere. Think of effecting such a control—namely 37 kilowatts variation—by means of a telephone transmitter.

This covers the important types of radio amplifiers. Radio investigators and experimenters generally will, however, undoubtedly find of interest the following articles which have appeared in this journal. If you cannot obtain a copy of the desired issues from the publishers you can see them at your local library in most cases.

Compress air amplifier applied to phonograph. Oct., 1915, issue.

Vibrating Reed Amplifier. By Samuel Cohen. Dec., 1915, issue.

Amplifying telephone receivers, Baldwin patent. Jan., 1916, issue.

Radium intensifies radio signals. Oct., 1916.

A new Magnetic Radio Relay—How to build one. It closes a local circuit for tape recorder or other apparatus. By Henri Mea. March, 1914, issue, page 162. (Note:—The magnet coil dimensions given are in error; instead of one ounce each magnet coil contains 11 ounces of No. 36 B. & S. gage enameled copper magnet wire, giving a resistance of 7,650 ohms for the two spools in series.)

Selenium, Relay. See present number of ELECTRICAL EXPERIMENTER, page 471.

Audion Amplifier Action—Exhaustive discussion of electronic movements, etc. Most complete article on this phase of the vacuum valve available. August, 1916, issue.

U. S. Navy Amplifone. See July, 1915, issue.

THE PHENOMENA OF ELECTRICAL CONDUCTION IN GASES.

(Continued from page 466)

graphic paths it can be seen that they have encountered no force strong enough nor any mass great enough to turn them aside in their passage thru many thousand molecules until the particle had slowed down a great deal. Another interesting point is evident here in the fact which can be obtained from the photographic path that the slower the ion is traveling the more ions it will produce, and the faster it travels the more likely it is to pass completely thru a molecule without hitting anything. The way in which an electron may pass thru a molecule has been illustrated in a previous paper by the way in which a pebble may be thrown thru the circle described by a rapidly revolving ball on a string without either touching the ball or the string. Similarly two molecules consisting, as in Fig. 5, of electrons rotating about nuclei, may pass thru each other without either of the two nuclei or the two electrons colliding, and the faster they are moving in the directions of the arrows the less likely it is that the rotating particles will collide.

The fact that the paths of the ions in Fig. 4 is quite different from the others shows that ionization may be of several different kinds, and in no way is this shown and explained more than by these photographic paths. This brings up the question as to just what the mechanism of ionization is. There is little doubt but that the beta particle produces ions in passing through molecules of air by ejecting an electron from each molecule, either by collision or by the force of its field. As the electron remains inert along the path of the ionizing particle it seems to have been suddenly loosed rather than forcibly ejected as by collision. The action of the

(Continued on Page 515)



Group of Students in Corner of Dynamo Testing Laboratory—Practical Training.

Learn an Electrical Trade

here in 6 months **Clip and mail the coupon below and get details how you can learn an Electrical Trade here in 6 months. 1/2 day work at good Pay, 1/2 day school—or work all day and attend evening class. Splendid positions provided students while learning, and when they finish course. Thorough, practical electrical trade instruction, training and development with actual tools, machines and apparatus to work on while learning. Electrical trade executives in great demand. Opportunities rich. Respond to the call—mail the coupon now.**

In Our Electrical Engineering Department High School Graduates Can Enter Students' Army Training Corps

Est. by War Department—Expenses Paid

If you are a high school graduate—18 years or older—the government wishes you to enter a Students' Army Training Corps as officially established here. Your tuition, board and lodging will be paid and you will receive soldier's salary of \$30.00 a month besides and here you will obtain education and training for Electrical Engineering, in which this school specializes. Enroll here—get details now. Unit rapidly being completed. You will be in government service, receiving the training and education for Army officer. Respond to your country's call—and take advantage of obtaining an Electrical Engineering Education besides—free.

Mail the Coupon Now—Don't Delay.

School of Engineering of Milwaukee
An Electrical Technicians' Institute
67-373 Broadway, Milwaukee, Wis.

COUPON FOR PARTICULARS
School of Engineering of Milwaukee,
67-373 Broadway, Milwaukee, Wis.

I am interested in your
 ... Student Army Training Corps.
 ... 6 Months Electrical Trade Courses.
 (Check Subject Interested In.)
 ... Electric Trouble and Lineman.
 ... Electrical Meterman
 ... Electrical Wireman
 ... Electrical Motor and General Repairman.
 ... Telephone Trouble and Repairman.
 ... Draftsman.

Please send details.

Name

Address

City State

Age Education

What 15¢ will bring You from the Nation's Capital

Washington, the home of the Pathfinder, is the nerve center of civilization; history is being made at this world capital. The Pathfinder's illustrated weekly review gives you a clear, impartial and correct diagnosis of public affairs during these strenuous, epoch-making days.

The little matter of 15c in stamps or coin will bring you the Pathfinder 13 weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for the Nation; a paper that prints all the news of the world and tells the truth and only the truth; now in its 26th year. This paper fills the bill without emptying the purse; it costs but \$1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, fairly, briefly—here it is. Send 25c to show that you might like such a paper, and we will send the Pathfinder on probation 13 weeks. The 15c does not repay us, but we are glad to invest in new friends. The Pathfinder, Box 76, Washington, D. C.

TYPEWRITER SENSATION PROMPT SHIPMENT.



\$4.00 per month buys a beautifully reconstructed, latest model visible typewriter, with back spacer, decimal tabulator, two-color ribbon, etc. Every late style feature and modern operating device. Sent on approval. Catalogue and special prices free.

Harry A. Smith, 738, 218 N. Wells St., Chicago, Ill.

ACTIVE SERVICE



\$1.25 Dependable for a life time. Made right to write right. Long or short—Red or Black. Absolute necessity to any business man or woman. Unequaled for general writing, billing, ruling and manifolded. Made of pure vulcanized rubber with non-corrosive, durable writing point. Lock-Cap prevents leaking. Extra size, 8 in., black only, \$1.50. Your name in gold inlay 35c. FREE: Liberal supply of ink with retail orders. Agents wanted. Good profits.

J. R. ULLRICH & CO., 27 Thames St., New York

\$5.

EXPERIMENTERS!



Student's Chromic Plunge Battery

This is an ideal battery for electrical experimental work where a very powerful current is not required. This battery will light a 2 volt lamp for several hours on one charge; it will run a small toy motor surprisingly well; it will do small electroplating work; it is ideal for testing work; it gives a fairly steady current, and as the zinc electrode can be pulled clear of the electrolyte, no materials are used when battery stands idle.

Best Amalgam Zinc only is used, as well as a highly porous carbon to ensure a steadier current. We furnish enough chromic salts for 4 charges. Full directions for operation and care of battery are included. Each battery tests 2 volts and 6 amperes when set up fresh. Not over 2 amperes should be drawn from battery continuously. By using six or eight of these batteries, a great many experiments can be performed. No solution can run out of this battery if upset by accident. This makes it an ideal portable battery. Size over all is 5 1/2". Shipping weight, 1 lb. No. 999. Student's Chromic Plunge Battery..... **\$0.50**



IMMEDIATE SHIPMENTS

The "Electro" Radiotone HIGH FREQUENCY SILENT TEST BUZZER

This instrument gives a wonderful high pitched MUSICAL NOTE in the receivers, impossible to obtain with the ordinary test buzzer. The RADIOTONE is built along entirely new lines; it is NOT an ordinary buzzer, reconstructed in some manner. The RADIOTONE has a single fine steel reed vibrating at a remarkably high speed, adjusted to its most efficient frequency at the factory. Hard silver contacts are used to make the instrument last practically forever.

Yes, the RADIOTONE is SILENT. In fact, it is so silent that you must place your ear on top of it to hear its beautiful musical note. You will be astounded at the wonderfully clear, 500 cycle note, sounding sharply in your receivers. To learn the codes, there is absolutely nothing like it. With the radiotone, a key and one dry cell and ANY telephone, a fine learner's set is had. Two or more such sets in series will afford no end of pleasure for intercommunication work. Shipping Weight 1 lb. Radiotone as described.....each **\$0.90**

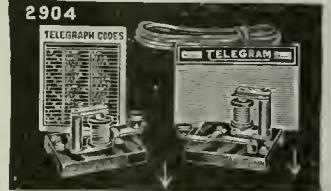


IMMEDIATE SHIPMENTS

The "Electro" Telegraph

Is not a toy, but a practical, honestly built telegraph outfit, which not only stands but works like the big commercial instruments. By studying the code for 30 days you can become a first-class telegraph operator. Such operators are in big demand now. Outfit consists of TWO complete telegraph instruments each measuring 3 1/2 x 2 1/2 x 2 1/4. All metal parts are highly nickel plated, including key lever. Note hard rubber knob.

