SPECIAL RADIO ISSUE

Science and Invention

APRIL
25 cents

FORMERLY
ELECTRICAL EXPERIMENTER

Awards of the $300.00 RADIO PRIZE CONTEST "The Simplest Radio Outfit"

THE SUPER NOSE

See Page 1113

You Can Learn to Boss This Job

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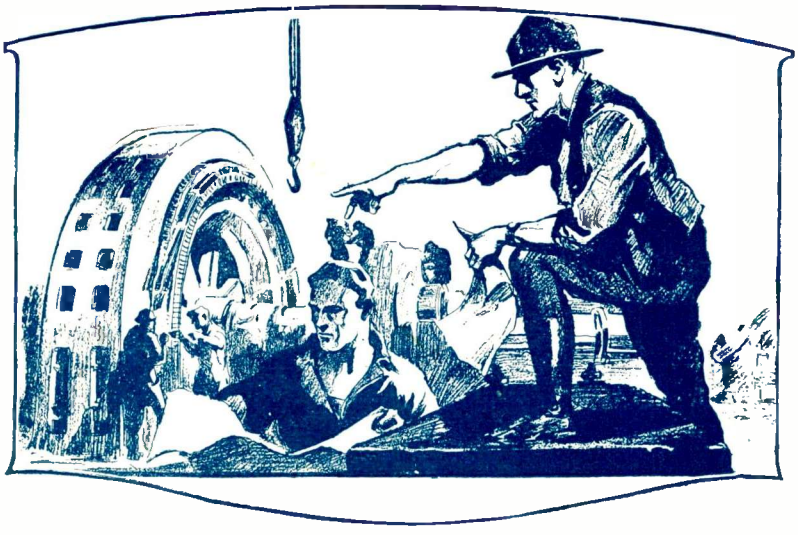

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Vol. IX
Whole No. 108

Science and Invention

FORMERLY

ELECTRICAL EXPERIMENTER

233 FULTON STREET-NEW YORK

April, 1922
No. 12

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Publishers of SCIENCE AND INVENTION, RADIO NEWS, and PRACTICAL ELECTRICS

Radio Broadcasting

A GREAT change has come about in the last two months. Overnight, the public seems to have "gone mad" over Radio. Laymen and others who have never paid the slightest attention to Radio before, are storming the Radio supply houses in a frantic search for Radio instruments, only to be disappointed as a rule because there is not enough material to satisfy the tremendous demand. There are now close to eighty broadcasting stations in the United States, new ones being added daily. These stations supply free entertainment to the masses and it is estimated that there are already over 1,000,000 Radio outfits of every sort and description in the United States.

This art is so new that it would be futile to guess what it will be like in ten years to come, but we can make certain prophecies that we are sure will be verified. At present let us say Newark or Pittsburg is sending out some information or entertainment. We sit in our parlor and our friends listen to it by means of a loud speaking receiver. It may be a dry lecture or some other form of entertainment that we do not like. The best we can do at present is to turn off a switch which will silence the loud-talker. In the future we will not be dependent upon just one form of entertainment, but we will be able to choose for ourselves as to whether we should have jazz, grand opera or a sermon. The present broadcasting stations use a wave length of 360 meters. In the future, each broadcasting station will have a dozen or more laboratories from which different forms of entertainment will be sent simultaneously, each on its own wave length.

For instance, the latest jazz selection may go out on 360.25 meters; a sermon will be broadcasted at 360.87 meters; a grand opera selection will go out at 360.50 meters. In other words, our tuning will be so refined that the different variations, differing by less than a fraction of a meter, will be perfectly distinguished and separated by the recipient, and will be reproduced without interference at the receiving end.

In the next few years it will be possible for us to take our meals with music, if we choose to do so, and after consulting the daily program we will only need to set the knob at the prescribed wave length, in order to get the form of entertainment desired.

If we wish, we can set our alarm clock in the morning, which in turn will set off the Radio outfit, and instead of being disturbed by a harsh alarm bell, our awakening will be to any tune that we have selected the night before.

One of the important things confronting the broadcasting stations is: How will they be paid for their service?

This applies particularly to broadcasting stations which cannot get indirect results from the sale of Radio apparatus, use of Radio patents, etc. Of course, some such stations, owned by department stores and newspapers, will continue broadcasting from the advertising motive, but let us say that the Metropolitan Opera Company of New York desires to broadcast their entire program. They would wish to be paid for the service. It would be impossible to force everyone who listens to pay, because everyone would listen-in anyway, unless means were found to prevent them. Such a means will be found very shortly; as a matter of fact one means exists to-day.

It is very simple. Suppose the Metropolitan Opera Company were to make a charge of say $3.00 per month for listening in to their broadcast. They would not publish in the newspapers or in any other manner the wave length on which they would broadcast. Such information would be sent by mail to subscribers only. After every act the wave length would be changed. Now we are all aware that if we do not know at what wave length a station is sending, it is difficult to quickly tune in. By trial we may succeed, but much of the music would be lost during our struggles with the tuning. Most people would pay a certain amount for the information, which would enable them to listen to the entire entertainment without having to hunt for a certain wave length.

H. GERNSBACK.

Contents for April, 1922

THE SUPER-NOSE ..... Front Cover
From a painting by Howard V. Brown
PILOTLESS PLANE CROSSES ENGLISH CHANNEL 1109
WHY NOT DOUBLE-DECK SUBWAYS 1110
By H. Gernsback, Member American Physical Society
AIRSHIP "ROMA" FALLS AND BURNS UP 1111
AUTOMATIC TRAIN CONTROL 1112
By C. S. Corrigan, C. E.
DR. HACKENSAW'S SECRETS.—No. 4—The SUPER-NOSE 1113
By Clement Fezandié
SNOW-FALL AND ROOF-FALL—WHY THE WASHINGTON THEATRE DISASTER OCCURRED 1116
By Charles Nevers Holmes
FOOD ADULTERANTS DETECTED MICROSCOPICALLY 1120
By Leon Augustus Hausman, Ph. D.
STONES THAT TALK 1122
By Dr. Alfred Gradenwitz
ELECTRIC COATING OF METALS 1124
By Robert G. Skerrett
POPULAR ASTRONOMY—DARK MARKINGS IN SKY 1126
By Isabel M. Lewis, M. A. of the U. S. Naval Observatory.
MOTOR HINTS—$50.00 PRIZE CONTEST 1128
PRACTICAL CHEMICAL EXPERIMENTS 1129
By Prof. Floyd L. Darrow
HOW-TO-MAKE-IT DEPARTMENT — $30.00 PRIZE CONTEST 1135
WRINKLES, RECIPES AND FORMULAS 1138
Edited by S. Gernsback
ANNOUNCEMENT OF PRIZE WINNERS IN $300.00 RADIOPHONE RECEIVING CONTEST 1140
NATIONAL RADIO BROADCAST BY BELL SYSTEM —ILLUSTRATED 1144
RADIO LOUD-TALKERS—HOW TO MAKE YOUR OWN EFFICIENTLY AND CHEAPLY 1146
By Henry Townsend
"THE RADIO BROADCAST"—THE FIRST AUTHENTIC AND COMPLETE LIST OF ALL THE RADIOPHONE BROADCASTING STATIONS IN UNITED STATES, WITH MAP 1148
RADIO FOR THE BEGINNER—No. 2 OF AN ELEMENTARY SERIES 1150
By Armstrong Perry

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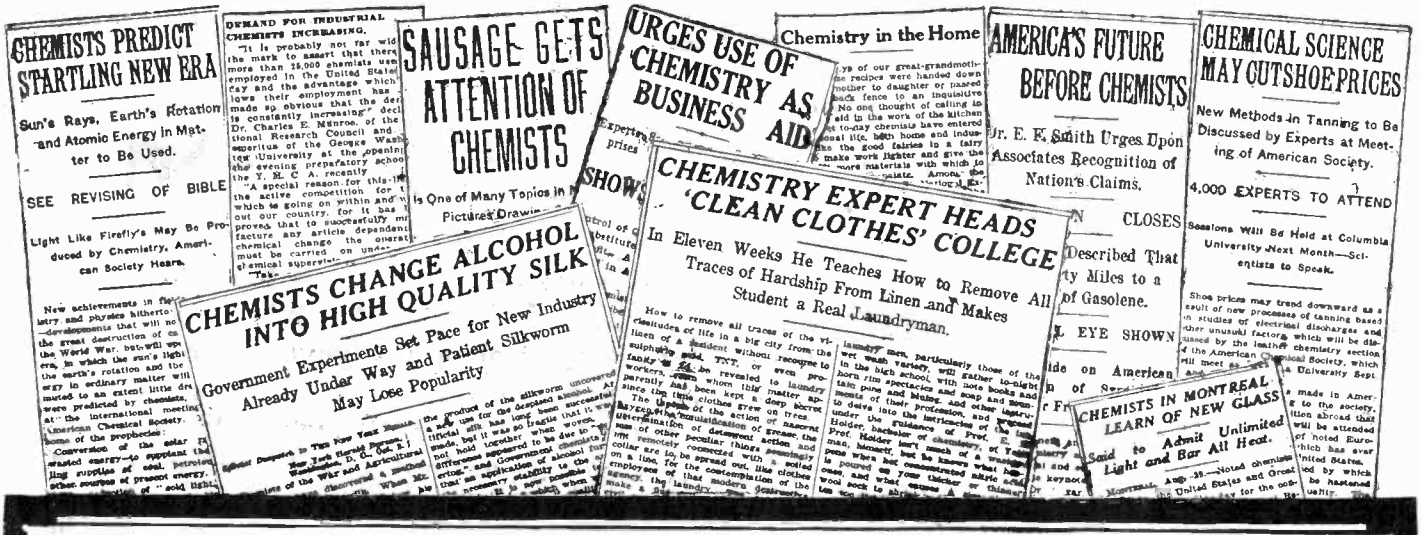

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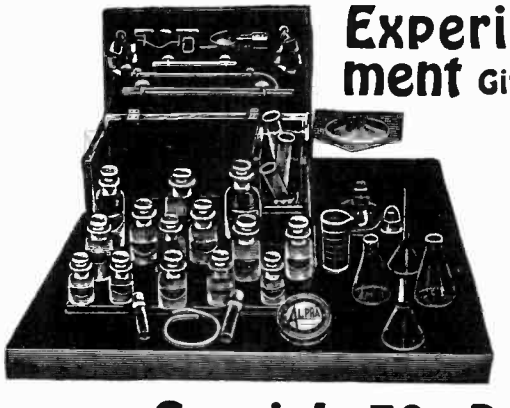

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S. I. April '22

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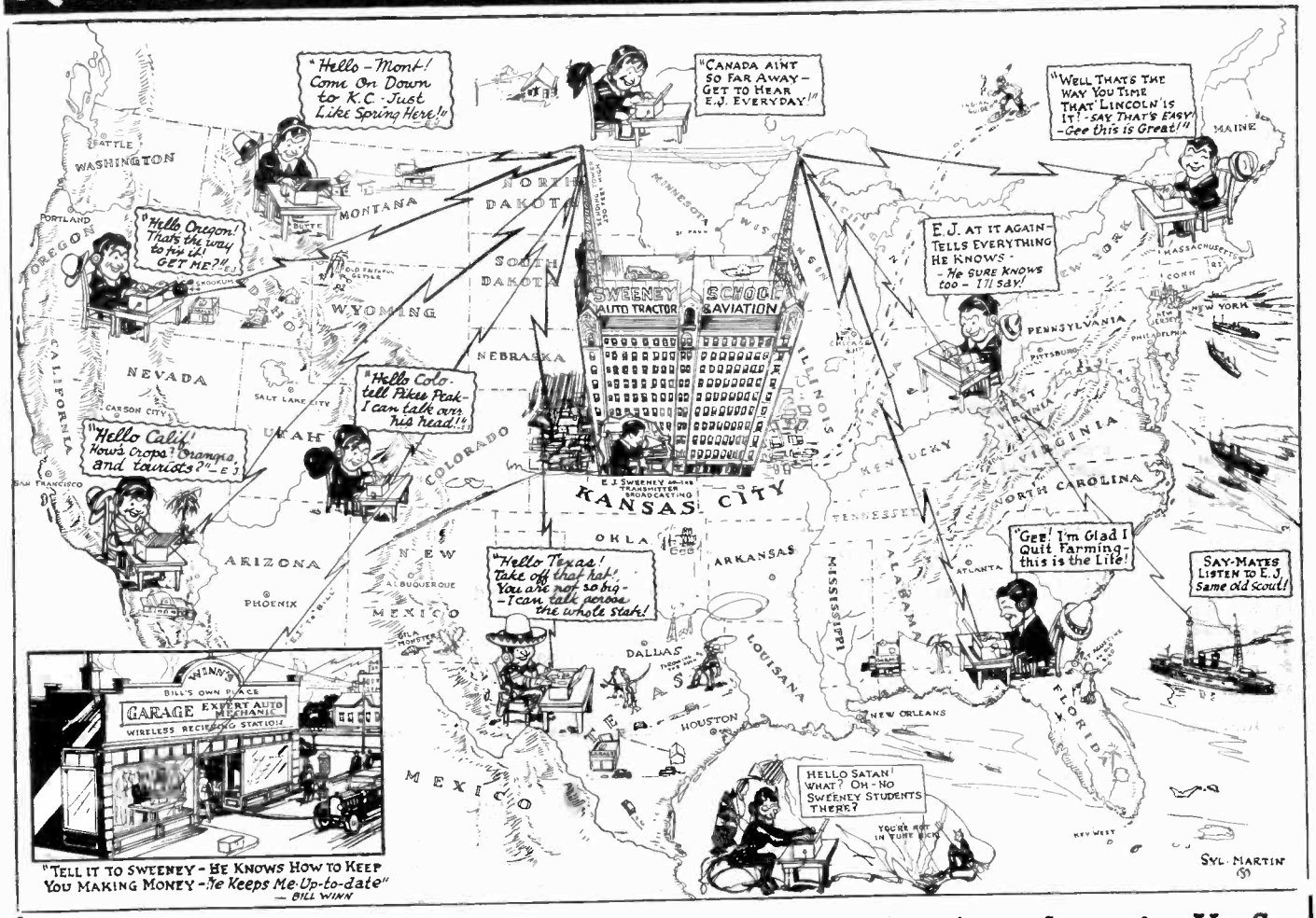

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WHO IS THE RIGHT MAN?

to have the agency for or make radio receiving sets? To install sets? The garage man or auto mechanic? At the Sweeney School learn how to handle radio work. Get an agency for a $25 receiving set. The first week you are home you can EARN the whole cost of your school tuition.

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What's Wrong in This Picture?

It's so easy to make embarrassing mistakes in public—so easy to commit blunders that make people misjudge you. Can you find the mistake or mistakes that are being made in this picture? Can you point out what is wrong? If you are not sure, read the interesting article below, and perhaps you will be able to find out.

IT is a mark of extreme good breeding and culture to be able to do at all times exactly what is correct. This is especially true in public where strangers judge us by what we do and say. The existence of fixed rules of etiquette makes it easy for people to know whether we are making mistakes or whether we are doing the thing that is absolutely correct and cultured. They are quick to judge—and quick to condemn. It depends entirely upon our knowledge of the important little rules of etiquette whether they respect and admire us, or receive an entirely wrong and prejudiced impression.

In public, many little questions of good conduct arise. By public, we mean at the theatre, in the street, on the train, in the restaurant and hotel—wherever men and women who are strangers mingle together and judge one another by action and speech. It is not enough to *know* that one is well-bred. One must see that the strangers one meets every day get no impression to the contrary.

Do you know the little rules of good conduct that divide the cultured from the uncultured, that serve as a barrier to keep the ill-bred out of the circles where they would be awkward and embarrassed? Do you know the important rules of etiquette that men of good society must observe, that women of good society are expected to follow rigidly? Perhaps the following questions will help you find out just how much you know about etiquette.

Do You Know—

- ***how*** to introduce men and women correctly?
- ***how*** to answer a dinner invitation?
- ***how*** to greet a man or woman acquaintance in public?
- ***how*** to plan church and house weddings?
- ***how*** to use table silver properly?
- ***how*** to word invitations and acknowledgments?
- ***how*** to avoid blunders at the theatre and opera?
- ***how*** to do at all times the thing that is absolutely correct and cultured?

Etiquette at the Theatre

When a man and woman walk down the theatre aisle together, should the man precede the woman? May they walk arm-in-arm? When the usher indicates their places, should the woman enter first or the man?

Many puzzling questions of conduct confront the members of a theatre party who occupy a box. Which seats should the women take and which the men? Should the women remove their hats—or don't they wear any? What should women wear to the theatre in the evening? What should men wear? Is it correct for a man to leave a woman alone during intermission?

At the theatre, evidences of good conduct can be more strikingly portrayed than perhaps anywhere else. Here, with people surrounding us on all sides, we are admired as being cultured, well-poised and attractive, or we are looked upon as coarse and ill-bred. It depends entirely upon how well one knows and follows the rules of etiquette.

At the Dance

How should the man ask a woman to dance? What should he say to her when the music ceases and he must return to his original partner? Do you know the correct dancing positions?

How should a woman accept a dance and how should she refuse it? How can the embarrassment of being a wall-flower be avoided? How many times may a girl dance with the same partner without breaking the rules of etiquette? Is it considered correct, in social circles, for a young woman to wander away from the ball-room with her partner?

Very often introductions must be made in the ball-room. Should a man be introduced to a woman, or a woman to a man? Is it correct to say, *Miss Brown, meet Mr. Smith* or *Mr. Smith, meet Miss Brown?* Which of these two forms is correct: *Bobby, this is Mrs. Smith* or *Mrs. Smith, this is Bobby?* When introducing a married woman and a single woman should you say, *Mrs. Brown, allow me to present Miss Smith* or *Miss Smith, allow me to present Mrs. Brown?*

When leaving the ball-room, is the guest expected to thank the hostess? What should the woman guest say when she leaves? What should the gentleman guest say? It is only by knowing exactly what is correct, that one can avoid the embarrassment and humiliation of social blunders, and win the respect and admiration of those whom one comes in contact with.