Telegraph code chart, telegraph blanks and connecting wire comes with set, but no batteries. Outfit works on 2 dry cells (one cell for each instrument). The "Electro" is the ONLY outfit that works both ways, each station can call; no switches, no extras. Nothing to get out of order. Guaranteed to please you or money back. Price Complete as illustrated (TWO INSTRUMENTS).. **\$1.25**



IMMEDIATE SHIPMENTS

The "Electro" Codophone (Patents Pending)

What this remarkable instrument is and does.

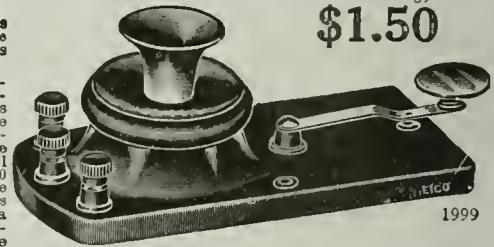
The "Electro" Codophone is positively the only instrument made that will imitate a 500 cycle note exactly as heard in a Wireless receiver. The loud-talking receiver equipped with a horn, talks so loud that you can hear the sound all over the room, even if there is a lot of other noise.

THAT'S NOT ALL. By loosening or tightening the receiver cap, a tone from the lowest, softest quality, up to the loudest and highest screaming sound can be had in a few seconds.

FOR INTERCOMMUNICATION. Using two dry cells for each instrument, two Codophones when connected with one wire and return ground, can be used for intercommunication between two houses one-half mile apart. One outfit alone replaces the old-fashioned learner's telegraph set, consisting of key and sounder.

The "Electro" Codophone is a handsome, well made instrument, fool proof, and built for hard work. Contacts are of hard silver 1/8 inch in diameter, that will outlast the instrument. There is also a neat code chart and full directions enabling any intelligent young man or girl to learn the codes within 30 days, practicing one-half hour a day.

Sizes: 6 1/2 x 3 x 2 1/4". Shipping weight, 2 lbs. The "Electro" Codophone as described, complete..... **\$1.50**



IMMEDIATE SHIPMENTS

"The Livest Catalog in America" Our big, new electrical cyclopedia No. 19 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 225 Big Pages, 600 Illustrations, 500 Instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 19 measures 7x3 1/4", Weight 1/2 lb. Beautiful stuff covers.



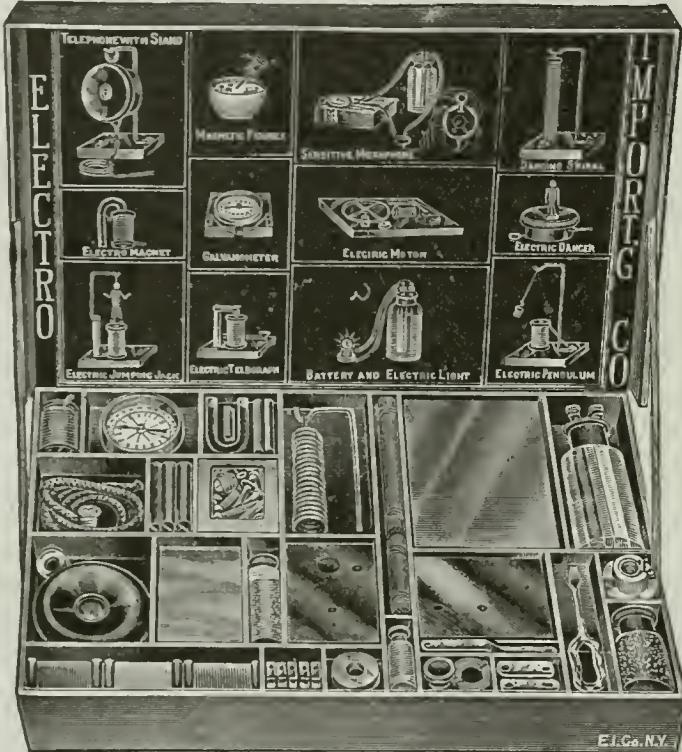
ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

I enclose herewith 6 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 19 as described.

NAME

ADDRESS

STATE E. E. 11-18



No. EX2002

"THE BOY'S ELECTRIC TOYS" contains enough material to make and complete over TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

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

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

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

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

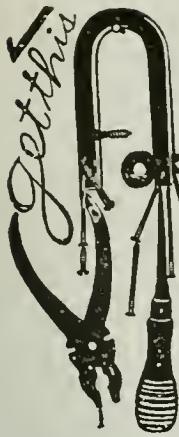
Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size over all of the outfit is 14 x 9 x 2 3/4". Shipping weight, 8 lbs. **\$5.00**
No. EX2002 "The Boy's Electric Toys" outfit as described.....

IMMEDIATE SHIPMENTS

ELECTRO IMPORTING CO., 231 Fulton St., NEW YORK



Big Powerful MAGNET

Finest tungsten magnet steel, absolutely permanent. Length 5 inches. Lifts about 3 pounds. Educational, useful and enables you to perform endless tests, experiments and make other magnets. Nothing better made. Sent parcel post \$1.00 each.

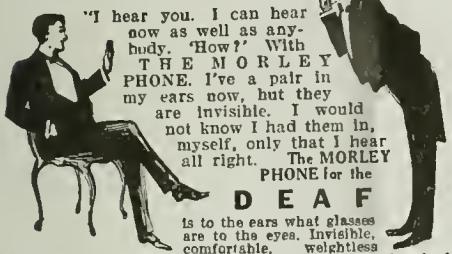
ELECTRIC GENERATORS

We also have a number of Holtzer-Cabot Hand Generators which we will dispose of at bargain prices. Give up to about 110 volts, alternating current. You can make direct if desired. Strictly high grade, fully up to H-C standards. While they last, \$5.00 each.

Order from this ad.

Watson Electric Co.
Dept. 211, Gas Bldg., Chicago

"Don't Shout"



"I hear you. I can hear now as well as anybody. How? With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right. THE MORLEY PHONE for the DEAF is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it." Over one hundred thousand sold. Write for booklet and testimonials. THE MORLEY CO., Dept. 748, Perry Bldg., Phila.

NO CARBON-MORE POWER-LESS FUEL

"NO-LEAK-O"

ONE PIECE OIL SEALING NORWOODS PISTON RING

OIL SEALING PISTON RINGS NOLEAKO

Gives results no other ring can. Every set guaranteed. 7 years' success. Popular price 50c. If your jobber can't supply you order direct P. Post is quick. Write for free booklet 04. AUTOMOBILE ACCESSORIES CO., Baltimore, Md.

SAVE 25% to 60%

on slightly used **GRAFLEX-KODAKS**

Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog**. Listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 111 days' Free Trial. Money back if not satisfied. You take no chance dealing with us. We have been in the photographic business over 10 years. Write Now.

CENTRAL CAMERA CO., Dept. 17B 124, So. Wabash Ave., Chicago

\$500 REWARD

We will pay \$500.00 reward to anyone who can permanently dim the brilliancy of the RAJAH IM. diamond without destroying it. **RAJAH IM. Diamonds** They stand all diamond tests—fire, acid, file and glass cutting. Their brilliancy is eternal. Guaranteed for a lifetime. Set in solid gold and sent **30 DAYS' FREE TRIAL** to you on. If you can tell it from a real diamond return it. Send today for our beautiful, FREE illustrated jewelry catalog in colors. Write now. **KRAUTH & REED, 159 N. State St., Dept. 209, CHICAGO, ILL.**

You Can Make Big Profits Charging Auto Storage Batteries

No experience necessary. Others are clearing an extra profit of \$100 to \$150 and more every month. Write for particulars or send \$15 first payment with trial order and get charger at once. Balance in 3 monthly payments of \$20 each. Pay from carolans. Good profit besides. Absolute money-back guarantee. No risk. Order now—from this ad.

Hobart Bros. Co., Box 11E, Troy, Ohio

TYPEWRITERS

ALL MAKES. SAVE \$25 TO \$50 on rebuilt by the well-known Young Process. Sold for low cash—installment or rented. Rental applies on purchase price. Write for full details and guarantee. Free trial. Young Typewriter Co., Dept. 657, Chicago

INSYDE TYRES Inner Armor

for Auto Tires. Double mileage, prevent blow-outs and punctures. Easily applied in any tire. Thousands sold. Details free. Agents wanted. Amer. Accessories Co., Dept. 53 Cincinnati

STAMMERERS

You can be cured quickly, permanently and privately. Write me personally for free booklet, "How to Stop Stammering." Samuel O. Robbins, Phila., Boston Stammerers' Institute, 246 Huntington Ave., Boston, Mass.