In the Street

There are countless tests of good manners that distinguish the well-bred in public. For instance, the man must know exactly what is correct when he is walking with a young woman. According to etiquette, is it ever permissible for a man to take a woman's arm? May a woman take a gentleman's arm? When walking with two women, should a man take his place between them or on the outside?

When is it permissible for a man to pay a woman's fare on the street-car or railroad? Who enters the car first, the woman or the man? Who leaves the car first?

If a man and woman who have met only once before encounter each other in the street, who should make the first sign of recognition? Is the woman expected to smile and nod before the gentleman raises his hat? On what occasions should the hat be raised?

People of culture can be recognized at once. They know exactly what to do and say on every occasion, and because they know that they are doing absolutely what is correct, they are calm, well-poised, dignified. They are able to mingle with the most highly cultivated people, in the highest social circles, and yet be entirely at ease.

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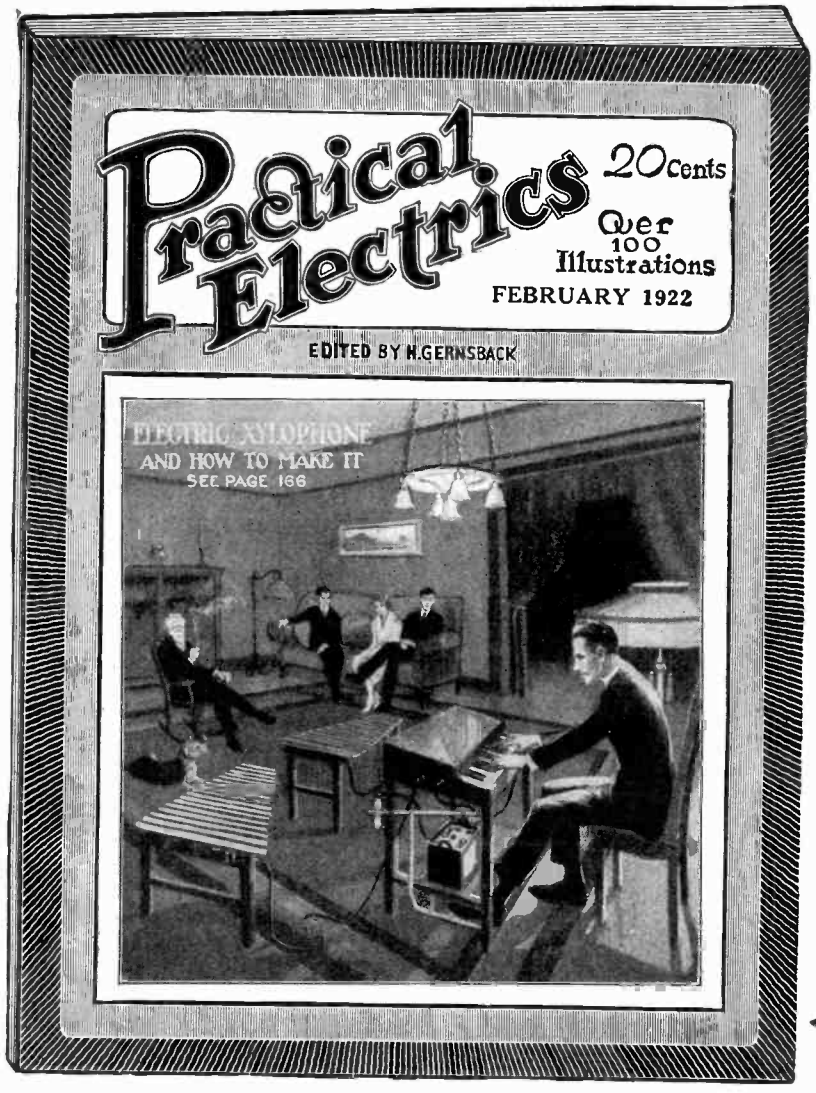

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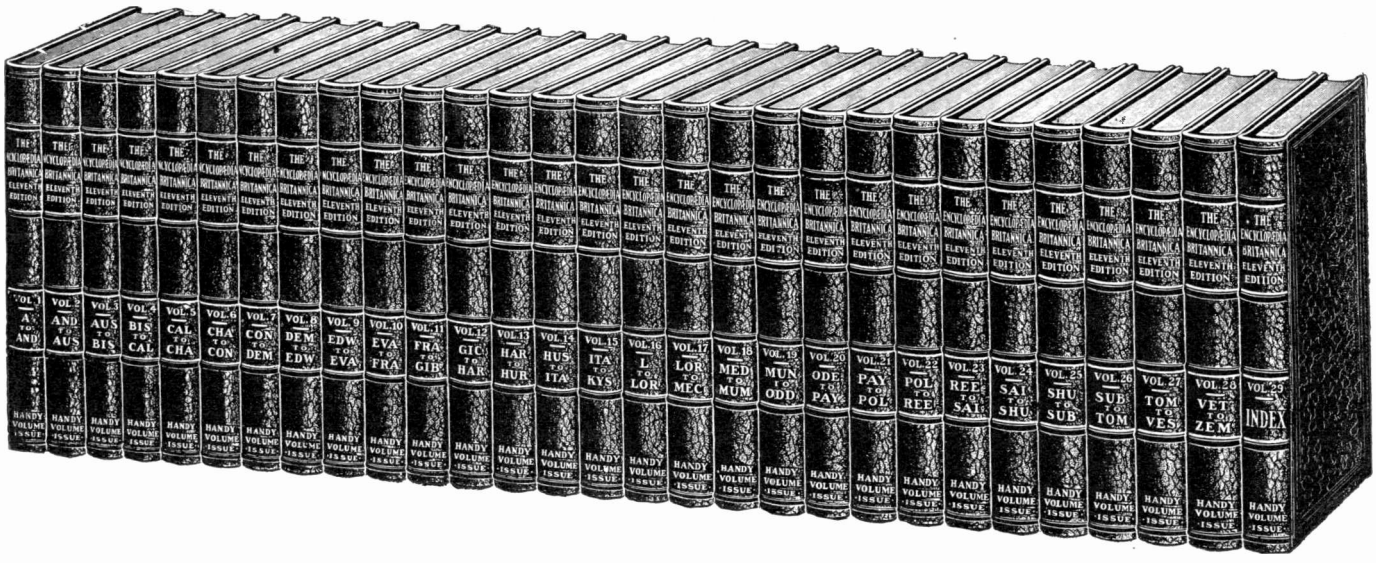

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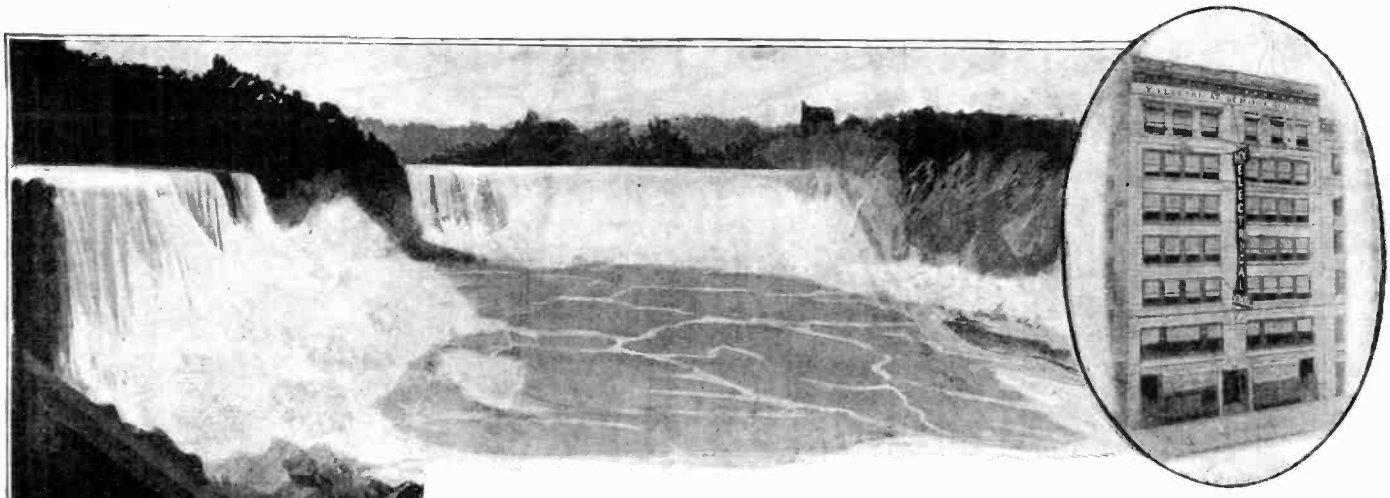

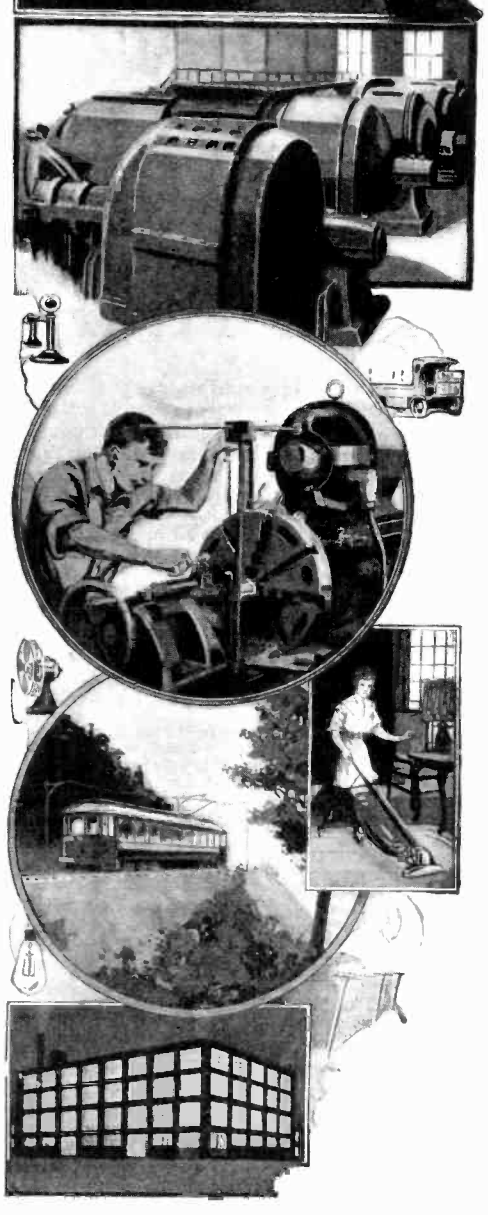

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Volume IX
Whole No. 108

Science and Invention

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APRIL
1922
No. 12

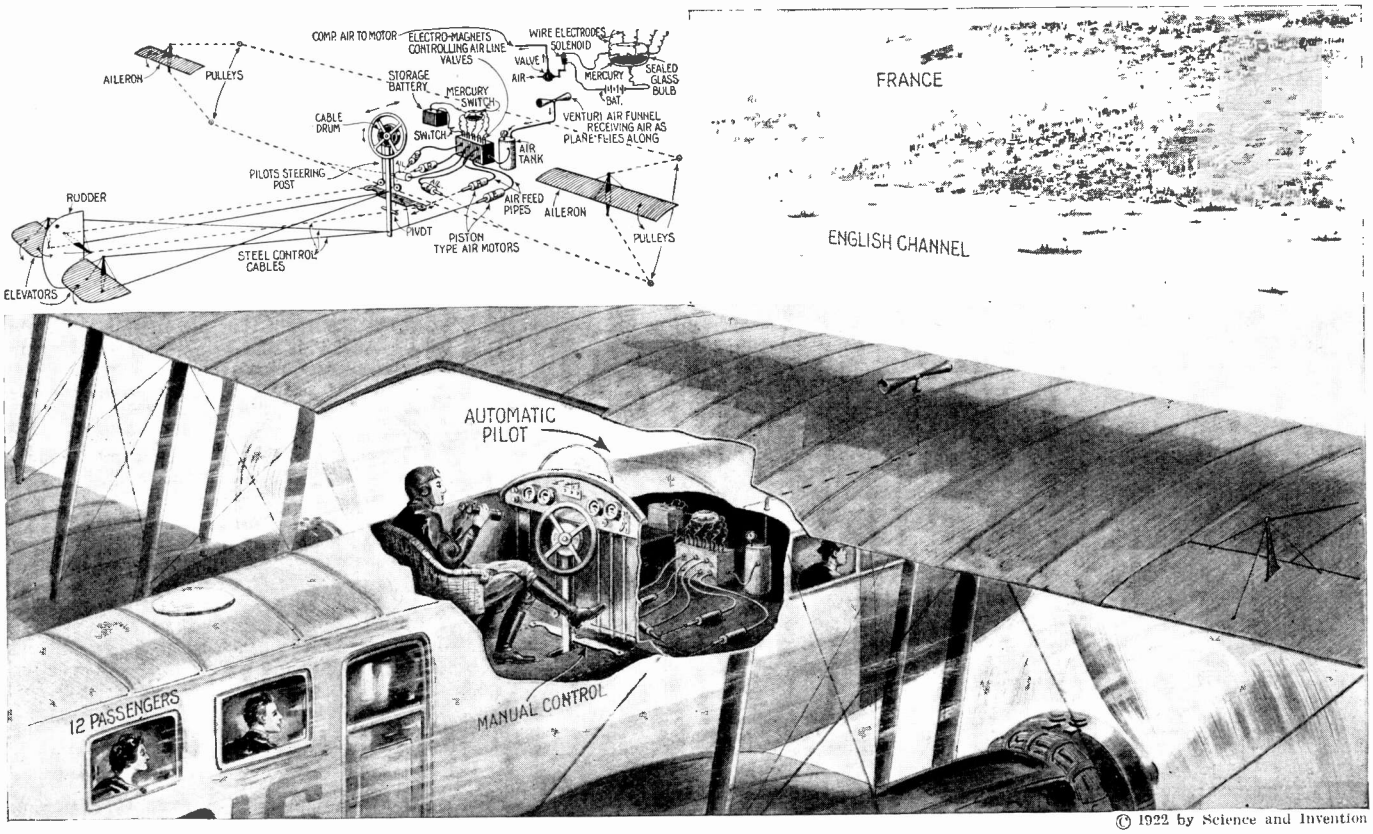
Pilotless Plane Crosses English Channel

PILOTLESS airplanes have been proposed by various inventors ever since the first heavier-than-air craft was successfully flown by the Wright Brothers, but it was not until recently, or February 11th to be exact, that a demonstration was given of a reliable mechanical air pilot. This electro-mechanical steering device guided a giant twin-engined Farman-Goliath airplane across the English Channel. The great bird of the air carried twelve passengers besides the pilot. The craft was maneuvered to a height well over 1,000 feet, under the guidance of its human pilot, when he threw the lever which connected the mechanical substitute to the aileron and rudder controls. The pilot then put his hands in his pockets and removed his feet from the control; the airplane with its human cargo traveled on for many miles steadily, the automatic steering and stabilizing apparatus correcting for air currents before the movement became perceptible to the human brain.

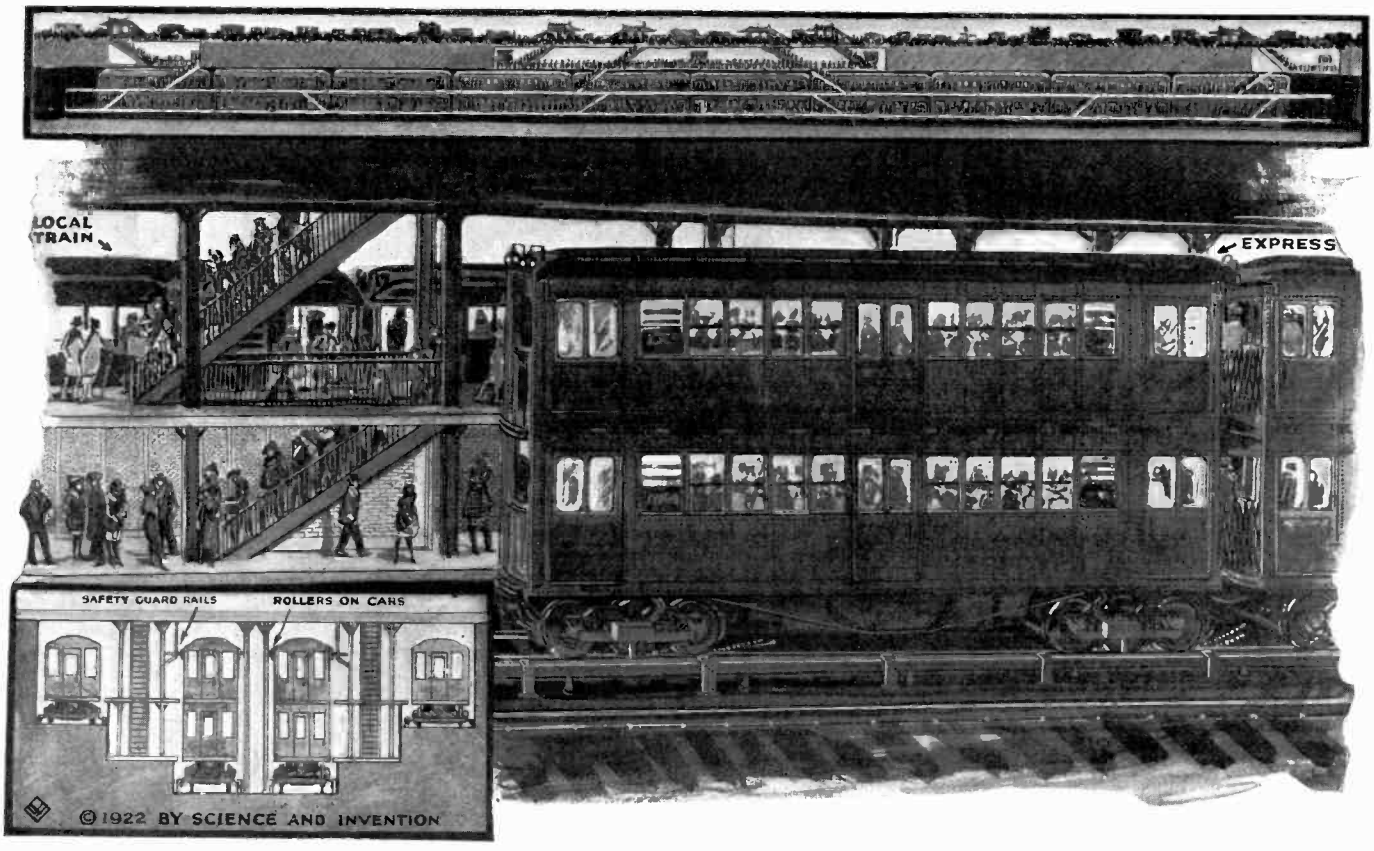
The inventor of this electro-mechanical airplane steering device is Mr. George Aveline, and in cable dispatches it is stated that the main principle of his invention is a quicksilver or mercury switch, which serves to open and close suitable valves connected with a compressed air motor system, as the accompanying diagram shows, so that as the airplane turns or rises and falls, the mercury, tending to preserve a constant level, short-circuits or open-circuits two or more sealed-in platinum wire electrodes in the glass switch chamber. The air necessary for operating the motor-controlled cylinders and pistons is obtained from a Venturi tube, arranged as shown in the diagram, which causes a downward air pressure as the plane speeds along at 80 to 100 miles an hour. The air rushing down the pipe leading from the Venturi funnel is trapped by means of check-valves, and stored in a tank, from which storage tank the necessary pulses of air are distributed into the various actuating cylinders connected with the different control wires by means of electro-mechanical actuated air valves, as illustrated in the diagram.

A number of automatic, electro-mechanical airplane pilots have been suggested and devised from time to time, many of them depending upon the movements of a gyroscope or rapidly rotating wheel, with which we are all familiar, in the form of a gyroscopic top. The spinning gyro wheel tends to preserve a fixed plane of revolution as the airship swerves up and down, and advantage has been taken by some inventors of this gyroscope action to arrange a series of electrical contacts about the spinning gyro, so that when the frame of the gyro moves with the airplane body, various contacts would be short-circuited or opened as the case might be, and a suitable control effected through its agency by electro-magnets or compresst air cylinders, which would raise and lower the horizontal rudders and the ailerons at the tips of the wings. The diagram herewith

(*Continued on page* 1164)



At Last an Automatically Stabilized Airplane Has Succeeded in Crossing the English Channel—a Gusty and Very Tricky Passage Indeed. After Arising to a Fair Altitude, the Pilot Let Go of the Controls, the Electro-Mechanical Control Device Steering the Plane and its Twelve Passengers, as Well as Compensating for Wind Changes and Air Currents, Long Before the Human Pilot Was Aware of Them.



Why Not Double-Deck Subways for the Larger Cities, Like New York, Philadelphia, Boston and Chicago, Where the Traffic Congestion Problems Have Reached Unbelievable Proportions? Some Engineers Have Advocated, in New York City for Example, the Use of More Subways, Spreading These Along the Different Avenues. The Present Writer, However, Has Struck on the Idea of Using Double-Deck Subway Cars Which Could be Readily Adapted to the Present Subway System, While it is in Operation, and at a Minimum of Expense, Time and Labor. The Greater Head Room Required for These Cars Would Necessitate Excavating and Shoring Up the Tracks, Section by Section, to Prevent the Interruption of Traffic.

Why Not Double-Deck Subways?

By H. Gernsback

Member of American Physical Society

AT the present time the inventor who can relieve the shameful conditions existing in our great local transportation arteries will be the man of the hour. Take, for instance, the subways of New York. It has come to a point where a ride becomes a physical hardship. If nothing is done to relieve this condition, it will, no doubt, affect the population adversely in the next generation. It is impossible or impractical today to run more than ten-car express trains. Neither can we run the trains faster than we do now, nor can we run more trains. As the city expands, more and more people crush into the subways and the hardship becomes more pronounced every day.

I propose a plan that has been thought out carefully, which is possible from an engineering standpoint, and which will immediately increase the capacity of the present subways 100 per cent. The illustration which I present herewith explains the idea. It simply means double-decking our present subway cars, making them similar to our buses in use today. By this double-decking the carrying capacity of each train will be increased exactly 100 per cent. The cars, of course, would be almost twice as high as they are now, or, to be exact, about 80 per cent. higher. Physically each of the two decks of the new cars would be exactly like the one deck of today, seats and standing room just as at present. There would be no stairs connecting the upper and lower level of the car. Passengers would board the new double car in the same manner as they do now. This necessitates, of course, two platforms, one above the other. The upper and the lower doors of the new cars would all open simultaneously, so that the loading of the upper and the lower level would take place at the same time. There is no technical difficulty in this. All we need to do is to build new platforms directly underneath the old ones, and to lower the road-bed of the present tracks about six and one-half feet. This also presents no engineering difficulties to-day, as the entire excavation can be done without ever stopping a train. The new road-bed would be excavated right below the present tracks, which latter would be underpinned, the same as our streets are underpinned today when we build a new subway. Traffic is never interfered with.

When the new road-bed with the tracks and electrical equipment is finished, it will take less than a month to knock out the remaining portion of the old track bed. During that time it would be possible to accommodate all the traffic on the present local tracks, running the locals as expresses southward in the morning, and northward in the evening. Anyway the hardship would not be any worse than it is today and could be endured for a month. Then the new cars would be installed and within four or five weeks at the most our subways would have a doubled capacity. I do not think that it would be necessary to use double-deck cars on the local tracks, as a study reveals that locals are never very busy anyway, even during rush hours. If necessary a change to the double-deck cars could always be made at any time later.

It might be thought that such cars would be very heavy and cumbersome, but such is not the case. Their weight would not be more than 25 per cent. above the weight of our present cars, which includes the extra 100 per cent. of passengers that they will carry.

From the operating standpoint it should also be noted that the double-deck cars would not cost much more to haul than the present ones. There would not be an increase of 10 per cent., and this should be very interesting to our traction companies, who would be able to collect more fares at practically no expenditure. No extra conductors would be absolutely necessary for these cars, but extra men would be required on the new platforms.

Contrary to the popular opinion, double-deck cars would not be top-heavy because so much of the weight would still remain in the trucks and motors at the bottom. Guard rails could be placed along the track, and rollers on the cars. These would serve the purpose of preventing the cars from tipping over while going around curves, should their motion become too rapid. There is, however, little danger of this, as operation of our present buses shows. It is an unheard-of occurrence for such a bus to tip over, the reason, of course, being that the center of gravity is very low.

A new idea which I term *"division of traffic"* would be possible with the double-deck cars. In the evening rush hours the upper deck would be unavailable for passengers *below* Forty-second Street. That means that passengers entering the train at Forty-second Street would find an empty train as far as they are concerned. That is impossible at present. In the morning hours the scheme can be reversed as would be found best by actual operation.

The entire scheme which I propose here could be put into operation at once without trouble within a year's time, and providing sufficient labor were used, quick relief could be had for the city.

Airship "Roma" Falls and Burns Up

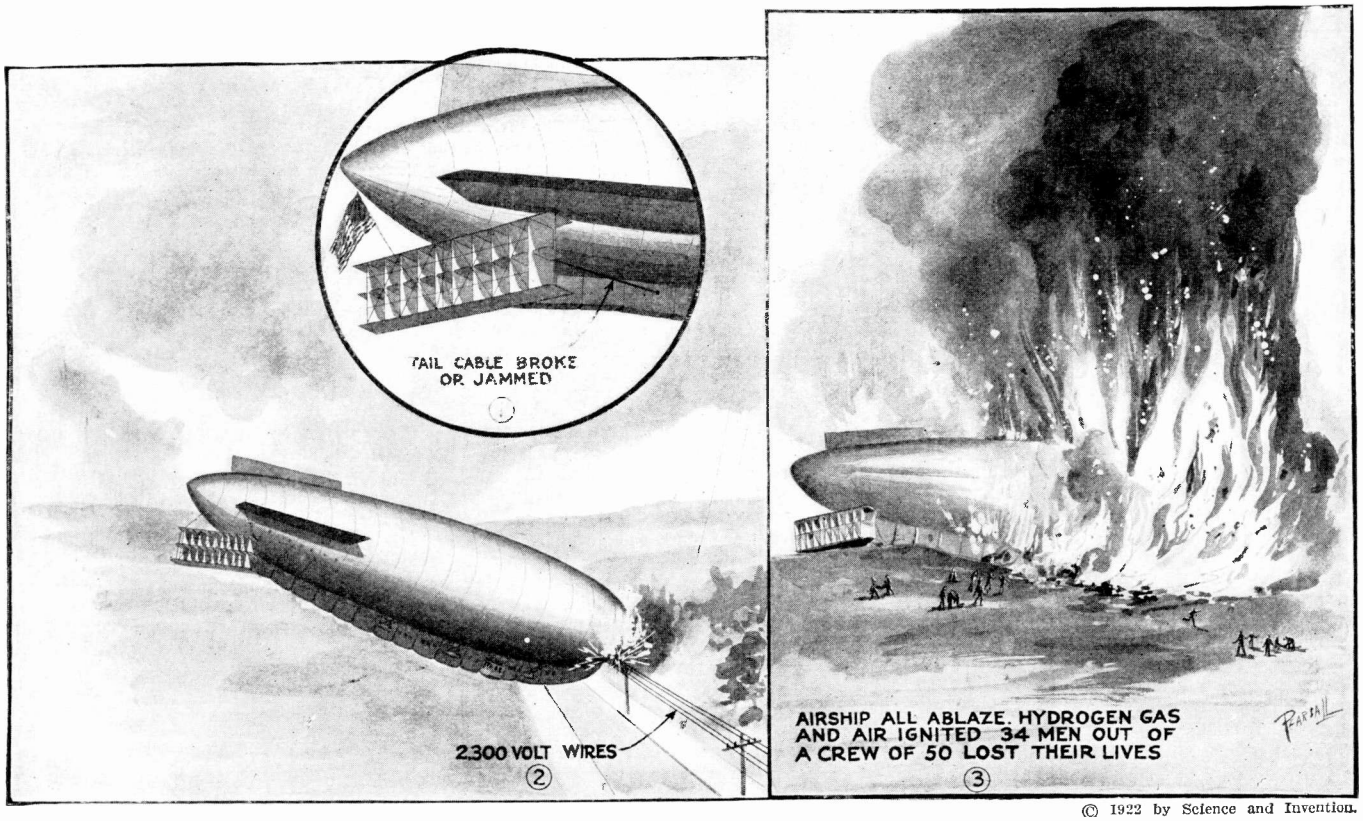
ANOTHER terrible catastrophe of the air occurred on February 21, the day before the nation's celebration of Washington's Birthday, when the largest semi-rigid airship, "Roma," built in Italy for the United States Army, was destroyed with a loss of thirty-four of her crew of fifty men. The accompanying illustrations show in movie fashion, the successive stages of this accident. Altho many theories and wild stories were circulated and published in newspapers directly after the destruction of the "Roma," which burnt up after it hit the ground, a clean bill of health was given the giant ship of the air by Lieutenant Colonel A. E. Fisher, chief of the lighter-than-air service at Langley Field, home station of the "Roma," and he stated that "there was nothing wrong with the craft when she left there on Tuesday on what proved to be her last flight."

Captain Reed said that it was a plausible theory to believe, as had been suggested, that the kite box hung down at the tail of the "Roma" so heavily as to displace the balance and point the ship into the nose dive.

The facts in the case so far as they can be learned, seem to show that the cables running from the pilot's cabin on the "Roma," back to the rudder either snapped or else jammed so as to be unworkable, and that the rudder being jammed in a certain position caused the nose of the airship to point groundward, and as indicated by several of the survivors, she could not be brought to a level keel, even when ballast was thrown overboard, and the next instant she crashed to the 2,500 volt feed wires supported on poles. When some of the metal work on the airship hit these wires, sparks were caused by the short-circuiting of the wires, which unmanned the ill-fated "Roma" survived the disaster, including Captain Walter J. Reed, chief pilot of the ship, the exact sequence of events which precipitated the great gas filled bag down on the high tension wires (undoubtedly forming a short-circuit and igniting the hydrogen gas as some of it mixed with the air thru punctures in the envelope of the airship), will never be known. Captain Reed, in a statement given out the day after the accident, as he lay at the Public Health Service Hospital, stated:

"I have no idea what caused the accident, and I doubt if it will ever be known. Of course we have our own theories, but we are not certain which is correct. I had known that there was trouble with the control of the ship, and it was impossible to correct it after it was discovered."

Helium gas is strongly argued for and the government severely criticized by



A Few Weeks Ago the World's Greatest Semi-Rigid Airship, the "Roma," Purchased By the U. S. Government for Army Use from Italy, Became Uncontrollable, Due to a Severed or Jammed Rudder Cable and Came to Grief in a Nose Dive. Thirty-four of Her Crew of Fifty Men Lost Their Lives. It Is Thought That the Hydrogen Gas with Which the Airship Was Filled, Mixing with the Air Caught Fire When the Frame of the Giant Airship Struck 2,500 Volt Feed Wires Carried on Poles, Which Caused Electric Sparks and in the Next Few Minutes the Massive Craft Was a Seething Inferno. It Was Impossible to Rescue Some of the Men Whose Lives Would Undoubtedly Have Been Saved if the Gas Compartments Had Been Filled with the Non-combustible Helium Gas Instead of Hydrogen, Many Experts Now Believe.

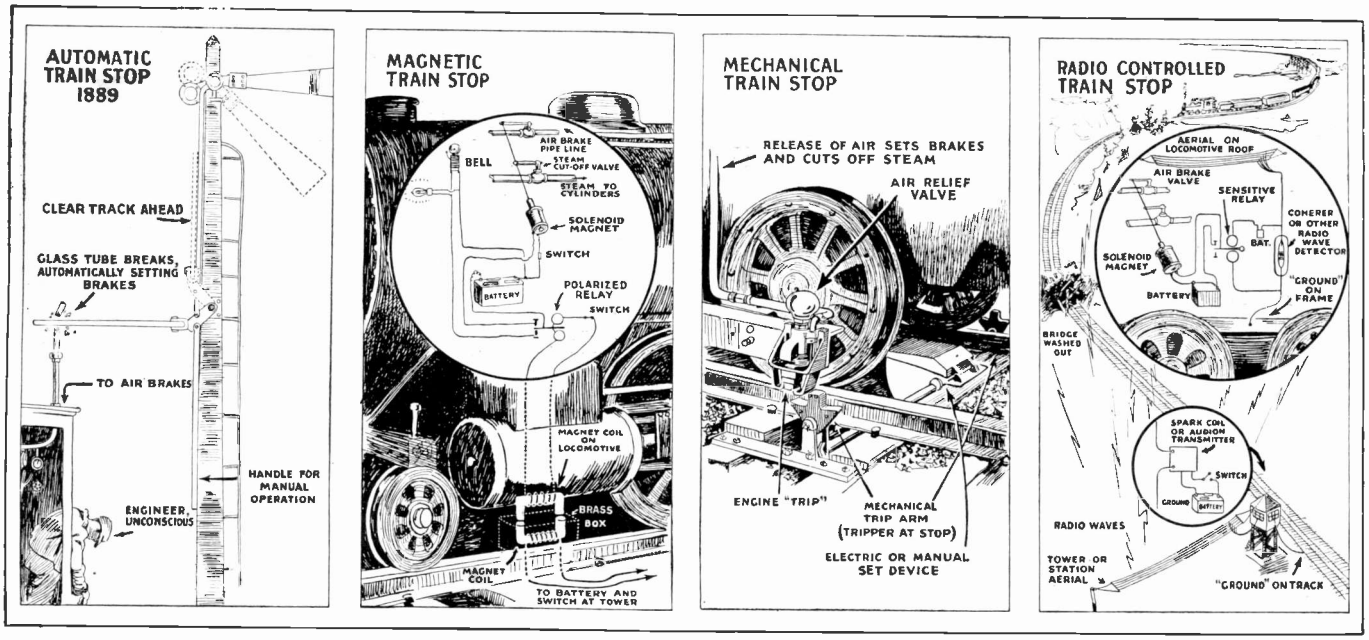
There is one question uppermost, perhaps, in the minds of many, and that is, why the non-inflammable helium gas was removed from the "Roma" just a few days before the accident, and the dangerous hydrogen gas replaced in her gas compartments. One of the reasons given for the removal of the helium gas was that it was desired to conserve this store of the gas, all of the available quantity of which was in the "Roma's" balloonets. Another point brought out in the arguments at Washington concerning this question, was that such a catastrophe would never have happened, or, at least, the toll of lives would only have been a fraction of those killed in the "Roma" disaster, if Congress had appropriated sufficient funds for the further separation of helium gas, which is produced only in the government plants at Fort Worth and Petrolia, Texas.

doubtedly ignited the hydrogen gas mixing with the air, hydrogen itself not being explosive.

The official investigators may talk all they like about the great number of lives that would have been lost had the "Roma" been filled with helium gas instead of the inflammable hydrogen gas, but we confidently believe that the government authorities, including Congress, and the aircraft experts and officers in charge, should have seen to it long ago that a good stiff argument was waged for helium gas, for when hydrogen gas is used there is no telling what is going to happen to such a 410 foot long envelope filled with it, whether the ship falls or takes a nose dive and crashes, or hits electric wires and causes a short-circuit, which might have been the case in this accident.

Even tho several of the crew that Lieutenant Clifford A. Tinker, of the United States Naval Reserve Force, now a consulting engineer in Washington. Lieutenant Tinker made the same suggestion as we have in mind, viz., "That if the 'Roma' had been filled with helium gas there would have been practically no loss of lives." This expert believes that Congress made a most serious mistake in not appropriating sufficient funds to have developed ample helium gas for all of the dirigibles which the Army or Navy might have in use. To quote Lieutenant Tinker further, we learn:

"If the 'Roma' had been filled with helium instead of hydrogen there would have been no explosion and no burning of gas. As it was, there was a terrific blaze from the burning of more than a million cubic feet of hydrogen gas, and the bodies were charred to a crisp."