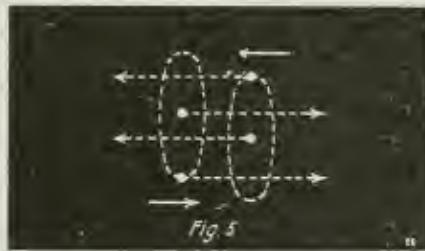
THE PHENOMENA OF ELECTRICAL CONDUCTION IN GASES.

(Continued from page 513)

alpha particle is quite similar, and it also seems that an electron is loosed from each molecule thru which the alpha particle travels, and in some cases several may be loosed, which might be expected from the greater size of the alpha particle.

In the case of short ether waves, say X-rays, the electrons seemed to be very forcibly ejected, for they branch off from the main path and every branch indicates the point where a collision took place and a new ion was produced. Hence the path of a ray of X-rays thru air is an intricate network. Just why ether waves produce this violent ejection in contrast to the passive ionization left in the path of alpha or beta particles remains a mystery.

In connection with the older molecular theory molecules were considered to be perfectly elastic so that on colliding with each other they bounced back with exactly as much energy as before. This assumption was necessary because if it were not true the molecules of any gas would slowly lose their energy and would fall to the bottom of their containing vessel as inert particles. In other words at each collision energy would be lost and the pressure would gradually decrease to zero. If we investigate the conditions of collisions it is apparent that reflections do



Showing How Two Molecules, Consisting of Electrons Rotating About Nuclei, May Pass Thru Each Other Without Either of the Two Nuclei or the Two Electrons Colliding. The Faster They Move the Less Chance of Collision of the Rotating Particles.

not always occur. The molecules might pass thru each other under proper conditions, or they might meet each other so that all the energy of one is used up in producing ionization and that one becomes inert, or they might be reflected. If they are reflected it may be from one or both of two causes:—The electric fields of the particles within the atom may oppose and repel each other, or some impenetrable centers more solid and material than electricity, if there be such, may collide and rebound. The fact bears repeating that an alpha particle may pass thru half a million molecules before experiencing such a force or such a material center. The faster the molecule travels of course the more chance it has of going completely thru another molecule. Ordinary gas molecules move at such relatively low speeds that practically all collisions produce reflection. The fact that the collision seems perfectly elastic is still difficult to explain unless as explained above, the reflection is due to the repulsion of electric fields; then the only loss of energy would be due to the ether and the ether is considered frictionless.

The field of the ionization of gases is one of the most promising in all science. In these papers the most important phenomena have been considered relative to electricity in gases and besides adding to our practical scientific knowledge and intellectual resources the light which it throws on the real electrical nature of matter and electricity is invaluable.

(Conclusion.)



Become a Doctor of Chiropractic

Advanced Science of Spinal Adjustment

This is the day of drugless healing! In Chiropractic—treatment of disease by spinal adjustment—science has made a forward step. Look at the newspapers and magazines—note the trend toward the principles of drugless healing, especially Chiropractic.

You can now become a Doctor of Chiropractic through home study during spare time! We teach you thoroughly either by mail or in class. You can know independence and position! Makes no difference where you live or what you do—you should be able to qualify for this great profession. Some of our graduates report that they

Earn \$3,000 or More a Year

Dr. M. D. Moore, Ky., writes of having 17 patients in one day at \$2 each. Dr. L. H. Roche, New Jersey, \$5,550 a year. Dr. A. H. Morrow, of Illinois, reports earning \$22 a day. We could name many other Chiropractors who are making good incomes. See the facts in our Free Book. It's only a question of profession on your part to enter a profession that is paying others \$3,000 to \$5,000 or more a year. Think what it would mean to you to earn such an income and to be your own boss with your own hours. Isn't this the kind of life you are desirous of leading? Well, it is now within your reach. Truly this is a chance for you!

22 CHARTS FREE

\$15 Set of 8 Anatomical Charts and \$16.50 Set of Nerve and Pain Area Charts

Yes, free to you without a cent, now or later. As an inducement to secure quick action, we will give absolutely free, our big, 72-page book; a \$16 set of eight Anatomical Charts, beautifully lithographed in lifelike colors, and also a complete set of colored Nerve and Pain Area and Concussion Charts, regular value, \$16.50.

Learn At Home In Spare Time

We train you by mail. You can learn at home in your spare time. You receive the personal instruction of men who are prominent in this great profession. Give us a portion of your spare time, and we will quickly train you to become a Doctor of Chiropractic, ready to step out and take your position of prestige in the world.

Mail Coupon NOW! Why elave your life away in work that you don't like—work that doesn't fit with your ambition? Here's the chance you've been looking for—the opportunity your ambition has sought! Mail coupon today and see the access that may be yours as a Doctor of Chiropractic. Don't delay.

AMERICAN UNIVERSITY

Manierre Bldg., Dept. 321 Chicago, Ill. Without cost or obligation, send me by mail, post-paid, your new illustrated 72-page book, and your Free Charts Offer.

Name.....
Street and No.....
City..... State.....

SAVE \$51

Genuine \$100 Oliver Typewriters now \$49. Brand new, never used. Direct from factory to you. Not second hand, not rebuilt. And we ship you an Oliver for free trial. No payment down. Keep it or return it. If you want to own it, pay us only \$3 per month. This is the greatest typewriter bargain on earth.



The Oliver Typewriter Co. 678 Oliver Typewriter Building Chicago, Ill.

MAGAZINES GOING UP!

Your Last Chance For Old Prices

With the next issue, the price of the **EXPERIMENTER**, as announced on another page, goes to \$2.00 a year. This is positively the last month in which the **ELECTRICAL EXPERIMENTER** can be secured for \$1.50—and for considerably less if clubbed in connection with other magazines.

With the tremendous advances in the price of paper, it is quite certain that the **ELECTRICAL EXPERIMENTER**, as well as the rest of the magazines, will have to go still higher, before another six months. By subscribing now for from one to five years, **YOU POSITIVELY WILL SAVE BIG MONEY.**

The prices below are unquestionably the lowest for standard magazines that it is possible to obtain anywhere. Only by a special arrangement with the publishers are these prices possible and they are good only until **October 31st**, after which date all prices as given on this page are withdrawn. Make up your list at once—do not delay. If you are already a subscriber and your subscription to the **EXPERIMENTER** runs for a long time, you may subscribe for any other magazines by deducting the price of the **EXPERIMENTER** from the clubs at the rate of \$1.25, (the special price allowed in clubbing with other magazines). Thus you can make up any club yourself of as many magazines as you wish from the list below.

All prices quoted are for subscribers in U. S. only. Canadian and foreign subscriptions require additional postage.

Electrical Experimenter \$1.50	Our Price
Popular Science..... 2.00	
Illustrated World, (Technical World).. 2.00	\$5.00
Regular Price.....\$5.50	
Electrical Experimenter \$1.50	Our Price
Scientific American.... 4.00	
Regular Price.....\$5.50	\$4.75
Electrical Experimenter \$1.50	Our Price
Popular Astronomy... 3.50	
Regular Price.....\$5.00	\$4.75
Electrical Experimenter \$1.50	Our Price
Wireless Age..... 2.00	
Etude 1.50	
Regular Price..... \$5.00	\$4.35
Electrical Experimenter \$1.50	Our Price
American Boy..... 1.50	
Boys' Magazine..... 1.00	
Regular Price.....\$4.00	\$3.25

Electrical Experimenter \$1.50	Our Price
American Boy..... 1.50	
St. Nicholas..... 3.00	
Youth's Companion... 2.00	
Regular Price.....\$8.00	\$7.00
Electrical Experimenter \$1.50	Our Price
Today's Housewife... .75	
McCall's Magazine.... .75	
Regular Price.....\$3.00	\$2.45
Electrical Experimenter \$1.50	Our Price
Collier's Weekly..... 2.50	
Literary Digest..... 3.00	
Regular Price.....\$7.00	\$6.75

Electrical Experimenter \$1.50	Our Price
Etude 1.50	
Regular Price.....\$3.00	\$2.60
Electrical Experimenter \$1.50	Our Price
Boys' Magazine..... 1.00	
Regular Price.....\$2.50	\$1.85
Electrical Experimenter \$1.50	Our Price
Everybody's Magazine. 1.50	
Delneator (all to one address) 2.00	
Regular Price.....\$5.00	\$4.35
Electrical Experimenter \$1.50	Our Price
Motion Picture Magazine 2.00	
Regular Price.....\$3.50	\$3.00
Electrical Experimenter \$1.50	Our Price
Everybody's 1.50	
American Magazine... 2.00	
Regular Price.....\$5.00	\$4.50