One of the Earliest Automatic Train Stops. The Cross Arm Extending From the Signal Pole Causes the Train to Stop by Breaking the Glass Tube, Thus Opening the Air Brake System and Setting the Brakes

One of the Leading Electrical Auto Train Stops Is That Employing Electro-Magnets Placed in the Track. The Moving Engine Coil Has a Current Induced in it, Which Actuates a Relay Operating the Steam and Air Valves

Mechanical Automatic Train Stop in Which a Tripping Device on the Track Is Set Manually or Electrically. The Trip Hits the Air Release Valve on the Side of the Engine and Causes the Brakes to Set

Several Radio Train Stops Have Been Proposed and Tried Out. The General Principle Is to Send Out a Radio Wave in Case of Danger, Causing a Receiving Apparatus to Operate the Steam and Air Brake Valves

Automatic Train Control

By C. S. CORRIGAN, C. E.

THE ever growing list of railroad collisions, due to careless or sleepy engineers running past danger signals, and the awful loss of life, so stirred public opinion in this country in 1920, that Congress was compelled to order the Interstate Commerce Commission to make the railroads install automatic train control devices.

Why wasn't the order issued at once? In compliance with various orders of Congress since 1906, the commission had spent fourteen years investigating, examining and reporting on train control devices, they had approved about thirty different systems that had come up to their requirements and specifications, their reports said "Automatic train control has long since passed the experimental stage. In fact no other safety devices such as the automatic coupler, the airbrake and the automatic block signal were perfected to as high a degree as the automatic train control before they were either ordered installed or were voluntarily adopted," and that "all systems in actual use showed a high degree of efficiency."

To show the railroads that they had delayed the order as long as possible, and anxious to free themselves from all blame, the commission in its order says, "We were not disposed, however, to issue an order requiring the installation by any carrier of any such device without further investigation," so in November, 1920, they appointed a committee which, in June, 1921, made a report showing an even greater proportion of collisions and loss of life than the average. Still the order was delayed. Then in December, 1921, a wreck near Philadelphia killed 23 persons and injured many others, this was evidently the last straw, for referring to it they say, "Had there been an adequate automatic train control device on that road this wreck would not have occurred."

So on January 11, this year, 1922, the Interstate Commerce Commission ordered 49 railroads to install automatic train control devices on at least one passenger engine division (about 100 miles) in some busy part of their road before July 1st, 1924, then apologized by adding, that on or before March 15, said roads might show cause why said order should not be entered. In view of the known opposition and delay by railroads, when ordered to install automatic couplers and other safety devices in the past, it seems that no such hint of their evading this order should have been given.

In another part of the order they tell the railroads that they will object on account of cost, then as if to show the shallowness of the excuse give data showing that in eleven years there had been 16,565 head-end and rear-end collisions (crossing collisions not included), resulting in more than $26,000,000 damage to railroad property, besides killing 3,089 persons and injuring 43,974. If we average these at $5,000 each, it would amount to $235,000,000, a total of $261,000,000 absolute loss, which would have provided block signals and train control on more than 3,100,000 miles of track and saved about $300,000,000 for them in the next ten years.

> 16,565 collisions in eleven years—3,089 persons killed and 43,974 injured, and 260 millions money loss is the record that aroused public sentiment, and made Congress, in 1920, order the I. C. C. to compel railroads to install automatic train control devices.
>
> The order was delayed until January 11, this year, and does not become effective until July, 1924.
>
> Every day of delay averages 5 collisions, 1 person killed, and 15 injured. Use your influence to prevent delay. Let the Commission know you know.

Of course the commission knew the roads would object on account of cost, that was the objection to all the other safety devices which are now saving them both time and money. This excuse should not be considered for a minute, in view of the immense saving in time and money to be attained, and the fact that human life and the misery caused by injuries cannot be measured in cash.

"We cannot find a satisfactory automatic train control device." That will be the universal plea and the one on which they will depend most to delay and postpone the installation of such apparatus. Some years ago when it was thought Congress would order train stops installed, the N. Y., N. H. & H., as the goat for all the roads, offered a prize of $10,000 for a satisfactory train control device. They showed that they were not sincere and have made themselves the laughing stock of present and future generations of signal men by imposing conditions that could not then, and never can be fulfilled. Although they accomplished their purpose which was to postpone the day of train control, they overdid it to such an extent that everyone has seen the joke and it cannot be repeated, because some of the systems they rejected then, have been in use on other roads for years, and are included among those which the commission reports "showed a high degree of efficiency."

The commission's requirements and specifications set forth in an appendix are very simple. They provide among other things, that the device shall operate to stop a train when the engineer fails to see or obey a danger signal, also when any essential part of the apparatus breaks or is removed, or when its energizing power fails; that it shall operate in all weather conditions which permit the operation of trains, and must control movement in either direction, also that none of its parts shall be a source of danger to trainmen and others.

Anyone with half an eye can see that when 50 railroads all over this country begin installing automatic train control devices, it is going to bring out a lot of in-

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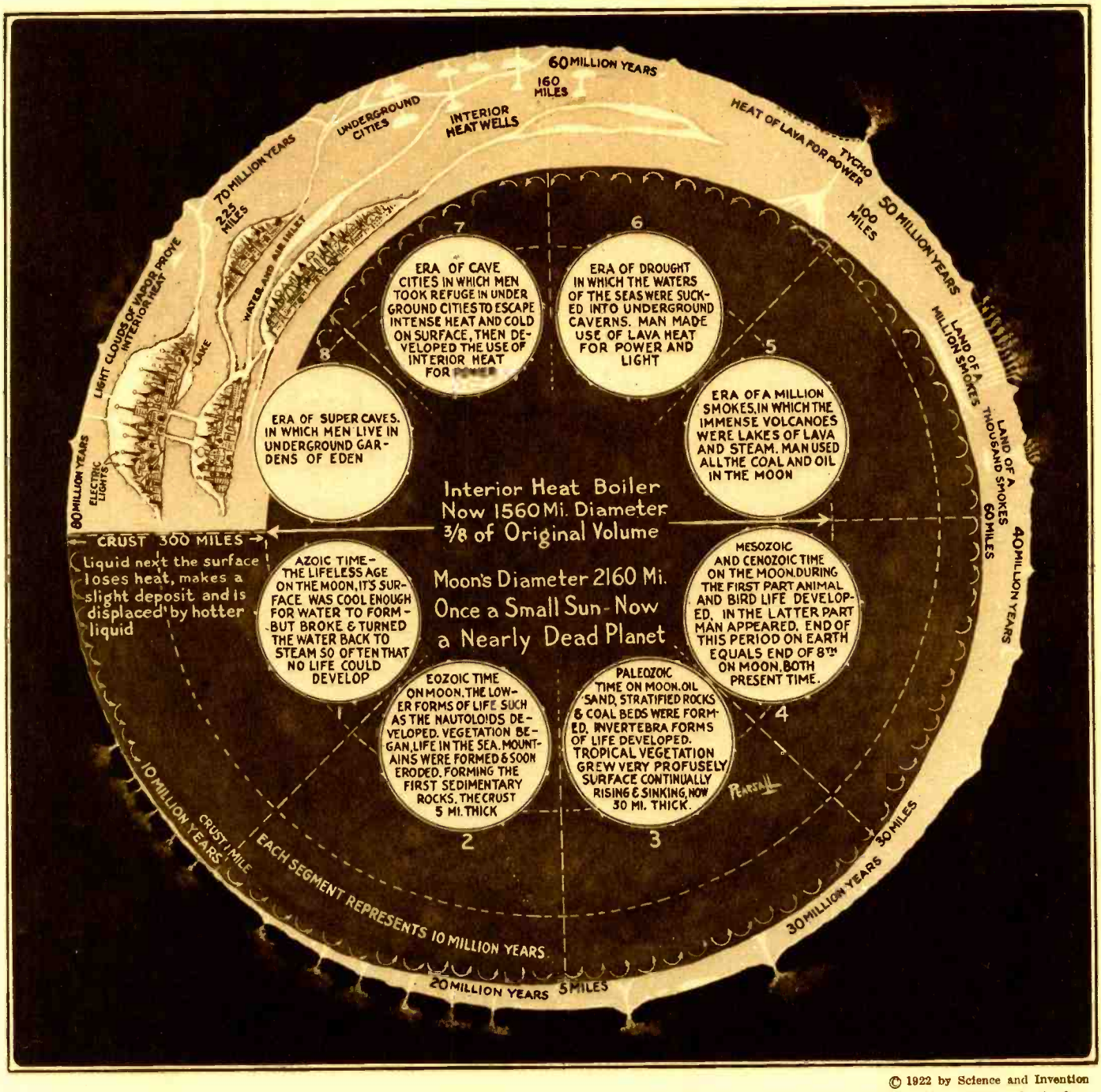


"Without Any Imagination at All, but Simply by Geological and Scientific Reasoning From What We See on the Moon's Surface, I Believe," Says the Author, "That There is Now Inside the Moon, and Some Day Will be Inside the Earth, Great Caves and Caverns Such as Those Shown; For the Reason That the Disappearance of the Moon's Atmosphere Caused Nature to Suck All the Water Inside, Along with the Air. The Moon's Inhabitants are Therefore Cave Dwellers"—

The Man in the Moon—A Super Cave Man

By C. S. CORRIGAN, C. E.

EVER since childhood you have thought of the Man in the Moon, as the picture you imagined you saw on the outside; when you look thru a telescope facts are revealed, the picture vanishes, and you see what is often described as a peeled orange studded with jewels and draped with strings of beads. The jewels are the craters of extinct volcanoes, the strings of beads radiating from some of them show where rivers of lava once flowed; the telescopes also show that the smooth floors of ancient oceans are dry as deserts, and that there is not enough air on the moon to sustain life. Scientists have also proved that having no atmosphere to retard them, the sun's rays shine hotter on the Moon's surface than even on the top of Earth's highest mountains, but in the Moon's deepest valleys there is only 1/500 as much air as at the top of Mt. Everest, so this heat is dissipated so quickly that even during a two weeks' long day, the ground never gets half as warm as the ice on the top of Mt. Everest, 60° F. below zero; during a lunar night it is as cold as space 459° F. below zero.

Altho these facts were well known years before, Poe looked thru an imaginative telescope of tremendous power and wrote for the New York *Sun* a wonderful imaginative story of the doings of little men on the Moon, which has been named by literateurs "The Moon Hoax."

Now Prof. Pickering of Harvard University, considering slight changes in color on the floor of some large lunar craters, where intermittent signs of water vapor appear, has made himself believe that organic life still exists on the Moon. Forgetful of the bright colorings, due to water vapor in rare atmosphere, seen on some of Earth's lofty mountains; he even goes so far as to imagine some airless heat retainer and water vapor distributor, right at the Moon's surface, capable of distributing so much heat and water that crops grow and ripen in 4 or 5 of our days, so a race of human Eskimos on the Moon might come out of their huts and farm these crater floors, gathering two crops a lunar day, on which to live during the two weeks' long night.

It is said that facts are stranger than fiction, and this is especially true of the

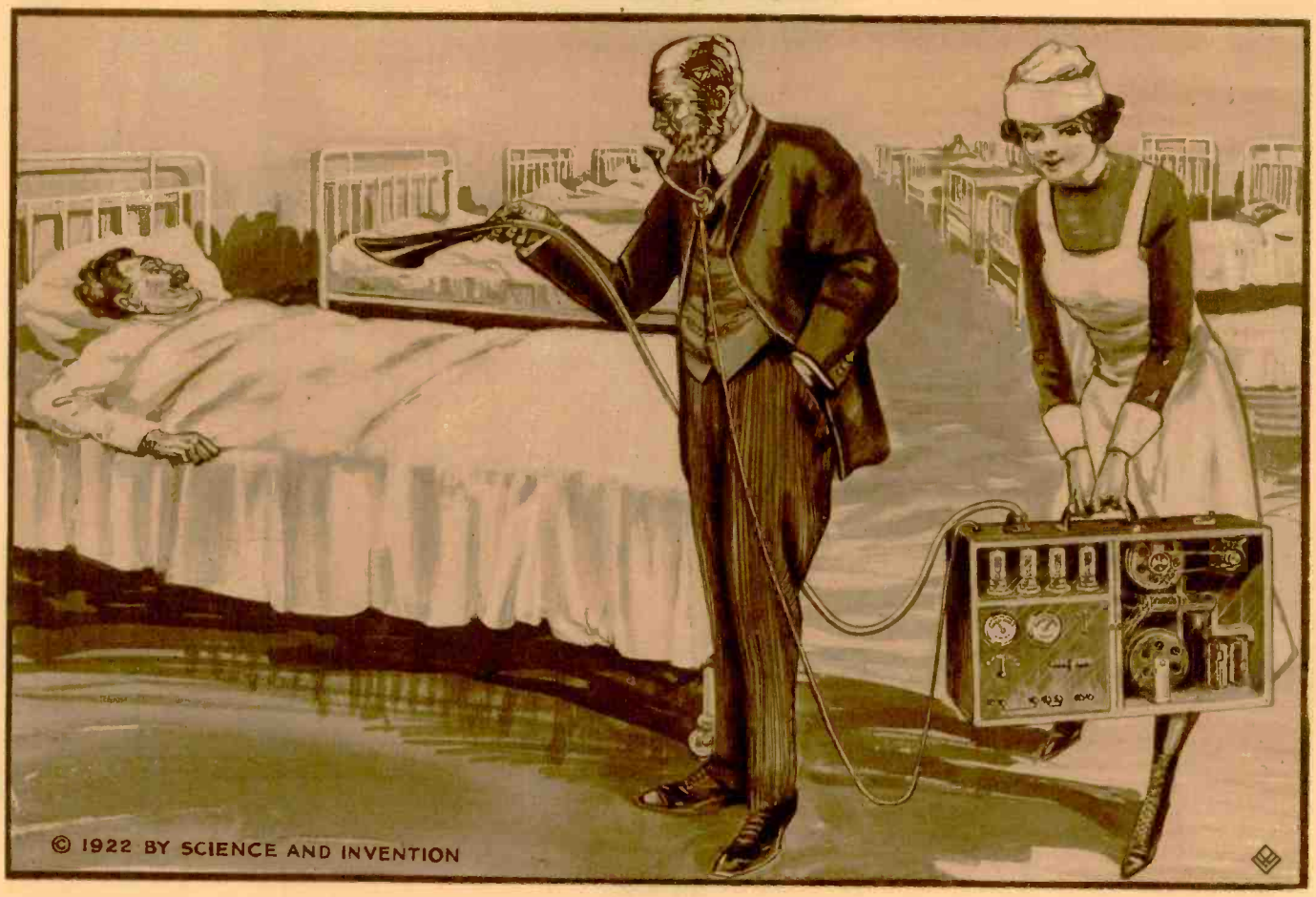
(*Continued on page* 1187)

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

No. 4—The Super-Nose

(Author's Note—If there has been one branch of science more neglected than any other, it is the science of smells. We have microscopes to help the sight, and microphones and audions to help the hearing, but nothing as yet to help the sense of smell. In this story I have endeavored to show some of the important uses to which a smell-intensifier could be put, for I am convinced that when men realize what valuable services such an instrument could render, the instrument will not be long in forthcoming.)



"'But I Cannot Pass Over in Silence the Immense Value of the Instrument to the Physician in Diagnosing Disease. . . . Every Disease Has Its Own Characteristic Odor. . . . In Female Hysteria, for Example, There is a Scent, as of Violets and Pineapple, and in Peritonitis There is an Easily Recognizable Scent of Musk,' Continued Dr. Hackensaw. 'I Merely Walk Thru a Hospital and One Sniff at a Patient Tells Me What Disease He is Suffering From.'"

"WHAT do you say you call that instrument, Doctor Hackensaw?"

"This, Mr. Rockett, is what I call a *Super-Nose*," answered the doctor.

"A super-nose!" echoed Silas Rockett, "what in the world is that?"

"It's an instrument for intensifying smell!"

The reporter snorted: "Good-night, doctor!" said he. "Keep your super-nose for those that want it. I live in New York City in a flat where somebody cooks cabbage almost every day and limburger cheese flourishes on Sundays. I find the smells plenty strong enough as it is. If you start to intensify them you can transform the city into a desert, inside of a week!"

"Pshaw!" exclaimed Doctor Hackensaw.

"And even the pleasant odors," continued Silas Rockett, "even *they* become oppressive if too powerful. I worked for one week in a vanilla factory and I found that even the delicate odor of vanilla becomes sickening when too strong!"

"True," replied Dr. Hackensaw, "but have you ever seen a dog annoyed by a strong smell? And yet you will admit that the dog's nose is far superior to yours. A manure-heap that would make you sick would to him be a pleasant odor. So with my instrument, I have been surprised to find that odors which are intensely disagreeable, often, when highly magnified, become most pleasing. But that's neither here nor there."

"Tell me, doctor, how you came to think of such an instrument?"

"Well, I was reflecting upon the conquests which man has made over Nature. At the present day man is superior to the brutes in every respect but one. In his automobile he can run faster than the swiftest horse, in his airplane he can fly faster than any bird, in his submarine he can swim more rapidly than any fish. With his telescope he can see further, and with his microscope he can see better than the animal with the keenest vision, and with his microphone and audion he can hear better than any known animal. It is only in the sense of smell that he is still inferior to the lower animals. The scent of a dog is far superior to that of a man, while we have good evidence to show that certain moths can scent their mates at the distance of a mile or so!"

"I see. So you decided to secure for mankind a scent as keen as that of the dog. But how did you set about it?"

"My first attempt," explained Dr. Hackensaw, "was made with a nose-trumpet. I thought that, just as an ear-trumpet collected more waves of sound, so a nose-trumpet would collect more of the odor and so intensify the smell. But a few experiments soon convinced me I was on the wrong track. The magnification of the smell was too small to be of any real value."

"Well?"

"The next thing I tried was improving my nose. Under the microscope I carefully dissected the scent glands of the dog and the antennæ of the moth, hoping, but in vain, to learn the secret of their power. Next I tried grafting the lining of a dog's nostrils into the nose of one of my assistants, who for the sake of science consented to the operation. I tried it on myself, too, but with very slight success."

"Good gracious!"

"Then I tried condensing smells. I placed one drop of scent in a room and left it until it had become imperceptible. Then I gathered the air of the room into a cylinder, liquefied this air, filtered out the inert liquid and thus obtained a concentrated solution of the odor. This method was much more successful. By its use I can detect the passage of a man several hours after he has passed. The method is, however, too clumsy and cumbersome for practical use. Finally,

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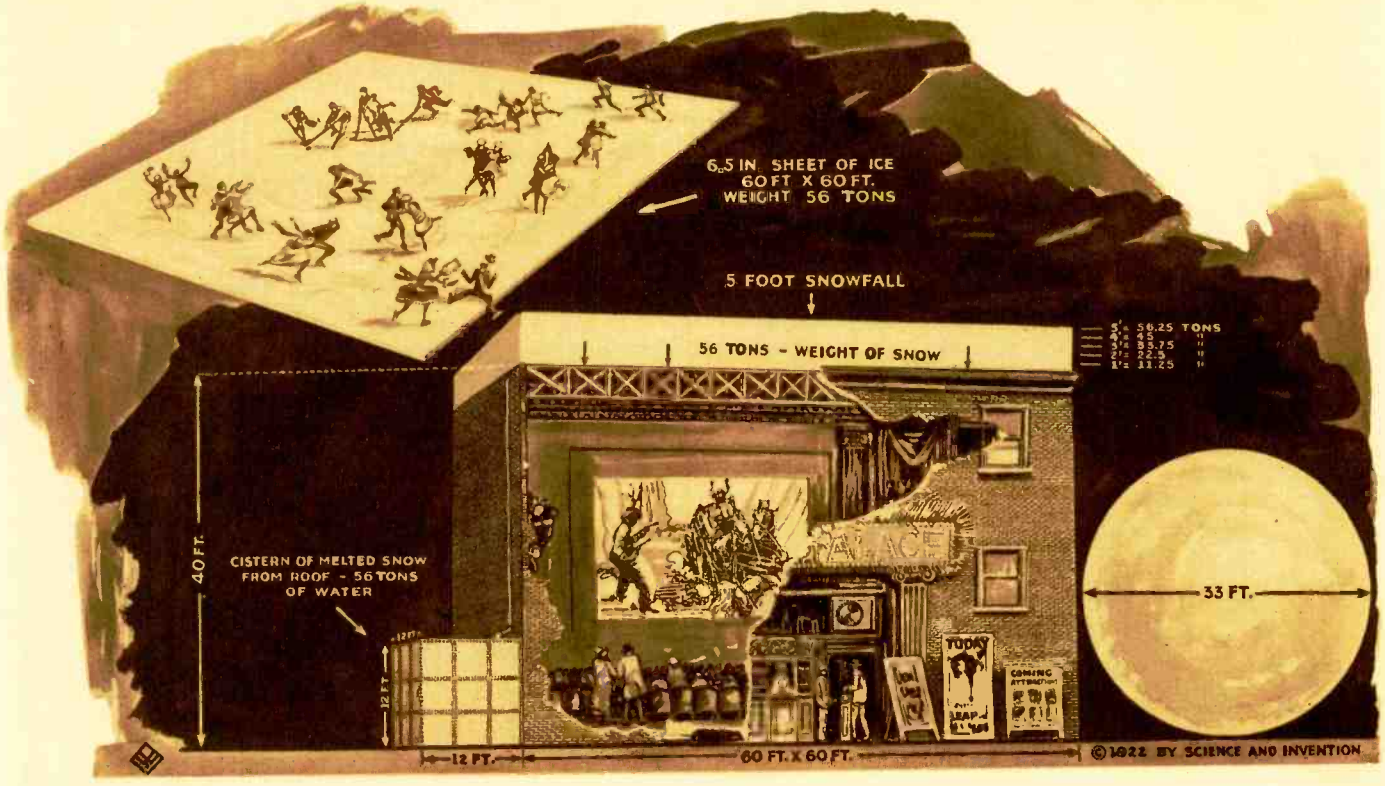

We Do Not Realize, Perhaps, What a Great Pressure a Roof Full of Snow Exerts on the Beams and Trusses, Frequently Causing the Roof to Fall In, as Did the Theatre Roof in Washington, D. C., Recently, When Nearly One Hundred People Lost Their Lives. Improper Design of the Walls and Roof Trusses, Careless Inspection or Poor Workmanship; Any One or All of These May be the Cause of Such a Roof Collapse, Except When a Phenomenal Fall or Drift of Snow May be the Cause

Snow Fall and Roof Fall

By CHARLES NEVERS HOLMES

A SNOW flake falling slowly and softly seems almost like a "trifle light as air." Like a thin strand of a thick rope, a snow flake is not of any consequence by itself. But just as in a union of many rope strands there is great strength, so in a myriad of snow flakes there is great weight. One snow flake weighs practically nothing, yet countless numbers of snow flakes represent an enormous weight, which, in the case of the recent heavy snowstorm at Washington, D. C., meant disaster and death for many of those who were seated beneath the roof of the Knickerbocker Motion Picture Theatre.

Of course, a rainfall is heavier than a snowfall of the same depth, inasmuch as a cubic foot of water weighs nearly 62½ pounds, whereas a cubic foot of snow varies from less than 5 pounds to as much as 32 pounds. That is, a cubic foot of dry, freshly fallen snow is as light in weight as in appearance, but what we call *very* wet snow may be about half as heavy as an equal bulk of water. The snow with which we are most familiar—normal snow—possesses about 1/10th the weight of water, or about 6¼th pounds per cubic foot. It is not nearly as heavy as frozen water or ice, with which we associate it, since a cubic foot of ice weighs about 58 pounds. Accordingly, we can understand why an ice-storm is likely to do more damage to trees and telephone wires than a snowstorm. But a snowstorm can be very disastrous, particularly, if too much snow accumulates upon too weak a roof.

Fortunately, it is usually snow, and not ice, which descends upon our dwellings. Nevertheless, during a very heavy snowstorm, a tremendous weight falls upon our streets and homes. According to the 1921 report of the New York Department of Taxes and Assessments, there was in that year in the Metropolis a total of about 437,000 buildings. And, making allowance for a natural increase in buildings since that report was published, it is probable that their total number now approximates 440,000. Respecting the total roof-area of these 440,000 buildings, big and little, we may estimate that area at about 1,300,000,000 square feet. Now, suppose there is a snowfall of one foot in depth. Such a snowstorm would deposit upon all of the roofs in New York City about 1,300,000,000 cubic feet of snow. If this snow were of the light, dry kind, there would be resting an approximate weight of four million tons upon all the roofs of New York, and, if this snow were to fall to a depth of two feet, and if it were twice as heavy as the normal, dry kind, then all the roofs of the Metropolis would be sustaining an approximate burden of 16 million tons.

Therefore, owing to the possible danger and damage from snowfalls, laws have been passed, directing that roofs shall be strong enough to support the weight of the heaviest snowfall. And not only is there danger from snowfall, but also from the pressure of violent wind. This provision against snow and wind varies, of course, with the pitch of the roof. If a roof has a pitch of 60 degrees, it must be made strong enough to sustain a snow and wind pressure amounting to 30 pounds per square foot; if it has a pitch of 30 degrees, 25 pounds per square foot; and if it has a pitch of only 15 degrees, 20 pounds. In the case of the ordinary dwelling house, its roof should be strong enough to support a pressure of 30 pounds, altho many inspectors require more than that, indeed, as high as 50 or 60 pounds per square foot. If a house which has a roof-area of 3600 square feet, is provided against a pressure of 60 pounds per square foot, it would take a snowfall of over 9 feet, if the snow were light and dry, to break down this roof. For example, each square foot, the slate upon a roof weighs 6½ pounds, its sheathing 3 pounds, its rafters 3 pounds, its purlings 2 pounds, and its truss 3½ pounds. These materials total a weight of 18 pounds per square foot, so that a roof containing 3600 square feet would weigh altogether almost 33 tons. That is to say, such a roof would have to be constructed strong enough so that it would not collapse under its own weight, and so that it could bear an additional snow and wind pressure of 30 pounds per square foot, or a total additional pressure of 54 tons. If this roof happened to sustain a weight of snow equal to 30 pounds per square foot, its total load would be 87 tons.

Thus a heavy snowstorm may so affect a weak roof that it would fall, after the storm was almost forgotten. For example, shortly after the Knickerbocker Theatre disaster, the roof of a freight depot, also in Washington, D. C., suddenly collapsed. Altho this depot's slate roof had been practically cleared from snow, there is no doubt that its collapse was caused by the strain imposed by the heavy snowfall. According to a newspaper account, this depot's roof was 400 feet long by 40 feet wide. Therefore, it is evident that it was weakened so that it collapsed later by its own weight of about 18 pounds per square foot and the additional weight of the snow, a total burden of about 250 tons.

The Gravity King

By CLELLAND J. BALL

ELIAS CRAIG, president of the American Airplane Co., Inc., swung slowly around in his swivel chair and faced his secretary who had just entered his private office.

"Well," he growled tersely, "What is it?"

"There is a messenger outside, sir," the secretary replied, "who has a letter which he insists upon delivering to you personally."

"Hmm—— Well, maybe its concerning that Lake Arbor deal. Show him in," and Craig turned back to his desk.

The secretary slipped out quietly and almost immediately the door opened and admitted a self-possessed young man of about twenty-six years. For an instant he paused at the door and surveyed the broad back and bullet head covered with iron gray hair of the man before him. Was it the shadow of the cloud that passed over the afternoon sun that darkened his eyes, or was it a look of bitter hate? But whatever it was it was gone almost as soon as it appeared, and he advanced with a quick firm step to the desk before him, and laid a sealed envelope before the president.

"There's no answer," he said as Craig looked up curiously, and before he could be questioned further he was gone.

"Quickest messenger I ever saw," growled Craig sarcastically to himself, "wasn't from the Lake Arbor people, either," as he opened the envelope with a quick movement of the cutter. Unfolding the letter he read with growing amazement the following:

May 17th, 1940.

AMERICAN AIRPLANE CO., INC.,
ELIAS CRAIG, *President*,
City.

DEAR SIR:

The airplane of the present type is destined in a few years to be entirely obsolete. No doubt you will smile at this statement, but I have the proof at hand in my latest successful invention—a super airboat which cannot fall to the earth, and which should attain a speed of three hundred miles per hour.

You will be startled to learn that after years of intensive experiments, I have finally discovered the great principle that makes my airboat a success, namely, *the repulsion of gravitation!*

Further details I cannot discuss in this letter. I have written you because of the immense capital you and your company represent. This capital is needed at present in order to properly place my invention before the public.

I shall be pleased to give you and your directors a demonstration with a small model tomorrow evening at 9 o'clock at my present address.

You as a business man must realize what it will mean to the company that first secures manufacturing rights to my machine. "A word to the wise——" you know. Very sincerely,

ABRAHAM NORTON.

77 Oakhurst Ave.

Now presidents of large companies are accustomed to receiving letters from all grades of inventors, most of whom offer world revolutionizing inventions which, however, revolutionize nothing but the inventors' pocket books—but Abraham Norton—ah, he was a different proposition. Appearing in the city a few years before the opening of this story, he had already produced several small but important and successful inventions, and he was known as a man of keen intellect and logical mind. While Craig did not know the man personally, he had often heard of him, consequently he stared dumbfounded at the letter in his hand for hearsay told him that Norton was not the man to say one thing and mean another.

"God!" he breathed, "the repulsion of gravitation! Is it possible?"

Sinking back in his chair his crafty brow wrinkled in thought, and his active mind swarmed with a thousand pictures. What an invention to control exclusively!

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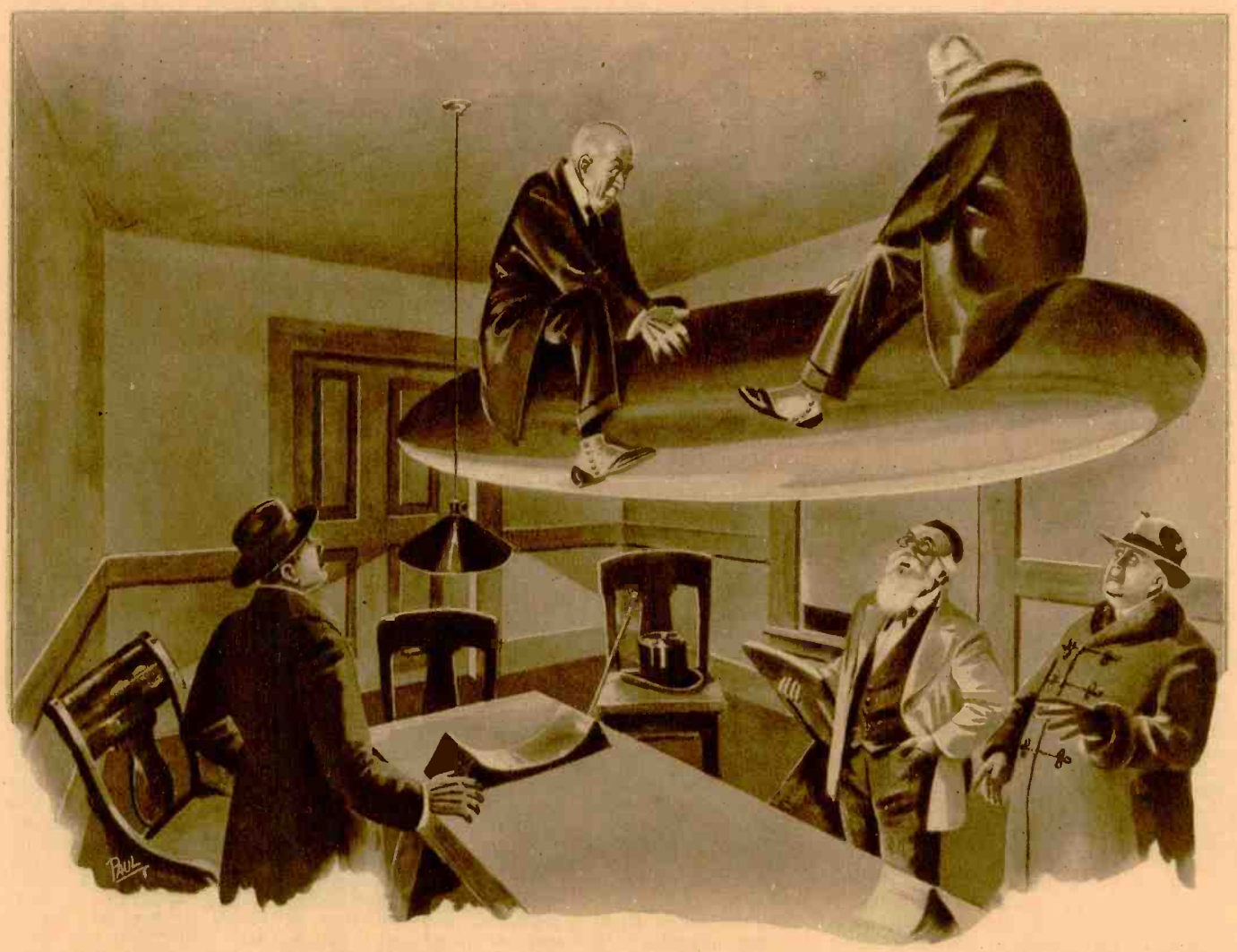

The Financiers Were Not Only Interested but Amazed by the Demonstration of the Gravity-Defying Airship, Which Exerted Such a Powerful Lifting Effort That It Finally Raised its Cigar-Shaped Shell Ceilingward, Carrying Two of the Spectators With It. Yes—It Looked as if Its Inventor Had at Last Solved the Problem of Nullifying Gravity and Free Flight; but What They Didn't Know Was That at That Very Minute They Were on Board a Powerful Airship Flying 10,000 Feet Above Their Home City and Rapidly Nosing Its Way Toward an Uninhabited Island in the South Seas.

Einstein On The Screen

By EDWIN HAYNES

NO subject is as often mentioned and as little understood, as the Einstein theory of relativity. The question is being asked everywhere as to what the new doctrine is—in the counting room, drawing room, on the street.

To illuminate the subject in part a motion picture was recently produced and is now being shown on the screen under the title, Reversibility and Relativity.

The picture was devised and directed by Delmar A. Whitson, a scientist and motion picture engineer of Los Angeles, and who has been an ardent disciple of Einstein for years. A second Einstein picture, on the gravitation of light, is now being photographed.

Interest attaches to the production of the Einstein picture by reason of the new demands made upon the art of motion picture photography and the difficulties encountered in securing some of the effects. The apparent drawing of a three dimensional figure on the screen was easily accomplished by using the method employed in producing animated cartoons.

To represent on the screen the assumption that an object moving through space at a high rate of speed in the direction of its length contracts longitudinally required mechanical ingenuity and the employment of the wizardry of the photographic art.

What is called a *frame* in the studios was constructed. An oblong plate glass, upon which stars, comets and other celestial images were depicted, was erected facing the position to be occupied by the camera. About six inches in front of this a second glass plate was set up, upon which was sprayed a solution which in production has the effect of interstellar stardust. Anterior to the second plate a transparent glass plate was erected, in the center of which a hole was drilled to serve as a point of attachment for a brass fixture having the same lateral dimensions as the end of a building brick. To this fixture seventy-two bricks were successfully attached, each brick being slightly shorter than its predecessor.

In taking pictures the middle and posterior plates were moved in the same direction, the one with celestial images on it twice as fast as the other; and the anterior plate, carrying the brick, was moved in the reverse direction at the same speed as that of the posterior plate. This movement of the three plates produces the illusion of the brick rapidly moving through space, an effect in itself incidentally an illustration of relativity. At brief intervals the camera was stopped and a change of bricks made. When the seventy-two bricks of varying lengths had been photographed in turn, the bricks were attached to the holder in sequence in reverse order, to illustrate the theory carried out to its logical conclusion.

When thrown upon the screen the brick seemingly decreases to a line and progressively increases in length until it attains its normal longitudinal dimension.

The most difficult problem of the undertaking was to apply the time-speed theory principle to a sphere representing the earth. It was necessary to preserve that diameter of the sphere which is at right angles to the direction of its motion, while the sphere contracted in the other direction into a gradually decreasing double-convex.