Electrical Experimenter \$1.50	Our Price
World's Work..... 4.00	
Regular Price.....\$5.50	\$4.25
Electrical Experimenter \$1.50	Our Price
Smart Set..... 3.00	
Regular Price.....\$4.50	\$3.50
Electrical Experimenter \$1.50	Our Price
Parisienne 2.00	
Regular Price.....\$3.50	\$3.00
Electrical Experimenter \$1.50	Our Price
Youth's Companion... 2.00	
Review of Reviews... 3.00	
Regular Price.....\$6.50	\$5.50
Electrical Experimenter \$1.50	Our Price
Pictorial Review..... 2.00	
McClure's Magazine... 1.50	
Regular Price.....\$5.00	\$4.50

Special Clubbing Prices of Electrical Experimenter WITH

	Regular Price	Our Rate Per Year		Regular Price	Our Rate Per Year
Adventure	\$4.50	\$4.25	Literary Digest	\$4.50	\$4.25
American Boy	3.00	2.50	McClure's Magazine	3.00	2.50
American Magazine	3.50	3.25	Metropolitan	4.00	3.25
Blue Cat	2.50	2.10	Modern Priscilla	3.00	2.75
Blue Book	3.50	3.25	Nation	5.50	4.75
Boys' World	2.00	1.75	Outing	4.50	4.25
Century	5.50	4.75	Outlook	5.50	4.75
Christian Herald	3.50	3.00	Pearson's Magazine	3.50	2.75
Collier's	4.00	3.75	Popular Science Monthly	3.50	3.25
New Country Life	6.50	5.25	Red Book	3.50	3.25
Delneator	3.50	3.00	Review of Reviews	4.50	4.25
Etude	3.00	2.60	St. Nicholas	4.50	3.50
Everybody's	3.50	2.50	Scientific American	5.50	4.75
Field & Stream	3.50	3.00	Scribner's Magazine	5.50	4.75
Film Fun	2.50	2.05	Smart Set	4.50	3.50
Grit	3.50	3.00	Wireless Age	3.50	3.00
Illustrated World (Technical World)	3.50	3.00	Woman's Home Companion	3.50	3.25
Judge (Weekly)	6.50	6.25	World's Work	5.50	4.25
Leslie's Weekly	6.50	6.25	Youth's Companion	3.50	3.25

Write for Special Prices on ANY Publication not listed here

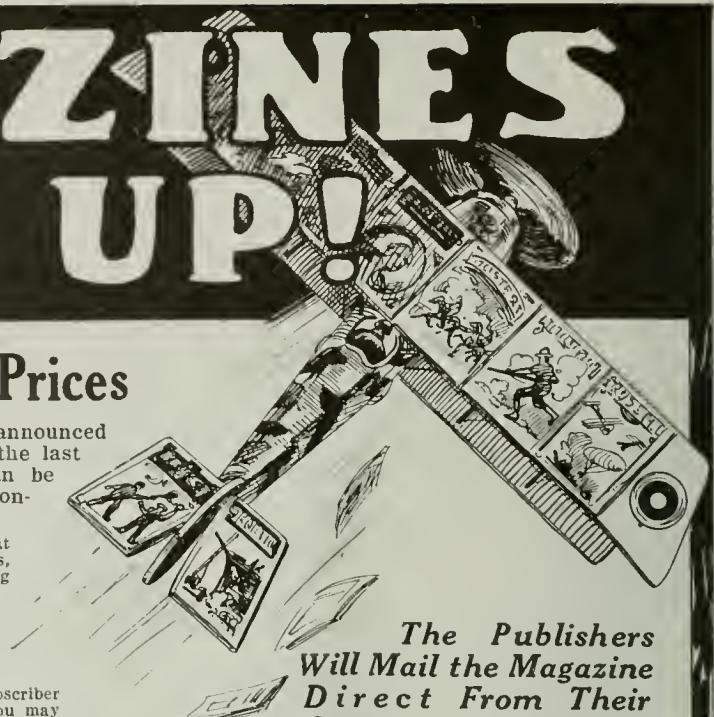
We will save you money

SEND ALL ORDERS TO "CIRCULATION DEPARTMENT"

EXPERIMENTER PUBLISHING CO., Inc.

233 Fulton Street, New York City, N. Y.

SEND FOR OUR FREE SUBSCRIPTION CATALOG



The Publishers Will Mail the Magazine Direct From Their Own Office to You

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms and dealers from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section six cents a word for each insertion. No advertisement for less than 60c accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the December issue should reach us not later than October 22.

The Circulation of the Experimenter is over 100,000 and climbing every month
EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Automobile Accessories

Fords Start Easy in Cold Weather with our new 1919 carburetors. 34 miles per gallon. Use cheapest gasoline or half kerosene. Increased power. Styles for any motor. Very slow on high. Attach it yourself. Big profits to agents. Money back guarantee. Thirty days' trial. Air-Friction Carburetor Co., 270 Madison, Dayton, Ohio.

Aviation

Learn Aviation Motor Mechanics or Aeroplane Building. Prepare for Government call or civilian work. Big money after few weeks. Write. Moler Aviation School, 105 S. Wells St., Chicago.

Motorcycles

Motorcycles from \$25 up—New and second-hand. Easy terms, large list to choose from, all makes. Send 4c stamps for Bulletin "A." Peerless Motorcycle Co., Watertown, Mass.

Motorcycles, \$40 up, Cash or Terms; all makes. Bulletin G-1, FREE, write to-day. Motorcycle Exchange, Rochester, N. Y.

For Advertisers

Twenty Word Ad in 100 Pulling Magazines, \$1. About 75,000 readers. Send copy now. Lindhorst Magic Shop, St. Louis.

"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America"; A little story of RESULTS, told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield, Coutlee, 225 West 39th St., New York.

Auctions

Auctioneers make from \$10 to \$15 a day. Free catalog. Missouri Auction School, Kansas City.

Models and Model Supplies

Producers of Results: Inventions developed. Models, Experimental Works, anything special in metal to order, novelties, spinning castings in any material, electrical devices, patterns of all kinds, plating, general manufacturing, designing, special tools, punches and dies, stampings. Send drawing or sample. Expert information free. John's Engineering Company, Dept. E, Cleveland, Ohio.

Instruction

Learn to Drum—in ten lessons by simplified method. Great demand for drummers, high salaries. No instruments to buy until you have learned. Surprising low price. Free booklet. Michigan School of Drumming, Dept. 163, Detroit, Michigan.

Scenery for Hire

Collapsible Scenery for all Plays. Amelia Grain, Philadelphia, Pennsylvania.

Agents Wanted

Insyde Tyres, inner armor for automobile tires, double mileage and prevent punctures and blow-outs. Quickly applied. Cost little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, O.

\$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Ave D, Decatur, Ill.

Easy, pleasant work for mechanics, shop men, clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Novelty Cutlery Co., 308 Bar St., Canton, Ohio.

Hel-Met The Kaiser Pin—Latest war novelty. Biggest hit out, every patriotic citizen wants one. Sample 10c. Wedge Mfg. Co., "KM," Binghantown, N. Y.

Books

Free—\$5,000 worth of valuable books as premiums. Write for more information and catalogue; it's free. I have many books on Natural healing, personal magnetism, Clairvoyance, seer-ship, Hypnotism, Mesmerism, concentration, character reading, mind power, etc. Tell me your wants. A. W. Martens, JX8, Burlington, Iowa.

100,000 Large Second Hand and New Books for sale cheap; costly bindings, 25c each; some cost \$25.00 when brand new; Technical, Mechanical, Scientific, Sex, Religious, History, Medicine, Surgery, Chemistry, Encyclopedias, Philosophy, Mathematics, Law, Fiction, International Correspondence School, Text. Improve your mind and self educate yourself. I urge you to send me 10c for big catalogue and make immediate selections. McCarthy, 219 So. Dearborn St., Chicago, Ill.

Electricity Made Simple, 233 pages, 108 illustrations, \$1 each, prepaid, or send for circulars. Satisfaction guaranteed. M. E. Kraybill, Jr., Boiling Springs, Pa.

Bookkeepers and Business Men—Something different in Bookkeeping. Perfection Business Summary. Makes business 100% more interesting and satisfactory. John Capehart, Frankfort, Ky.