It assists the imagination in contemplating this contraction to conceive of each hemisphere as composed of parallel sections decreasing in circumference from the vertical axial line both ways. By contraction this hypothetical sphere collapses towards the rigid axis, the smaller sections passing within the larger.

Numerous attempts were made to get varying degrees of contraction in a rubber balloon, subtended inside by a wire hoop at its vertical axial line, and enclosed in a hermetically sealed glass container, into which compressed air was introduced.

Deflation of the balloon was partly achieved by this method, but the air pressure shattered the glass of the container, before the desired degree of deflation was attained. Success was finally achieved after days of trial by the adoption of an entirely new plan. As in most inventions the greatest results are usually accomplished by simple devices, the gradual deflation and inflation of the balloon was

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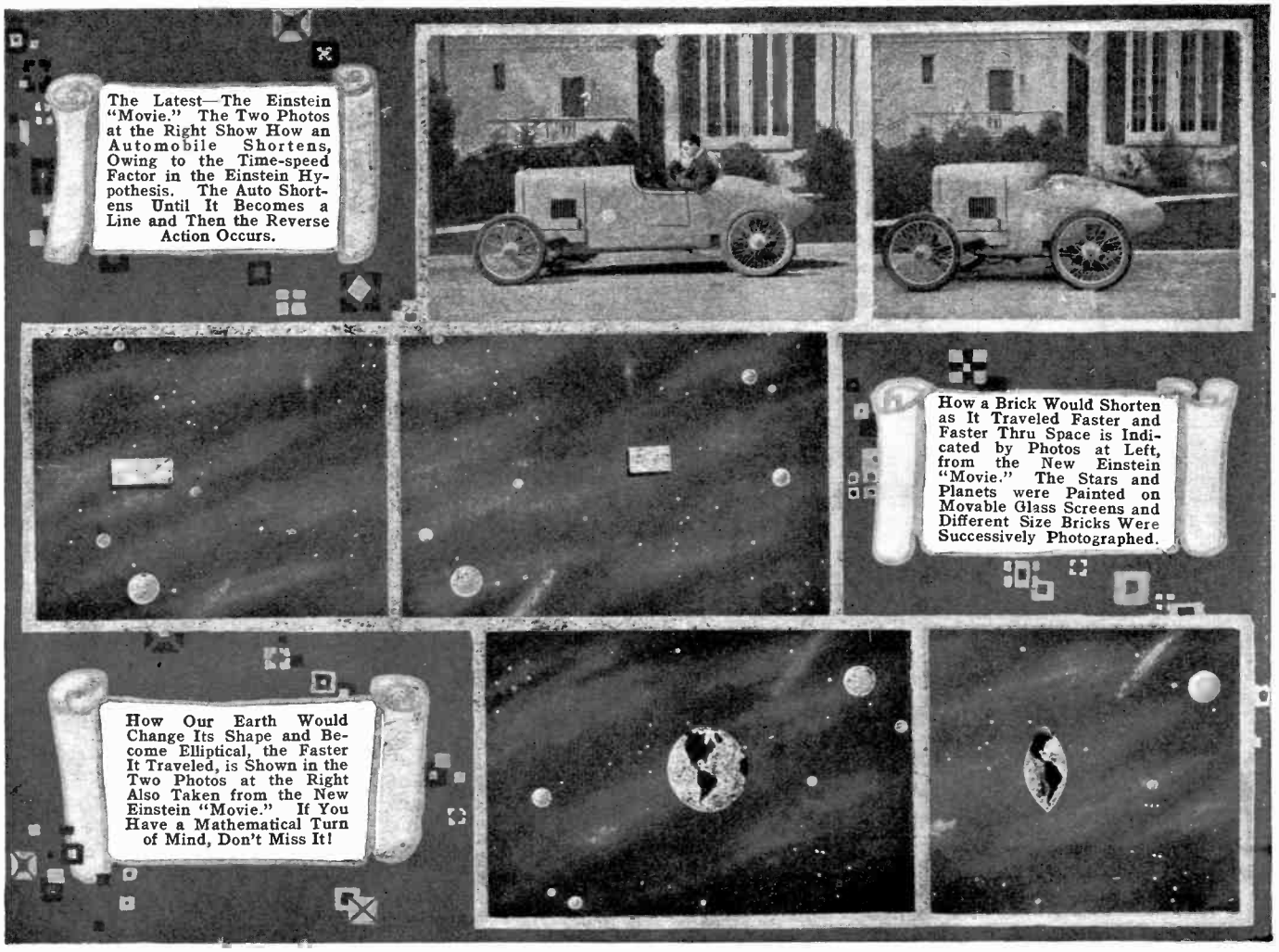


The Latest—The Einstein "Movie." The Two Photos at the Right Show How an Automobile Shortens, Owing to the Time-speed Factor in the Einstein Hypothesis. The Auto Shortens Until It Becomes a Line and Then the Reverse Action Occurs.

How a Brick Would Shorten as It Traveled Faster and Faster Thru Space is Indicated by Photos at Left, from the New Einstein "Movie." The Stars and Planets were Painted on Movable Glass Screens and Different Size Bricks Were Successively Photographed.

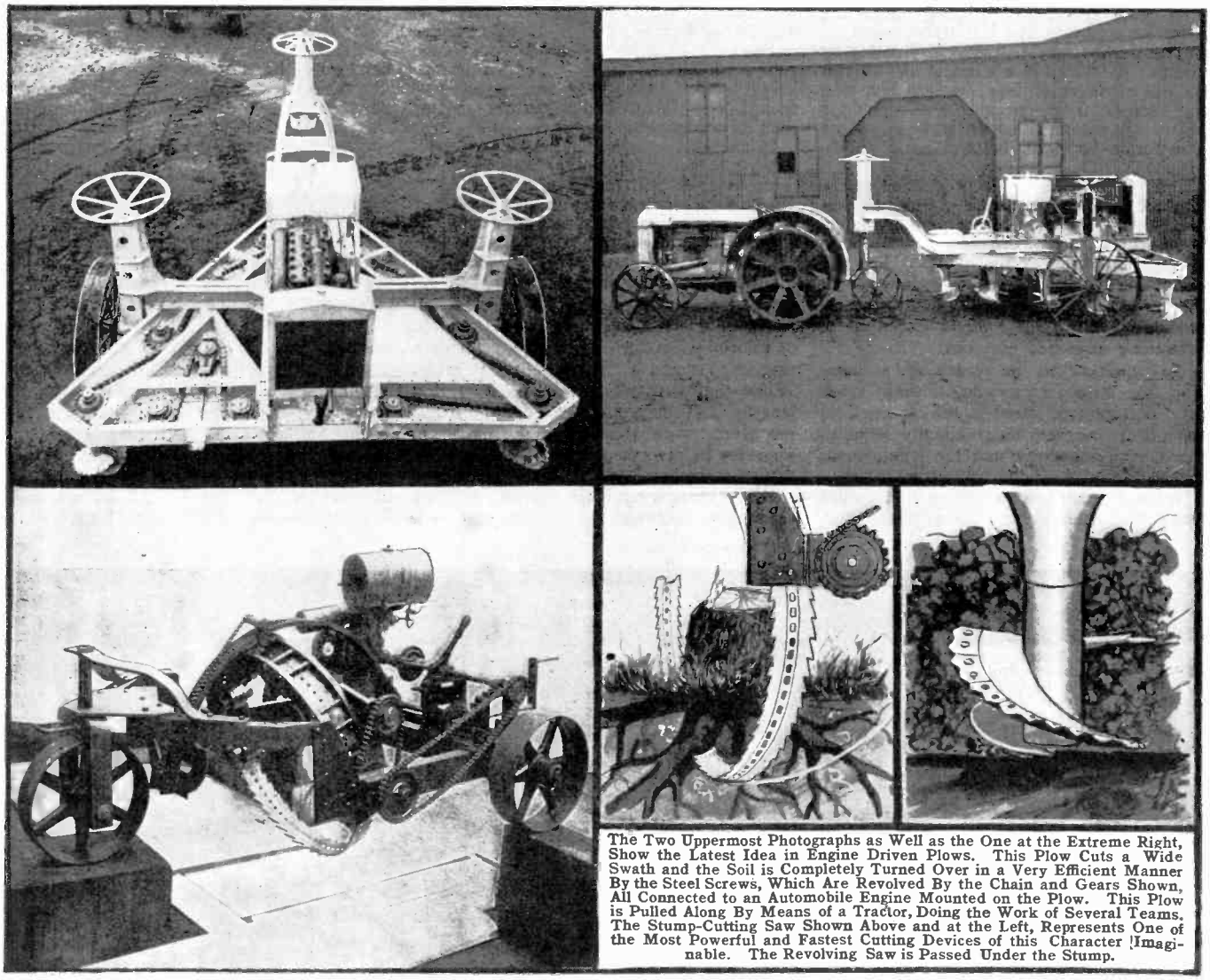
How Our Earth Would Change Its Shape and Become Elliptical, the Faster It Traveled, is Shown in the Two Photos at the Right Also Taken from the New Einstein "Movie." If You Have a Mathematical Turn of Mind, Don't Miss It!

To Revolutionize Farming

By E. M. STEVENSON

A SPIRAL bladed plow, that harrows and seeds in one operation, has been invented by Mr. L. S. Adams, of Webster Groves, Missouri, who, as General Manager of his company, is manufacturing these plows, as well as a circular stump cutter and a road surface leveler. The two first mentioned machines are shown herewith.

Rotary Plow and a Stump Cutting Saw



The Two Uppermost Photographs as Well as the One at the Extreme Right, Show the Latest Idea in Engine Driven Plows. This Plow Cuts a Wide Swath and the Soil is Completely Turned Over in a Very Efficient Manner By the Steel Screws, Which Are Revolved By the Chain and Gears Shown, All Connected to an Automobile Engine Mounted on the Plow. This Plow is Pulled Along By Means of a Tractor, Doing the Work of Several Teams. The Stump-Cutting Saw Shown Above and at the Left, Represents One of the Most Powerful and Fastest Cutting Devices of this Character Imaginable. The Revolving Saw is Passed Under the Stump.

This plow is triangular in shape and carries nine spiral cutters of a specially hardened steel. Each cutter, from the front of the plow to the rear, cuts thru a section of earth just missed by the blade in front of it. The wheels of the plow are placed directly in front of the last cutter, and this, plowing the ground the wheels pass over, leaves in the wake of the plow a swath of plowed and pulverized ground twelve feet wide.

The particular beauty of this plow lies in its strength, simplicity of construction and the rapidity with which it completes the preparation of the ground at one operation, by thoroly mixing the soil and vegetation. Another beautiful feature of this plow is in the perfect control of the depth of plowing. By raising or lowering the running wheels, the drills may be set at any desired depth, as deep as sixteen inches if desired, according to the kind of crops to be planted each year. In certain parts of this country this plow will be of inestimable advantage where the land is in the desired condition for only a very short season. By the old method of plowing, it has been impossible to plow the ground in the dry farming sections before the rains came, and then, having prepared the soil, it was necessary to wait until the following year for planting, so that the seed could get the benefit of the very little rain that falls there. With the Adams plow the ground may be prepared at any time during the dry season, regardless of how hard and packed it may be; the plow goes thru hard and soft ground alike and pulverizes it at the same time, making the ground ready for seeding.

Mr. Adams has found by personal experience that nitrogen, the element most difficult to get and hold in the soil, is found in the roots of the vegetation and by turning it over as is done by the present method of plowing, this element is found near the top of the soil, thus the ground is only inoculated with all its nourishing elements a few inches in depth. But with the Adams plow the ground and vegetation are mixed together thoroly, thereby getting an absolutely even distribution thru the entire depth of plowing. In addition to this a new patent feature has been added to this plow enabling seed and fertilizer to be fed through the drills, so that the complete operation from plowing to seeding is done at once.

The blades of the plow are operated by an endless chain, driven by a 45 H. P. four cylinder Buda motor and is pulled by a motor tractor, or may be quite readily pulled by six horses.

The stump cutter shown here will be of the greatest value in the clearing of land in the west and southwest where a practical means of getting rid of the enormous stumps has been needed for so long.

This cutter is fitted with a double edged band saw blade of stone cutting steel, eight inches wide and twelve feet in diameter. The saw, originally designed to rotate at 1,200 R. P. M., and driven by a gasoline motor, has been greatly improved, and now oscillates a varied number of inches, giving the effect of a cross-cut saw. It starts on a downward slope, cuts thru the soil, thru the stump under ground and will cut as deep as thirty inches and thru any kind of soil. It cuts in a circular direction, being controlled over an arc of 180° above and parallel to and underneath the ground. It will cut any stump up to eight feet in diameter.

This cutter is very easily pulled around and may be either drawn by a small tractor or by horses.

The Latest Innovation Which is Bound to Please the Amateur Photographer, is a Film Substitute Made of Paper. This Paper Film is Placed in the Camera, the Same as the Regular Photographic Film. It May be Loaded in Daylight and Removed in the Same Manner. The Film, When Developed, First Shows a Negative View of the Subject. It is Then Bleached and the Image is Reversed. The Entire Operation Consumes no More Than Seven Minutes. Duplicates Are Made by a Special Device, as Shown in the Photo at the Right.

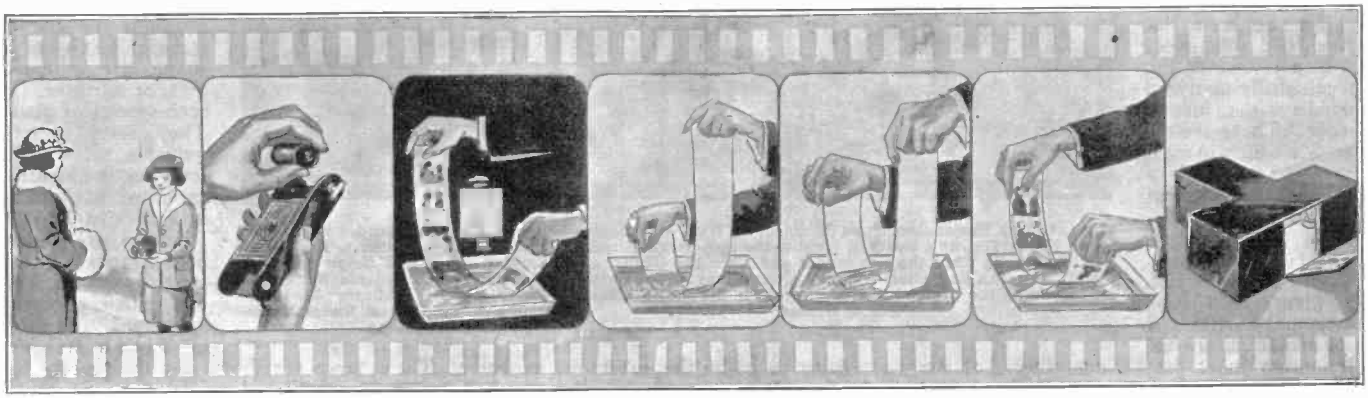
Photos Direct On Paper

FOR a great many years attempts have been made to place substitutes for photographic films upon the market. These films and plate substitutes were at first developed as a war necessity, where extreme speed in the development of negatives and the speedy production of prints became necessary for military operations. The war measures, however, were not available for amateur use until recently, when a new film was announced, especially designed for amateur photographers.

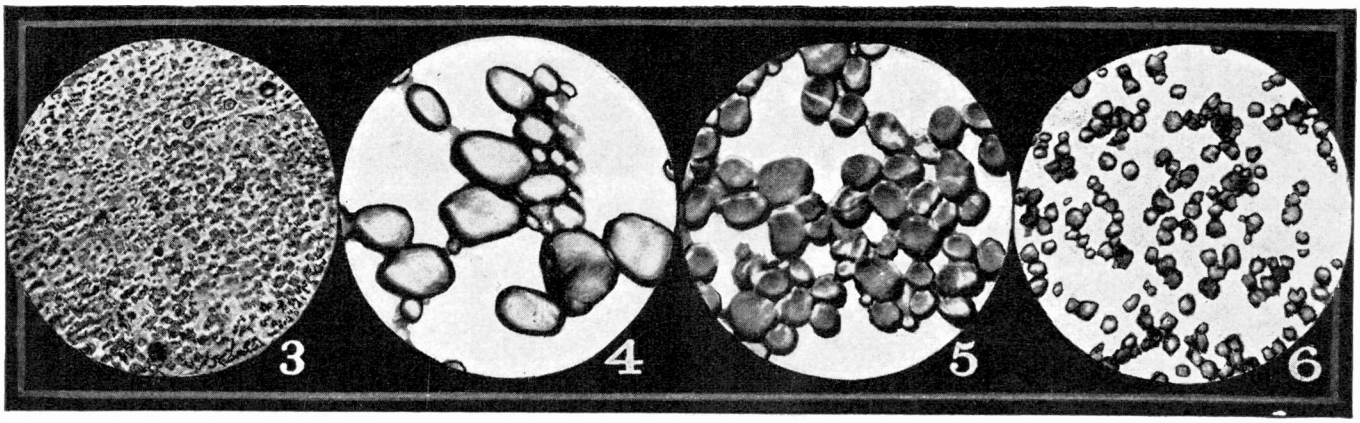
The new paper film is made basically of paper, and is made in both sheet and roll forms. This paper is coated with a special sensitized solution on one side and the other is covered with gelatine. After the pictures have been taken in the usual way the paper film is removed from the camera and handled in the same manner as the regular celluloid film. It is then taken into the darkroom, where the usual method of development is proceeded with under ruby light; a special developing solution is used. The image that appears in this stage is a *negative* of the original photographed objects, and those portions which were perfectly white in the original appear black. From this solution the film is removed and passed thru water, whereupon it is inserted into the bleaching solution. It is left in contact with the bleaching agent until all trace of the image has disappeared. This latter process can be carried on in ordinary daylight, the use of the ruby lamp having now been dispensed with. The paper film is again rinsed in the water and then passed thru a sulphite of soda bath, where the yellowish tinge found on the paper is effectively removed. The final stage of the process is the development of a positive image, which according to the solution employed, appears in either sepia or black and white. The paper film is taken from the last solution, placed between two blotters and permitted to dry for two or three minutes when it may be cut up and mounted in the album or reprints of the particular picture desired may be made immediately by means of an auxiliary device resembling to a remarkable degree an ordinary post-card projector.