To Get Better Pictures: Read the Amateur Photographer's Weekly; illustrated; weekly prize competitions; print criticisms; many unique features; \$1.50 per year; three months' trial subscription 25c. Abel Publishing Company, 401 Caxton Bldg., Cleveland, Ohio.

Fire Sale of Slightly Damaged Books. Due to fire in our stock rooms, a great many of our books were water stained, but not otherwise damaged. Rather than dispose of them to dealers we prefer to give our readers the benefit. Look at this list! Our celebrated Wireless Course, 160 pages, 400 illustration; Experimental Electricity Course, 160 pages, 350 illustrations; How to Make Wireless Sending Instruments. These three books for \$1.00 prepaid. Regular selling price of these three books is \$2.50. We guarantee you will be satisfied. Experimenter Publishing Co., Inc., 233 Fulton St., New York City.

Old E. E. Back Numbers: We have some valuable old E. E. back numbers on hand as follows: 1915—Jan., March, April, June, July, Aug., Sept., Oct., Nov., Dec., price each 35c. 1916—Jan., Feb., March, May, June, August, Sept., Oct., Nov., Dec., price each 35c. 1917—Jan., Feb., March, Apr., May, June, July, Aug., Sept., Oct., each 35c; Nov., Dec., each 20c. 1918—Jan., Feb., Mar., Apr., May, June, July, each 20c; Aug., Sept., Oct., each 15c. We can fill orders at once upon receipt of your remittance, and if you have not these numbers already, now is your chance to get them, as they probably will be snapped up very quickly. Experimenter Publishing Co., 233 Fulton St., New York City.

Business Opportunities

Make Die-Castings. Sketch, Sample, Booklet, and Proposition, 12c. R. Byrd, Box 227, Erie, Pa.

Build up an Income in Oil—Others are doing it—Why not you? Today is the opportunity. Join our easy monthly payment plan NOW—It may mean hundreds in profits. Write for information. National Oil Drilling Co., Dept. K, Houston, Texas.

FREE—Special Offer—\$6.00 worth of Expert Money Making Formulas and \$15.50 in cash given free if you send \$1 for one year's subscription to the "Magic Advertiser," the magazine that pays you to read it. Formulas include Magic Fuel Saver, Egg substitute, Magic Cough Syrup, Indian Salve, Transfer of photos on to watch dials and cases and many others. Send \$1 today. This offer is limited. Address Lindhorst Magic Shop, Dept EX, St. Louis, Mo.

I Made \$20,000 here past four years making burial vaults. Will start you in same permanent business without capital. Absolutely no selling. Stamp brings details. Charles Murphy, Dept. 3, Bloomington, Ind.

Dollars Yearly in Your Backyard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America"; A little story of RESULTS, told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet, which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 West 39th Street, New York.

Mr. Business-Man—Your advertisement here will be read by over 100,000 live prospects. The "Opportunity Ad-lets" of the Electrical Experimenter bring quick and positive results. For proof of what they have done for others address Classified Department, 233 Fulton Street, New York.

Watches

Expert Watch Repairing. Reduced Prices. References, Leo Hirsh, Elkhart, Ind.

Miscellaneous

Scientific Problems Solved—pertaining to electricity, physics, chemistry, electro-therapeutics, radio, etc., for \$1 and up; promptly and correctly. Ephraim Duskins, 1760 Bergen St., Brooklyn, N. Y.

Catch Fish. Descriptive folder containing valuable information mailed for stamp. George Julian, Albany Building, Boston.

Silvering Mirrors, Simple Commercial Formula, \$5. Elmore Lowe, 157 Hines Terrace, Macon, Ga.

Tobacco or Snuff Habit Cured or no pay. \$1.00 if cured. Remedy sent on trial. Superba Co., SA, Baltimore, Md.

Luminous Paint makes watches, clocks, anything visible at night. 25c bottle. Luminous Paint Co., 2426X Polk St., Chicago.

For Sale—Reducing valves, tools of all kinds, stamps and other articles. Write me your needs. Address Store, 1047 Fulton St., Brooklyn, N. Y.

Pyorrhea—H. E. Kely, D. D. S., M. D., pyorrhea specialist for 15 years, has developed a successful home treatment for pyorrhea. Purifying, healing, preventative. Full month's treatment and booklet, \$1. Circular free. Dr. H. E. Kely, Glenwood & Woodland Aves., Leonia, N.J.

Dogs

High Class fox, coon and wolf dogs for sale. Arthur Sampey, Springfield, Missouri.

Patent Attorneys

Patents and trademarks—Send sketch or model for actual search and report. Write for booklet of instructions on patent practice and procedure. Prompt personal service. George P. Khmel, Patent Lawyer, 99-K Oriental Bldg., Washington, D. C.

Millions spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free books—tell how to protect your self, how to invent, ideas wanted, how we help you sell. 212 Patent Dept., American Industries, Inc., Washington, D. C.

Patent Your Own Inventions. Save attorney's fees; we prepare applications; furnish full instructions and give satisfaction. Free information. Carl Larsen Co., Park Row Building, New York City.

M. F. Miller, Ouray Building, Washington, D. C., Patent Attorney, Mechanical and Electrical Expert. Best quality of work and results. Moderate charges. Advice free.

Patents on Easy Payments. Send model or sketch for Free Search and Certified Registration of your Invention for Your Protection. Free Book tells what to invent and How to Obtain a Patent on Easy Payments. C. C. Hines & Co., 593 Loan & Trust Bldg., Washington, D. C.

Your Idea Wanted. Patent Your Invention. I'll help you market it. Send for 4 free books, list of patent buyers, hundreds of ideas wanted, etc. Advice free. Patents advertised free. Richard B. Owen, Patent Lawyer, 130 Owen Bldg., Washington, D. C., or 2278T Woolworth Bldg., New York.

Patents—Without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

Inventions Wanted! Manufacturers constantly writing us for patents. List of inventions actually requested and book "How to Obtain a Patent" sent free. Send rough sketch for free report regarding patentability. Special assistance given our clients in selling patents. Write for details of interest to every inventor. Chandler & Chandler, Patent Attorneys, Est. 21 years, 551 7th St., Washington, D. C.

Photo Developing

Kodakers: How would you like to get a 9 x 11 enlargement of your best negatives free? Drop us a card right now asking about it. Films developed at 10c per roll, prints 3c, 4c and 5c each. Satisfaction guaranteed. Ford's Foto Studio, Ellensburg, Washington.

Mail us 15c with any size film for development and 6 velvet prints. Or send 6 negatives any size and 15c for 6 prints. 8 x 10" mounted enlargements 35c. Prompt, perfect service. Roanoke Photo Finishing Co., 255 Bell Ave., Roanoke, Va.

Stammering

St-stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 105 Potomac Bank Building, Washington, D. C.

Help Wanted

Men, Women, 18 or over, wanted immediately for U. S. Government War positions. Thousands clerical positions open, \$100 month. Easy work. Write immediately for list positions. Franklin Institute, Dept. W26, Rochester, N. Y.

Men Wanted to join American Toy Manufacturers to make Toy Soldiers, Army, Navy and other toys. Homeworkers on small scale. Manufacturers on large scale. Greatest chance for industrious people for independent business. Enormous demand in American Made Toys. War stopped all importation. We buy these goods all year, whole output or surplus over sales, paying fixed prices. Anyone can turn out perfect work without experience or additional tools. Hundreds and more made per hour. Casting form outhits, \$3.00 up. Booklet and information free. Toy Soldier Manufacturing Co., 32 Union Square, N. Y.

To Ascertain the Vocation for which you are best adapted send for Zancig's Revised Horoscope. Send date of your birth and 25c. Prof. Zancig, 109 West 87th St., New York.

Monthly income paid those writing lists of names for us at home, spare time; no supplies to purchase, no investment, expense or other work required; postal brings particulars. National Exchange, Box 1001, New York.

News Correspondents

Earn \$25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Song Poems Wanted

Write the Words for a Song. We write music and guarantee publisher's acceptance. Submit poems on war, love, or any subject. Chester Music Co., 538 S. Dearborn St., Suite 265, Chicago.

Electrical Supplies & Appliances

Electrical Tattooing Machines and supplies, Catalogue FREE. Prof. Temke, Exp., 517 Central, Cincinnati, Ohio.

Make Dry Batteries. Simple, practical instructions with blue print, 25 cents. Dirigo Sales Company, Bath, Maine.

Recharge 25 dry cells for five cents. Directions 10c. Gilbert, 28 Chestnut, Binghamton, N. Y.