The description of the process may seem long and rather difficult, but such is not the case. By actual test photographs of the staff writer were returned to him thoroly dried and completed seven and one-half minutes after the camera clicked, and no attempt at speeding up the process was made.

The paper film is said to be ten per cent. more rapid than the best celluloid film now found upon the market. Immediately after the paper has been removed from the final stage of development it may be torn across and the center will be found to be perfectly dry. The paper is remarkable for its tonic values and qualities. Its other advantages are its ability to quickly turn out a finished print, which work may be done by any amateur within ten minutes after commencing development; the cutting down of the darkroom time; cutting down expenses decidedly, and the power of selecting only those prints which are good enough for reprinting without even wasting a single sheet of paper. Its only drawback is the fact that the right side of the object appears on the left side of the photo, in other words, the picture looks as tho it were viewed thru a mirror. This difficulty is corrected in every reprint or enlargement made from the first positive. In those instances where only one print is desired the paper film holds great prospects of becoming widely adopted.



This "Movie" Shows the Stages Thru Which One of These Paper Films Pass. Reading From Left to Right, We Have, First, Taking of the Pictures. Second, Removing Film From the Camera. Third, Developing—a Negative Image Appears. Fourth, Bleaching—in Which All Trace of the Image is Removed From the Paper Film. Fifth, Clearing With Sulphite of Soda. Here the Paper Becomes Pure White. Sixth, Redeveloping, a Positive Image Appears. Seventh, Making Duplicates by Means of an Improvised Post-card Projector. The Entire Stages in the Developing Process Consume no More Than 7 Minutes. Only One of the Operations is Conducted in a Dark Room.



Photographs, Known Technically as Photomicrographs, Made Thru the Microscope Shown in Fig. 1. Fig. 3, Medium Quality Milk, Showing Fat Globules. Fig. 4, Starch Granules of the Potato. Fig. 5, Starch Granules of the Lima Bean. Fig. 6, Starch Granules From Corn.

Food Adulterants Detected Microscopically

By LEON AUGUSTUS HAUSMAN, PH. D.

How the Microscopist is Able to Detect and Name Adulterants in Alimental Substances

THE growth of microscopic analysis of many diverse substances has grown during the past decade to immense proportions. No longer is the microscope solely the instrument of the zoölogist or botanist, but also of the metallurgist and commercial researcher in general. This is because of the ready adaptability of the microscope to the examination of the minute structure of an object, or to the examination of the constituent materials of substances which have been finely ground or pulverized.

Without a microscope it is possible to recognize the structural parts of animal and plant tissues, and to refer each to its original source, only when the tissues are in large masses. When these are finely ground, however, and mixed together in what appear to be homogeneous pastes, powders or cakes, the problem seems to be a different one. However, even in such a case we may still use the eye as the chief criterion if its power be augmented by the instrument we know as the compound microscope (Fig. 1). Thru this powerful instrument many substances can be made to reveal the secrets of their derivation.

There are but few food substances which cannot be successfully analyzed under the microscope. These are the liquids which in most cases demand a chemical treatment before their constituents can be accurately determined. Wherever there exist, however, in a food substance particles of solid matter, an examination under the various powers of the microscope, combined in some cases with special treatments of mountings, or lighting, will not fail to disclose the nature and sources of the constituent materials. It is possible to detect in admixtures, for example, extremely minute quantities of adulterants. *Thus one part of turmeric has been detected in* 448 *parts of mustard.*

The methods of micro-analysis of foods are in many instances somewhat complex, but in general, examinations may be made simply by placing minute quantities of the substance to be tested on a glass slide, covering this with a cover glass, and placing it directly on the stage of the microscope (see Fig. 1). Sometimes it is necessary to bathe the substance in water before applying the cover glass, such a procedure being known as *mounting.*

Oils of various sorts, together with xylol, alcohol, chloroform, and other liquids, are sometimes used as the mounting media. The object on the microscope stage is lighted by means of a beam from the special microscope lamp, reflected upward by the microscope mirror thru the condenser, where its intensity is regulated. With such an instrument as that shown in Fig. 1 it is possible to secure a magnification of objects as great as 3,000 diameters. For ordinary analysis, however, more moderate powers are sufficient.

The microscopist who is called upon to examine and pronounce upon the constituents of a great variety of substances must have a fundamental knowledge, at least, of botany, zoölogy and chemistry, and must be able to recognize the characteristics of a great host of animal and plant tissues. For micro-analysis means simply the recognition, in mixtures, of the various particles which compose them, and the tabulating of the sources of all these various recognizable particles.

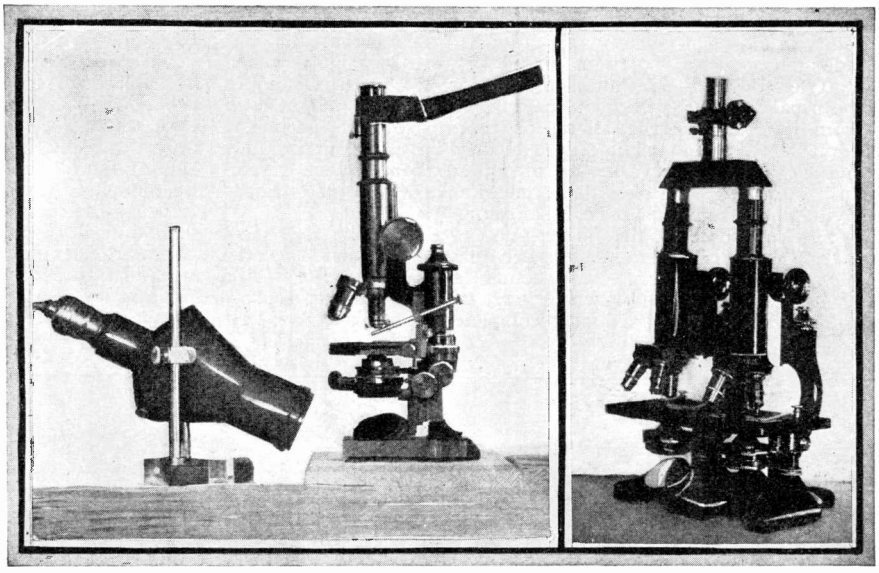


Fig. 1, A High Power Compound Microscope, With Microscope Lamp Which Throws a Beam of Light to the Sub-Stage Mirror, and Thence Up Thru the Condenser and Thru the Object on the Stage. The Extension Tube is a Convenient Arrangement for Obviating the Craning of the Neck Over the Vertical Eye-Piece or Ocular.

Fig. 2, Two Microscopes Fitted with a Comparison Ocular. The Large Lateral Screw Just Below the Eye-Piece Regulates a Scale Within the Eye-Piece for Delicate Measurements of the Objects Under Examination.

Detecting Starch

One of the most important and frequently encountered food substances is starch. It is one of the most widely distributed elements in plant cells. Starch exists in the form of granules, and these granules are characteristic, either in shape, size or markings, or all three, for each species of plant. They form a very valuable set of criteria for the identification of adulterants in food. In Figs. 4, 5 and 6 are shown photographs taken thru the microscope, and called photomicrographs, of three common starches. These three are shown for the reason that they are used, and particularly the starch from the potato (Fig. 4), as adulterants in many foods. Thus the writer had occasion not long ago to examine some water-soluble *cocoa* which he found to be almost one-third potato starch.

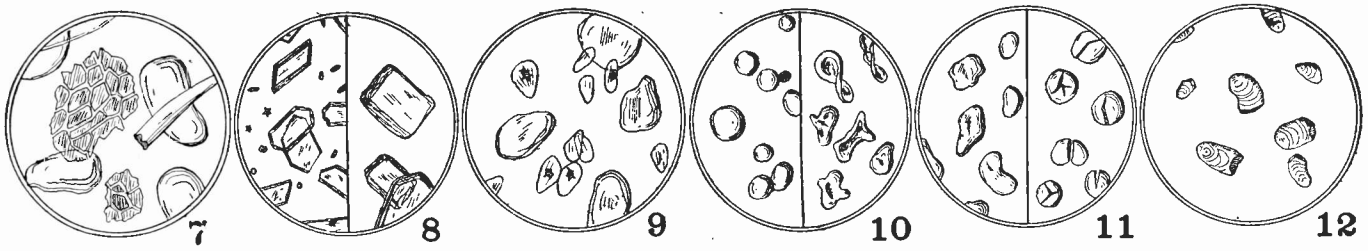


Fig. 7, Gooseberry Jam, Adulterated with Apple. The Large Ovate Cells Are the Pulp-Cells of the Apple. Fig. 8, Left, Honey, Showing the Characteristic Crystals, and Pollen Grains From Flowers; Right, Crystals of Cane Sugar, With Which Honey Is Sometimes Adulterated (as Seen in the Comparison Ocular, Fig. 2). Fig. 9, Cherry Preserve, Adulterated with Turnip. The Large Ovate Cells Are the Pulp-Cells of the Turnip. Fig. 10, Left, Raw Wheat Starch; Right, Wheat Starch Boiled, as in Puddings (as Seen in the Comparison Ocular, Fig. 2). Fig. 11, Left, Wheat Starch Baked, as in Bread and Cake; Right, Wheat Starch Baked Dry, Without Moisture (as Seen in the Comparison Ocular, Fig. 2). Fig. 12, Sago Starch, Showing the Characteristic Truncated Ends.

Testing Milk

In Fig. 3 we have a photomicrograph of milk, of medium quality, i. e., richness. The richness of milk is shown by the presence of the fat globules. In milk made *rich* by the addition of cerebral, or other thickening substances, the presence of the foreign material can be detected at once under the microscope.

The question is often asked whether it is possible to distinguish between food substances which have undergone the process of cooking, in various ways. In most cases, yes. Heat, moist or dry, affects the vegetable or animal tissues in characteristic ways, and the identifications are merely a matter of observation and study. In Figs. 10 and 11, for example, are shown wheat starch granules which have been cooked as in bread, or boiled as in puddings, or dry-baked. Compare these with each other, and then with the raw granules. These figures were drawn from a device which is of great use to the micro-analyst, termed the comparison ocular (Fig. 2). By means of this ocular, or eyepiece, it is possible to bring into the same field of view, where they may be accurately compared, two objects on the stages of two different microscopes. In the same area of vision, as shown in the figures, each microscope contributes just half of its field. With such a device it is easy for the microscopist to compare unknown plant or animal tissues with various tissues which have been identified, and whose sources have been carefully determined

Turnip Pulp in Marmalade

Figs. 7 and 9 show two very common means of adulteration often found in preserves, marmalades, etc., i. e., adulteration with apple or turnip pulp. The large, globular, or ovate cells of these substances can be readily identified without previous preparation other than smearing the material to be tested evenly and thinly over the microscopic slide, and covering with the cover glass.

Honey That Is Not Honey

Fig. 8 shows the appearance of honey under the microscope, with its characteristically shaped crystals and included pollen grains from the flowers which the bees have visited; and also some crystals of cane sugar with which strained honey is all too frequently adulterated. The sources from which the honey has been derived can be accurately determined from the pollen grains which it contains, since each species of plant produces, in its blossoms, pollen grains of characteristic appearance.

The field of analysis over which the use of the microscope can be extended by the well-trained scientist is surprisingly broad, and its boundaries are constantly widening. Almost without exception any substance, save a clear, pure liquid, when properly prepared for and examined under the microscope, will render up the secrets of its original source or sources to the observer.

Furthermore, by the examination of accurately-known quantities of a substance suspected of containing adulteratives the percentages of the various substances present can be accurately stated. This method was used recently by the writer in a series of examinations of samples of flours of different sorts, where the starch grains could be counted, much after the manner in which blood corpuscles are counted by the physiologist.

It may be affirmed, almost without qualification, that the analysis of many alimentary substances, as well as of various pills and mendicaments (particularly for cattle and other domestic animals) is impossible without the aid of the compound microscope.

Motorship's Good Showing

The difference between 750 and 3,000 tons is the fuel saving effected by the new motorship *Alba*, the first British motor passenger liner, which was recently put into the British and African service.

Two double-bottomed tanks contain the 750 tons of oil fuel found necessary for the voyage from Liverpool to West Africa and back. A coal-fired steamer of similar dimensions, it was said by the British and African Steam Navigation Company, which put the *Alba* on the Liverpool-African route, would require 3,000 tons of fuel in order to obtain the same radius of action.

Her dimensions are: Length, 450 feet; breadth, 55 feet 6 inches, and depth, 33 feet, while her speed is fourteen knots and her tonnage 8,000. Her two eight-cylinder four-cycle Diesel engines develop at 120 r. p. m. a. b. h. p. of 4,800. The holds are left free for cargo.

RESULTS OF OUR VOTING CONTEST

Last December we published a voting coupon and asked our readers to vote what articles they liked best, and which ones they did not approve of. The voting coupon was used very enthusiastically by many readers, altogether over 80,000 votes having been received and classified. We are pleased to publish, herewith, the results; the departments are listed in the order of their preference. Thus, for instance, the "General Department" had the largest number of votes, while "Book Reviews" had the smallest.

Inasmuch as the Editor is duty bound to publish what the readers want, we are doing just that, and have enlarged with this issue those departments which our readers desire to see more of, and reduced others, also omitting some departments altogether, in which our readers evidently were not interested. The departments which we have discontinued are "Home Mechanics," "Scientific Humor," and "What To Invent." The appended list is in the order of our readers' preference:

1. General Department
2. How-to-Make-It
3. Wrinkle Department
4. Oracle Department
5. Chemistry Department
6. Editorials
7. Constructor
8. Radio Department
9. Astronomy Department
10. Latest Patents
11. Editor's Mail Bag
12. Motor Hints
13. Patent Advice
14. What To Invent
15. Scientific Humor
16. Home Mechanics
17. Book Review

Chaulmoogra Oil and Leprosy

The U. S. Public Health Service has felt it necessary to prevent the too optimistic and extravagant claims recently appearing in the newspapers in regard to the curative effects of chaulmoogra oil derivatives on leprosy. While the use of the oil and of its derivatives has resulted in a considerable number of apparent cures, it is as yet too soon to tell whether these will be permanent.

The ethyl esters of chaulmoogra oil, the use of which has largely supplanted the oil itself, constitute a most valuable agent in the treatment of leprosy. In treating young persons and those in the early stages of the disease, the improvement has been rapid and striking; in older persons and older cases it is less so. Of the cases paroled from the leprosy stations in the Hawaiian Islands so far about 8 per cent. have relapsed and returned for treatment. This was to be expected; and on the whole the results have been so favorable as to make treatment of the disease hopeful. But only time can tell.

Stones That Talk

By DR. ALFRED GRADENWITZ

IT is no everyday occurrence to have to witness a distinctly new electrical phenomenon, a phenomenon which none of the text books known to the writer or to anyone of his readers would be able to account for, but which, nevertheless, bids fair to revolutionize many branches of electrical engineering, Radio among the rest. This has today been my good fortune, for Dr. K. Rottgardt, Director of the Huth Radio Co. of Berlin, had sent me an invitation to his lecture on the Johnsen-Rahbek invention as developed and applied in actual practice by his own firm.

"When in 1919," the lecturer, after some introductory remarks, went on to say, "I had been invited by the inventors to come to Copenhagen and acquaint myself with the new phenomenon, and two gentlemen began their demonstration by asking me to touch a strip of tin-foil on their door. This, after some conceivable hesitation (for an electrical engineer in such cases always suspects some danger of shock), I eventually agreed to do, when, very much to my surprise, some hidden voice shouted out of the tin-foil: 'How do you do, Dr. Rottgardt.' This startling introduction sufficed to interest me in the matter and to make me expect something unusual."

Some short accounts of the fundamental phenomenon have, of course, been published already both in this country and

Electrical Attraction Without Magnetism or Iron

abroad, but the many applications which, thanks to the co-operation of the Huth Co., have been developed to a commercial stage, were here, for the first time, made known.

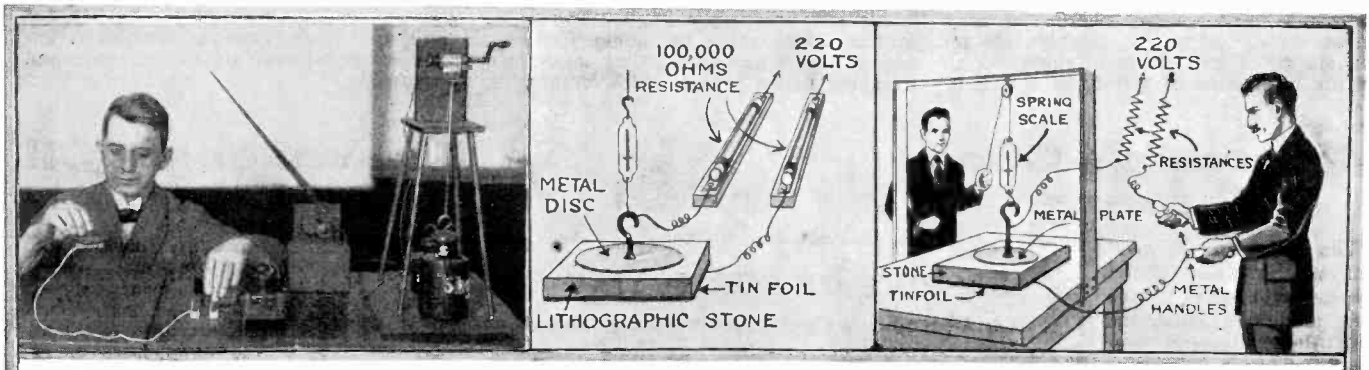
The phenomenon in question was, at first, illustrated by some striking experiments: An ordinary lithographic stone 75 grams in weight, coated on one of its faces with tin-foil was, by means of a thin wire, connected up to one of the terminals of an electric current, the other terminal communicating with a brass plate. A slight continuous current was then found to flow thru *the stone*, which, strange to say, *would firmly cling to the plate*, immediately to be released, as soon as the circuit was broken. The experimenter's own body could, as well, be used as conductor, in the place of the wire, thus illustrating the smallness of the electric current producing this remarkable effect. Moreover, the plate may consist of any metal, or even of any non-metallic substance, provided that one at least of the two materials possesses some trace of electrical conductivity, which, by the way, it may receive by artificial means. It is very striking, for example, to witness the mutual attraction of two stone slabs.