Electricians. Send \$1.50 for 16 blue prints of Motor Windings. 10 A. C. Single, two and three-phase, and 6 D. C. or set of 20 A. C., 6 D. C., and 6 Rotary Converter Drawings for \$2.25. Connecting and Winding made easy. Superior Electric Company, Lock Box 1372, Pittsburgh, Pa.

Selenium 97% pure for making two highest sensitive cells with direction for same. One Dollar. Madaler, Experimental Laboratory, Good Ground, L. I.

A Binder for The Electrical Experimenter will preserve your copies for all time. Price, 50c. Postage on 3 lbs is extra. Send for one today. Experimenter Publishing Co., 233 Fulton Street, New York City.

Motion Pictures

Motion Picture Machines bought and sold; bargain lists free. National Equipment Company, Duluth, Minnesota.

Printing

100 Bond Noteheads, 4 lines and 100 envelopes, prepaid, \$1.00 Southwestern, 1413-H Berendo, Los Angeles.

We Print Anything. Cuts made from photographs. Commercial Press, Batavia, Ohio.

Tricks, Puzzles and Games

1000 stage tricks with 500 illustrations. Catalogue 10c, small catalogue FREE. Hornman Magic Co., Sta. 6, 470 Eighth Avenue, New York.

Tricks, Puzzles, Jokes, Toys, Games, Novelties, Doll and Cane Racks, Plays, Wigs, Stage Supplies, Escapes and Illusions. Large 1917 catalogue free. Oakes Magical Co., Dept. 549, Oshkosh, Wis.

Lighting Powder, Sneezing Power, Stink Bombs, Shooting Cigars, Cigarette, Matches, 90c per dozen assorted; six dozen, \$5.00. Lesson in magic and ventriloquism free. Sylvian's Magic Shop, 192 Clifford, Providence, R. I.

Phonographs

Build Your Own Phonographs and manufacture them for profit. Drawing instructions, Parts, Price List, Blue Prints, etc., complete, sent free upon request. Write today. Associated Phonograph Co., Dept. E-1, Cincinnati, Ohio.

Build Your Phonograph. "Perfection" high quality spring and electric Motors, Tone Arms, Reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Indiana Phonograph Supply Co., Indianapolis, Indiana.

Stamps and Coins

Stamps—61 all different free. Postage, 3c. Mention paper. Quaker Stamp Co. Toledo, Ohio.

500 Finely Mixed United States or Foreign Stamps, 12c. Philatelic Star, Madison, N. Y.

California Gold, Quarter Size, 7c; Half-dollar size, 53c; Dollar size, \$1.10; Large cent, 182c and catalogue, 10c. Norman Shultz, Kings City, Mo.

15 Coins, 30 cents per package. Sample coin trays, 25 cents each. Order now. C. Johnson, 100 Maiden Lane, N. Y.

202 Different Stamps, 21c; 100 different U. S., 23c; Luther Club, Box 1054, Detroit, Mich.

200 all different really fine Postage Stamps, 23c. Dayton, East Foxboro, Mass.

Postcards

Everything in Postcards. Live-wire list free. Worth while samples 25c. Mention subjects preferred. Mutual Supply Co., Bradford, Pa.

Twenty Beautiful Postcards, 10c. Castle Co., N. Locust, Hagerstown, Md.

Scientific Exchange Columns

YOU undoubtedly have something you'd like to buy, sell or exchange. In your attic, or workshop, or some far corner of your closet, you probably have dozens of long-forgotten articles, useless to you now, but very useful to someone else. Live readers with something to "swap" or sell have found that the surest and quickest way to make the desired trade is thru and in these columns.

Remember, the U. S. Postal Laws protect you. No one can "do" or cheat you. Of 3,495 "ads" published in these columns during the past five years, only fifteen complaints were reported to us, and each one was adjusted to the full satisfaction of the complainant.

The rates are: *Five cents per word* (name and address to be counted.) *Remittance must accompany all orders.* No advertisement for less than 50c accepted. We reserve the right to refuse any advertisement which we consider misleading or objectionable. Dealers' advertising accepted in Opportunity Ad-let columns only. Advertisements for Dec. issue should reach us not later than Oct. 22.

OVER 100,000 CIRCULATION

Wanted—Bicycle motor attachment or motor-wheel. Harold Lambert, Haverstraw, N. Y.

Swap \$5 moving Picture Machine for chemicals. Morton Wiener, 404 Bay St., Taunton, Mass.

Fifty Dollar Course in Salesmanship—Will exchange for wireless or high frequency apparatus. E. W. Minor, Sargeant St., Hartford, Conn.

Sell—Direct Current 110 volt rheostat. Price \$3.50. Granville Whittlesey, Wilton, Conn.

For Sale—1½" spark coil, condenser, spark gap and Knapp Motor. Practically new. Write Harry Switzer, Dexter, Iowa.

Wanted—Complete set of Electrician's tools. Will buy or swap for set Hawkins' Electrical Guides. Irving Hayman, 188 South Second St., Brooklyn, N. Y.

Sell—Cornet, Chemicals, Storage Battery, Electrical apparatus. Fred Stephan, 516 Carpenter, Oak Park, Illinois.

Wanted—Library of World's Greatest Scientists (7 volumes). Edward Olson, R. No. 1, Mt. Vernon, Wash.

Wanted—A Henderson or other make motorcycle or engine. What have you? A. W. Womack, 2020 Stuart Ave., Richmond, Va.

For Sale Cheap—Lot of small stuff, electrical and otherwise. Write for list quickly. K. M. Smith, Hingham Center, Mass.

Wanted to buy Perforating Telegraph Recorder, lately sold by Electro Importing Co. Box 93, Creighton, Pa.

Wireless, sends 6 miles, receives 700 miles. Price sending, \$4. Receiving, \$7.75. Both, \$10. Never used P. E. Send for list of other electrical things. E. W. Spadoni, Box 179, Summit, Ill.

For Sale—Telegraph Instruments; spark coils; condenser, telescope; microscope. Dickson, 1033 Parkson Place, Cincinnati, Ohio.

Swap—Complete \$20 Receiving Set, \$12. coaster-brake wheel, two E. I. 6-60 dynamos, assortment of electrical goods for a two cylinder motorcycle. All letters answered. A. Weidlich, Jr., 1061 Blake Ave., Brooklyn, N. Y.

Exchange—Courses "Mechanical Engineering," "Electrical Engineering;" Combined Lathe; Saw-Grinder; III-grade Relay Sounder Key; Bosch, Splittdorf racing magnetos; typewriter; automobile generator; mechanical drafting equipment; fine Clarinet. Want: Screw-cutting Lathe; Chemical Laboratory; Wireless; I. C. S. Chemical Engineering; Automobile Powerplant; Motorcycle; Saxophone. What? H. S. C., Box 144, Anderson, Indiana.

Wanted—A good 1 or 1½ K. W. sending transformer, any make. All letters answered. Donald Pratt, 2326 Farragut Ave., Chicago, Ill.

Sell—Each never used: ¼ H. P., 110 D. C. folding machine motor, \$15. Murdock .001 M. F. Variable Condenser, \$3. Grebe Detector Stand, \$3. Gilbert Miller, Delphos, Ohio.

For Sale—\$10 Erector, \$5 or swap. Andrew Ellison, Kirksville, Mo.

Partial List of Subjects Covered

Elements of Electricity—Electrical Measurements—Underwriter's Electrical Requirements—Theory, Calculation, Design and Construction of Direct Current Generators and Motors—Types of Generators and Motors—Management of Electrical Machinery—Electric Lighting—Alternating Current Machinery—Electric Lighting—Alternating Current Machinery—Power Transmission—Electric Railways—Self-Propelled Railway Cars—Trackless Trolleys—Power Stations—Switchboards and Switching—Storage Batteries—Applied Electro-Batteries—Applied Electro-chemistry—Electric Elevators—Electric Welding and Heating—Wireless Telegraphy and Telephony—Land and Submarine Telegraphy.



Complete Electrical Education Yours for Only 7c a Day!

Here at last in book form is the new way to learn electricity. All that has been learned about electricity is clearly explained in the Cyclopedia of Applied Electricity—7 massive volumes, completely indexed. Written by 27 of the country's foremost authorities, in such easy-to-understand language that learning electricity through this library is more fascinating than reading a novel. And you can have this remarkable electrical education in book form for only 7c a day, and at a bargain price.

7 Massive Volumes Shipped Free

These 7 splendid volumes will be sent to you promptly on receipt of coupon. Examine the books in your own home. Read page after page. Note that they are not thin handbooks, but thick, encyclopedia-size volumes, handsomely bound in half-morocco leather, gold stamped. Each one measures 7 by 10 inches, and is 2 inches thick. Over 3,000 illustrations are contained in the 3500 pages. The entire set will be shipped to you, without a penny's deposit, for free examination.

Not One Penny in Advance

Just mail the coupon. When the books arrive read all about Elements of Electricity, Electrical Measurements, Underwriters Requirements, Theory, Calculation, Design and Construction of Generators and Motors, Dynamo-Electric Machinery, Lighting Machinery. Read about every electrical process from wiring bells to wireless telegraphy. Send no money now. If after examination you decide to keep the books pay on easy terms of only 7c a day.

This Bargain Offer Must End

Regular price of these pay-raising books is \$35.00. If after examination you decide to keep the Cyclopedia of Applied Electricity pay only \$2.00 a month until the special advertising price of \$19.80 has been paid. With the books, a year's Consulting Membership in the American Technical Society is included free. Regular price of this membership is \$12.00. It includes the advice of a corps of electrical experts on any questions you may want answered for a whole year free. Mail coupon now. See the books before you decide to buy. You don't risk a penny. This generous offer cannot be continued indefinitely as raising prices of paper and printing will soon force us to increase the price. Mail the coupon this very minute.

Experts Wanted

Electrical Engineers, Substation Operators, Trouble Men, Switchboard Operators and Dynamo Tenders are wanted by light and power companies everywhere. The demand for their services exceeds the supply. Why not prepare yourself—in your spare time—for a job paying \$1,500 to \$5,000 yearly? The Library of Electricity will give you the knowledge you need—in plain everyday language.

American Technical Society
Dept. E 3388
Chicago, U. S. A.

Please send Cyclopedia of Applied Electricity for seven days' examination, I to pay shipping charges. I will send \$2.00 within seven days and \$2.00 a month until I have paid \$19.80 or notify you and hold the books subject to your order. Title not to pass until fully paid.

Name

Address

Reference



Get Started Now

in the

Industry of the Future

There is an opening for you at once in one of America's foremost Aircraft Plants

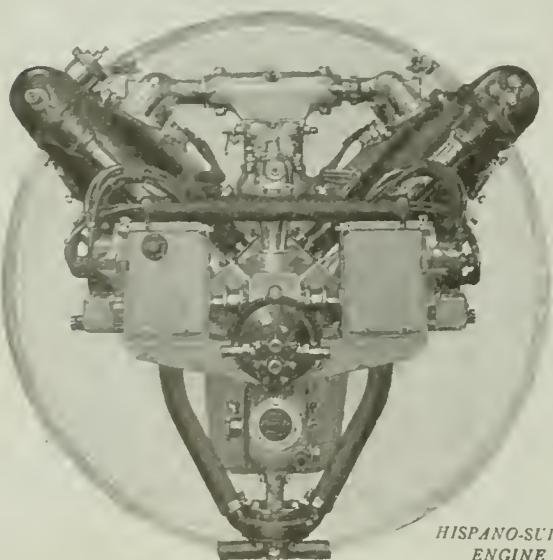
There is a place for you in our New Brunswick (N. J.) or Long Island City Plant where you can earn good wages at the start, serve your country, and at the same time fit yourself for a good position in what is rapidly becoming the foremost industry of the world.

Here is your opportunity to make a place for yourself in a young and growing industry that promises to offer even greater opportunities than were opened up in the pioneer days of the automobile.

Skilled Mechanics and Operators Needed

At present we are engaged solely in the manufacture of aeroplane motors for Pershing's Army.

To meet our ever increasing schedule of production, we must have the man power to operate the machines in our various departments. We want your help. We want skilled mechanics, machine operators, inspectors, draftsmen, etc. *We will pay good wages for the right men.*



HISPANO-SUIZA
ENGINE



Earn While You Learn

To men without any previous technical training we give a thorough and intensive course in our School of Instruction. We pay you during your period of instruction a rate higher than that of many actual shop rates until you are fully trained to hold down a regular job at full factory pay. Period of instruction takes from four to ten days.

need be no dull times for you or your family in New Brunswick.

One Hour from New York City

New Brunswick is just one hour out of New York on the Pennsylvania. It is within short commuting distance of Newark, Elizabeth, Trenton and Philadelphia.

Your Duty Is Here

In fairness to yourself you can't afford to pass up this opportunity to advance yourself and serve your country, too.

Write, phone or apply in person to Employment and Welfare Department, Wright-Martin Aircraft Corporation, New Brunswick, N. J., Div. C1.

Long Island City Plant

Our new Plant at Long Island City has openings for the following:

TOOLMAKERS—
Toolroom Machinists and Grinder Hands.

Tool Temperers.
Tool Trouble Men.

JOB SETTERS for the following:

Acme,
J. & L.

Gisholt,
Milling Machines
Gridley Single Spindle,
Warner & Swasey,
Crankshafts,

Pratt & Whitney,
Internal and External
Grinder Hands.

EXPERT MACHINISTS—

Engine Lathe Hands,
Gisholt Operator,
J. & L. Operator,
Lo Swing Operators,
Crankshaft Grinders,
Crankshaft Lappers

DEMONSTRATORS (EXPERT) who thoroughly understand the machining on the following work:

Crankshaft Lappers.
Acme and Gridley Automatics.

Apply at once, Borden & Starr Aves., Long Island City.

Wright-Martin Aircraft Corporation

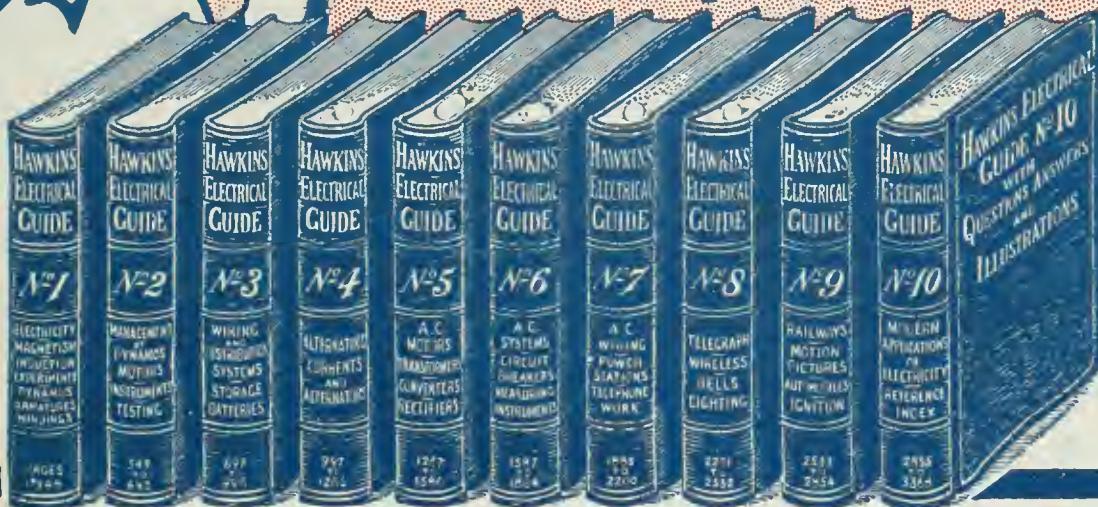
New Brunswick, N. J., U. S. A.





Every Electrical Man Wants These Books and we ship them **FREE** for your inspection

Flexible
Covers
—
Handy
Pocket-
Size
Volumes



10
Volumes
3500
Pages
4700
Pictures
\$1 Per
Volume
\$1 Per
Month

Just what you need to know to succeed in **ELECTRICITY**

EVERY electrician, every engineer, every mechanic should know about these wonderfully helpful instructive books, which give in plain words a complete working knowledge of electrical engineering in all its phases.

You run into some new electrical problem almost every day. The information you need to help you in your every day work is in

HAWKINS ELECTRICAL GUIDES

These books place electricity at your finger ends. They cover every imaginable subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—chock full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering. They will help you in every detail of the day's electrical work. You can't ask an electrical question that Hawkins Guides can't answer.

Pocket-Size Flexible Covers

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers. You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use, you will never again want to be without them. Try it at our expense.

SEND NO MONEY

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay \$1.00 down and remit the balance of \$9.00 on the easy payment of \$1.00 a month till paid for.

Use this coupon to get the books. It will pay you many times over.

THEO. AUDEL & CO.
72 Fifth Ave. New York, N. Y.

SEND NO MONEY-USE THE COUPON

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 359 illustrations. Electrical signs and symbols—static and current electricity—primary—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—horsepower—selection and installation of dynamo and motors—galvanometers—standard cells—current measurement—resistance measurement—voltmeters—wattmeters—watt hour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles—alternating current diagrams—the power factor—alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors—induction motors, transformers; losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 298 pages, 472 illustrations. Alternating current systems—switching devices—circuit breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 316 pages, 379 illustrations. Alternating current, wiring power stations—turbines; management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro plating—electro-therapeutic—X-rays, etc.

Also a complete 126-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides.

There are over 13,500 cross references. You find what you want to know instantly.

THEO. AUDEL & CO.
72 Fifth Avenue
New York, N. Y.

Please submit me for examination Hawkins Electrical Guides (price \$1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you \$1 within seven days and to further mail you \$1 each month until paid.

What Electrical Men Say

Helped Him Make Good

"It is only right for me to recommend highly the Hawkins Guides, for they have been of the greatest assistance to me in placing me in my present position as Superintendent of Construction Department of one of Ohio's largest Electrical Companies. I would like to see every man have a set of Hawkins Guides."
Geo. Knecht, Columbus, Ohio.

In the Naval Electrical Dept.

"The Hawkins Guides are great help to me in the Naval Electrical Department, which they cover very thoroughly."
C. J. Cornell,
U. S. Receiving Ship, Brooklyn, N. Y.

Superintendent

"I am now superintendent of the Dunnville Hydro-Electric Systems, and Hawkins Guides were a great help to me in holding down a responsible position."
W. E. Swartz, Dunnville, Ontario.

Wireless Operators

"I have worked wireless for ten years—but I wish I had these books years ago, as they have saved me a great deal of trouble."
H. Marshall,
Steamer M & B No. 2,
Walkerville, Ont.

Signature

Occupation

Business Address

Residence

Reference

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers



These Are The Hours That Count

MOST of your time is mortgaged to work, meals and sleep. But the hours after supper are *yours*, and your whole future depends on how you spend them. You can fritter them away on profitless pleasure, or you can make those hours bring you position, money, power, *real success* in life. Thousands of splendid, good-paying positions are waiting in every field of work for men *trained to fill them*. There is a big job waiting for *you*—in your present work or any line you choose. Get ready for it! You can do it without losing a minute from work or a wink of sleep, without hurrying a single meal, and with plenty of time left for recreation. You can do it in one hour after supper each night, right at home, through the International Correspondence Schools.

Yes—You Can Win Success in an Hour a Day

Hundreds of thousands have proved it. The designer of the Packard, "Twin Six" and hundreds of other Engineers, climbed to success through I.C.S. help. The builder of the great Equitable Building, and hundreds of Architects and Contractors, won their way to the top through I.C.S. spare-time study. Many of this country's foremost Advertising and Sales Managers prepared for their present positions in spare hours under I.C.S. instruction.

For 26 years men in offices, stores, shops, factories, mines, railroads—in every line of technical and commercial work—have been winning promotion and increased salaries through the I.C.S. Over 100,000 men are getting ready *right now* in the I.C.S. way for the bigger jobs ahead.

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 6162, SCRANTON, PA.

TEAR OUT HERE
Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- | | | |
|--|---|--|
| <input type="checkbox"/> ADVERTISING | <input type="checkbox"/> ELECTRICAL ENGINEER | <input type="checkbox"/> MECHANICAL ENGINEER |
| <input type="checkbox"/> SALESMANSHIP | <input type="checkbox"/> Electrician | <input type="checkbox"/> Mechanical Draftsman |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Electric Wiring | <input type="checkbox"/> Machine Designer |
| <input type="checkbox"/> BUSINESS (complete) | <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Machine Shop Practice |
| <input type="checkbox"/> Commercial Law | <input type="checkbox"/> Electric Car Running | <input type="checkbox"/> Boilermaker or Designer |
| <input type="checkbox"/> Certified Public Accountant | <input type="checkbox"/> Heavy Electric Traction | <input type="checkbox"/> Patternmaker |
| <input type="checkbox"/> Higher Accounting | <input type="checkbox"/> Electrical Draftsman | <input type="checkbox"/> Toolmaker |
| <input type="checkbox"/> Railway Accountant | <input type="checkbox"/> Electric Machine Designer | <input type="checkbox"/> Foundry Work |
| <input type="checkbox"/> BOOKKEEPER | <input type="checkbox"/> Telegraph Engineer | <input type="checkbox"/> Blacksmith |
| <input type="checkbox"/> Stenographer & Typist | <input type="checkbox"/> Telephone Work | <input type="checkbox"/> Sheet-Metal Worker |
| <input type="checkbox"/> Good English | <input type="checkbox"/> ARCHITECT | <input type="checkbox"/> STEAM ENGINEER |
| <input type="checkbox"/> Window Trimmer | <input type="checkbox"/> Architectural Draftsman | <input type="checkbox"/> Stationary Fireman |
| <input type="checkbox"/> Show-Card Writer | <input type="checkbox"/> Contractor and Builder | <input type="checkbox"/> MARINE ENGINEER |
| <input type="checkbox"/> Sign Painter | <input type="checkbox"/> Building Foreman | <input type="checkbox"/> GAS ENGINE OPERATING |
| <input type="checkbox"/> CIVIL SERVICE | <input type="checkbox"/> Carpenter | <input type="checkbox"/> Refrigeration Engineer |
| <input type="checkbox"/> Railway Mail Clerk | <input type="checkbox"/> Concrete Builder | <input type="checkbox"/> CIVIL ENGINEER |
| <input type="checkbox"/> Mail Carrier | <input type="checkbox"/> PLUMBER & STEAM FITTER | <input type="checkbox"/> Surveying and Mapping |
| <input type="checkbox"/> CARTOONIST | <input type="checkbox"/> Heating and Ventilation | <input type="checkbox"/> R. R. Constructing |
| <input type="checkbox"/> Illustrator | <input type="checkbox"/> Plumbing Inspector | <input type="checkbox"/> Bridge Engineer |
| <input type="checkbox"/> Perspective Drawlog | <input type="checkbox"/> Foreman Plumber | <input type="checkbox"/> SHIP DRAFTSMAN |
| <input type="checkbox"/> Carpet Designer | <input type="checkbox"/> CHEMIST | <input type="checkbox"/> Structural Draftsman |
| <input type="checkbox"/> Wallpaper Designer | <input type="checkbox"/> Analytical Chemist | <input type="checkbox"/> Structural Engineer |
| <input type="checkbox"/> Bookcover Designer | <input type="checkbox"/> MINING ENGINEER | <input type="checkbox"/> Municipal Engineer |
| <input type="checkbox"/> TEACHER | <input type="checkbox"/> Coal Mining | <input type="checkbox"/> NAVIGATION <input type="checkbox"/> Spanish |
| <input type="checkbox"/> Common School Subjects | <input type="checkbox"/> Metal Mining | <input type="checkbox"/> Motor Boat Runn'g <input type="checkbox"/> French |
| <input type="checkbox"/> High School Subjects | <input type="checkbox"/> Metallurgist or Prospector | <input type="checkbox"/> AGRICULTURE <input type="checkbox"/> Italian |
| <input type="checkbox"/> Mathematics | <input type="checkbox"/> Assayer | <input type="checkbox"/> Fruit Growing |
| <input type="checkbox"/> AUTOMOBILE OPERATING | <input type="checkbox"/> TEXTILE OVERSEER/SEPT. | <input type="checkbox"/> Vegetable Growing |
| <input type="checkbox"/> Automobile Repairing | <input type="checkbox"/> Cotton Manufacturing | <input type="checkbox"/> Live Stock and Dairying |
| <input type="checkbox"/> Auto. Electrical Work | <input type="checkbox"/> Woollen Manufacturing | <input type="checkbox"/> POULTRY RAISING |

Name _____
 Occupation _____ Employer _____
 Street and No. _____
 City _____ State _____

Canadians may send this Coupon to
International Correspondence Schools, Montreal, Can.

Your Chance Is Here!

No matter where you live, the I.C.S. will come to you. No matter what your handicaps, or how small your means, we have a plan to meet your circumstances. No matter how limited your previous education, the simply written, wonderfully illustrated I.C.S. textbooks make it easy to learn. No matter what career you may choose, some one of the 280 I.C.S. Courses will surely suit your needs.

Make Your Start Now!

When everything has been made easy for you—when one hour a day spent with the I.C.S. in the quiet of your own home will bring you a bigger income, more comforts, more pleasures, all that success means, can you afford to let another single priceless hour of spare time go to waste? Make your start right now! This is all we ask: Without cost, without obligating yourself in any way, put it up to us to prove how we can help you.

**Just Mark
and Mail This Coupon**