In order to understand this phenomenon it will be well to remember that the stone and metal plate constitute an electrical condenser. Inasmuch as the stone slab is polished as smooth as possible, their distance in the case of what seems to be actual contact is 1/100 to 1/200 millimeter. Now, as the effect of a condenser (or Leyden jar), of course, is the higher as the two conductors come closer together, this system is bound to exert exceptional effects. Moreover, the arrangement opposes to the electrical current a truly enormous resistance, in one case as much as 20 million ohms, that is, a figure so high as to make any line resistances appear negligible. It will therefore readily be understood that the current allowed to pass thru the system should be quite minimal, of the order of one millionth ampere. This is how a very strong attraction is produced by an almost infinitesimal current.

The phenomenon thus is much more universal in its media than is electro-magnetism, being present with equal intensity in any metal, and, it seems, in practically any non-metallic substance. Another striking advantage is that *the electrical energy* required to sustain a given weight, *is* in the case of the new attraction, 300-500 *times less than with an electro-magnet.*

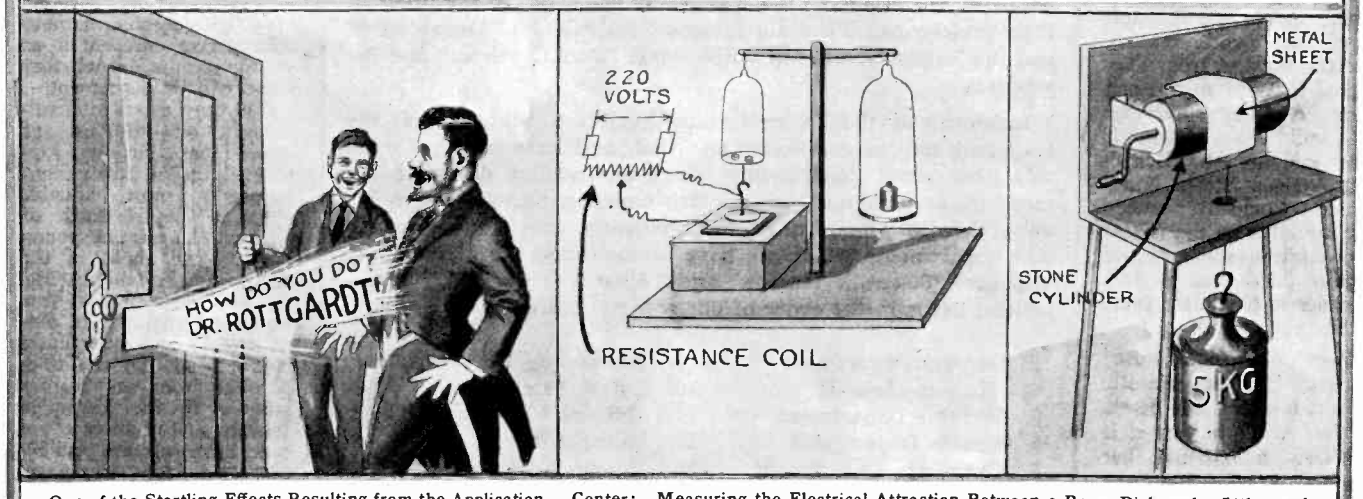
Even much stronger effects are obtained by using a *stone cylinder* in the place of a

(*Continued on page* 1160)



This Photograph Shows the Fundamental Experiment, with the Metal Disk Clinging to the Stone Slab. To the Right, a Cylindrical Stone Carrying a Five Kilogram (11 Pound) Weight.

Center: The Fundamental Test of the New Electrical Phenomenon Wherein it Was Demonstrated that When an Infinitesimal Current Was Passed Thru the Combination of a Lithograph Stone, Coated on One Side with Tinfoil and Having on its Upper Face a Metal Disk as Shown, That a Very Strong Attraction Was Manifested Between the Two.



One of the Startling Effects Resulting from the Application of the New Electrical Phenomena, Which Eliminates All Electro-Magnetic Action, Is the Possibility of Making a Tinfoil or Metal Sheet "Talk," as Here Illustrated. The Electrical Action Is Direct, Neither Magnetic nor Static.

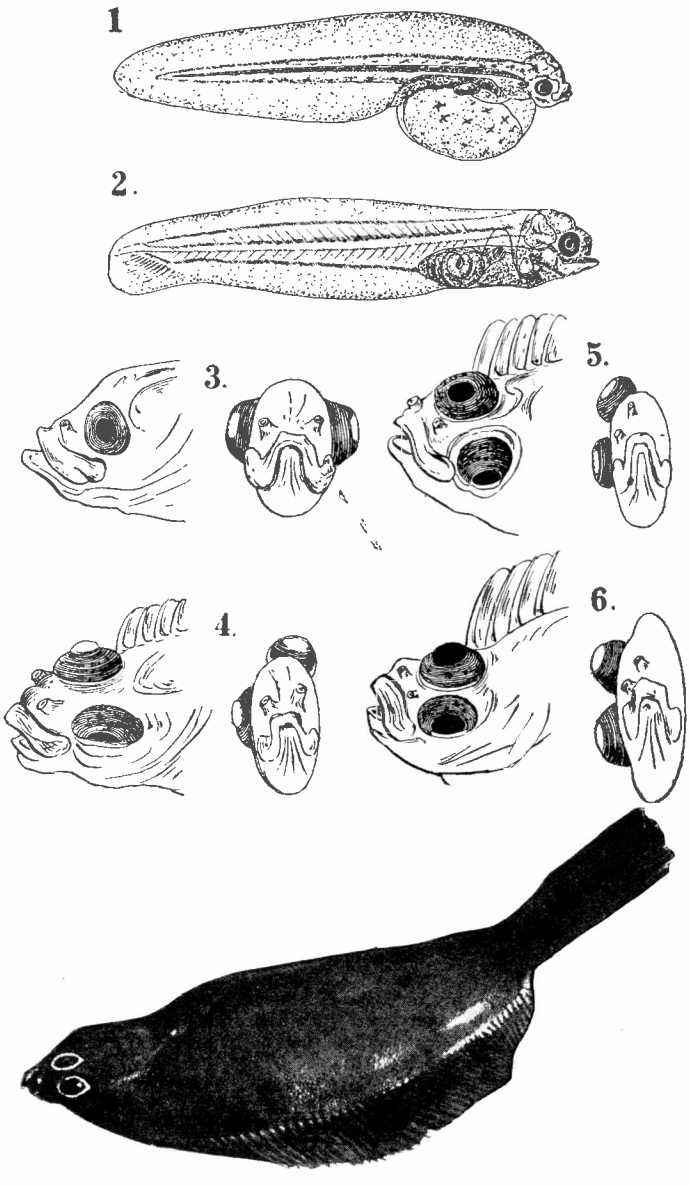
Center: Measuring the Electrical Attraction Between a Brass Disk and a Lithograph Stone, by Means of a Chemist's Balance. Right: A Stone Cylinder, Usually Lithograph Stone and a Metal Ribbon or Sheet With Less Than One-tenth Watt Retaining a Weight of 11 Pounds.

The Traveling Eye of the Flat Fish

By DR. E. BADE

PECULIAR fish, strongly compressed and with a high and flattened body, inhabit all waters. Of these the flat fish living in the ocean are so narrow that they are unable to keep themselves upright. They are forced to swim on their side, and, in this position, they rest on the bottom of the sea. The side of the body facing upward is usually the right, seldom the left. But the most unique, almost grotesque phenomenon, is that both eyes are found on one side of the body, a fact unparalleled in any other vertebrates.

These flat fish, when they hatch from the egg, are normal and symmetrical in every respect. They have an eye on each side of the head, and swim in an upright position. After a few weeks, when the flounder is about half an inch in length the body becomes broader and flatter, and they gradually begin to swim on their side. At the same time they go down to the bottom to rest. Oftener and for a longer period they turn to one and the same side, and now, when they are five-eighths of an inch in length, the eye begins to travel.



Perhaps One of the Strangest Freaks in All Nature is the Flat Fish Living in the Ocean, the Eyes of Which Travel Around the Head as the Fish Grows Older. When the Flat Fish is Young, the Eyes Are Normal and Symmetrical, One on Each Side of the Head, But for Various Reasons, Owing Principally to the Great Flatness of the Fish and its Difficulty in Swimming with the Body Edgewise or Normal, These Fish Gradually Begin to Swim on Their Side. At the Same Time They Go to the Bottom to Rest.

The primary reason for the movement of the eye is found in the ancestors of the flat fish, now extinct, which inhabited rocky shores. Here, between the clefts of the rocks, they found supports for their wide, flat bodies. When these fish were brought to a level beach thru natural agencies, they no longer could keep their bodies upright. They were forced to a horizontal position. When the young flat fish lie on their side, the eye facing the sand moves to escape the irritating grit.

This is made possible by an unsymmetrical growth of the skull. The under eye slowly moves toward the forehead, pressing in the still soft cartilaginous bone of the head. It sometimes happens that the traveling eye remains in this position, due to the hardening of the bony tissues. Then the eye is visible from both sides.

The wandering of the eye is especially noticeable in those flat fish which develop dorsal fins projecting beyond the eyes. Here the organ moves *under* the fin to the *other* side. The muscles of the eye become peculiarly modified by this change of situation and this latter disposition characterizes itself by its extraordinary flexibility.

Another cause for the movement of the eye is found in the fact that at the time the fish give up their vertical swimming and the body lies on its side, the eye is irresistibly drawn to the light, and draws the parts in its immediate vicinity around with it. In fact the entire front part of the head is pulled toward the right, a process which is possible as long as the bones of the head are still cartilaginous.

The movement of the eye is produced by the muscles of the eye, which exert a pulling force. This indents the soft bony tissues and lifts the eye over obstructions. When it has reached its new destination, it exerts another pressure which produces the eye socket in the still soft tissues. This, after hardening, keeps the eye in its new position. Especially active in this respect is a fold of the skin, which follows the eye in its movement and aids the muscles of the eye.

Young flat fish are found in far greater numbers in the open ocean than near the shore, while the adults are coast fish, some species even seeking fresh waters. Everywhere, where the waters roll over the soft sands, flat fish will be found. If they rest on the bottom, they are soon covered by the moving sands so that only the head and the greenish eyes project. It is difficult to recognize them in this position since the flat body and the assumed color resemble the surroundings. If one has seen these fish burying themselves in the sand it can easily be understood how protective their peculiar shape is.

When These Flat Fish Are About 5/8 of an Inch in Length, the Eyes Begin to Travel, Several Successive Stages of This Movement of the Eyes Being Shown in the Figures Numbered From 1 to 6, Reproduced Herewith From the Author's Original Drawing. The Movement of the Eye is Produced by the Muscles of the Eye, Which Exert a Pulling Force on it. This Indents the Soft, Bony Tissues of the Young Fish and Lifts the Eye Over Obstructions. When it Has Reached its New Destination, it Exerts Another Pressure Which Produces the Eye Socket in the Still Soft Tissues. The Lower Photo Shows a Flat Fish with Misplaced Eyes

The swimming flat fish move closely along the bottom with a wavy, undulating movement. Here they seek their food, which consists of mussels, tiny crustaceans, snails and worms.

The more or less pronounced and changeable coloration is especially observable in the flat fish. Flounders brought into a tank whose bottom is covered with white and black pebbles assume light and dark colored angular spots so that they are almost invisible. The various colors of the skin are found in star-shaped cells which contain yellow, red, brown or black pigments. These cells have the property of elongating or contracting, and it is these which change the color of the skin. Under the action of various stimuli such as pressure, light, heat, electricity, etc., they quickly change their form, sometimes appearing as regular spots, at others as branching structures which cover the entire body. In this phase the color of the skin is most prominent.

What Is One-Rabbit Power

The speed of the jackrabbit has been tested, in a race conducted by the Motorcycle Club of Colorado Springs. It was a cross-country run. The men on the motorcycles succeeded in running down the rabbits, at the end of five miles. They timed the little beasts all the way.

For the first mile the jackrabbits ran at a speed of 50 miles an hour. They covered the second mile at 40 miles an hour, and then settled down steadily to 35 miles and kept that up until they were overhauled.

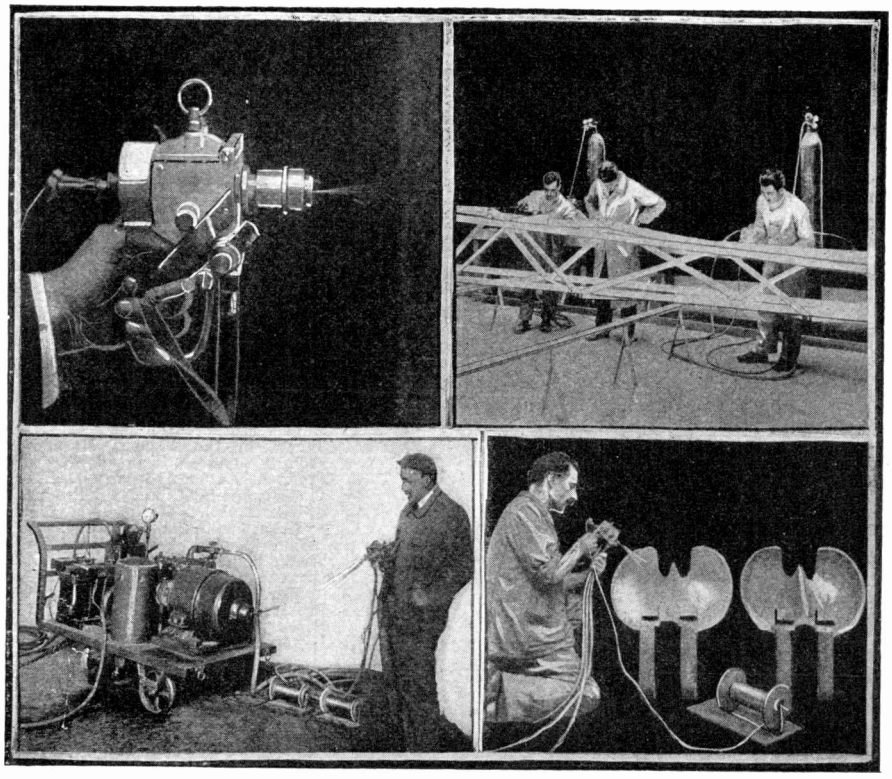
Perhaps the jackrabbit is the swiftest creature on four feet—if it may be said to run on four feet. The fastest horse stands no chance with it. Man can only overtake it by the aid of powerful machinery.

The force represented in that jumping rabbit is something to wonder at. Many a traveler in the West, observing a scared "jack" leaping up a mountainside and only touching the high spots, has envied him his freedom and power. An elephant with corresponding energy concentrated in his hind legs might jump over a mountain. And all the rabbit's power comes from a little green salad stuff. Our gas engines burn concentrated fuel. The rabbit's engine is more efficient than any of ours.

Metal-Spraying by Electricity

By ROBERT G. SKERRETT

HOW IRON IS ZINC-COATED AND WEATHER-PROOFED



The Upper Left-Hand Photo Shows a Close-up View of the Schoop Electro-Plating Pistol Which Sprays Fine Particles of Zinc or Other Molten Metal, On Metal or Other Objects to Any Desired Thickness. Upper Right-Hand Photo Shows Steel Transmission Towers Being Zinc-Coated and Weather-Proofed With the Metal-Spraying Pistol. Lower Left-Hand Photo Shows Portable Outfit for Metal-Spraying Bridges or Other Structures in Position, While Lower Right-Hand Photo Shows Steel Water Wheel Buckets Being Lead-Coated With the New Pistol.

THE electro-pistol of M. U. Schoop, a Swiss engineer, is the latest development in metal-spraying processes, and is proving a boon in numerous departments of industry. Just think of it, instead of applying a protective coating by electroplating or galvanizing, this unique apparatus makes it possible to shoot minute particles of molten metal upon various surfaces and thus to build up a veneer which is intimately bound to the underlying mass.

This inventor has likewise perfected other apparatus for a similar service; but these melt the metal by an oxy-acetylene flame and then project it by a stream of comprest air. However, his desire to deal with metals of higher fusing points, and to obtain certain technical advantages, induced him a few years ago to try to fit the electric arc to his needs. Step by step he has mastered many difficulties, and to-day his electro-pistol is widely employed in Europe.

Electro-metallurgy has proved that any metal can be fused in the electric furnace, and, what is equally to the point, in any desired quantity. Engineer Schoop, therefore, has so adapted the electric arc that he can both melt his metals and spray them in a manner that prevents objectionable reactions within his relatively miniature apparatus. Not only that, but he has ingeniously devised a way to maintain a steady replenishment of new metal to be fused by the incandescent arc.

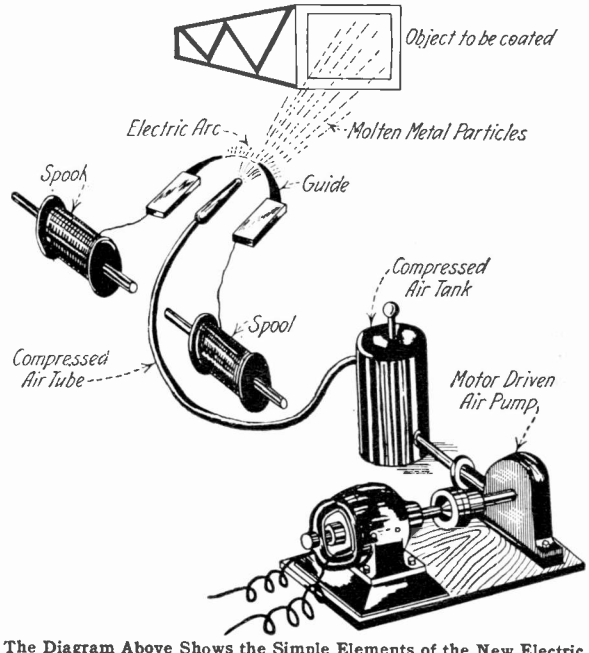
Knowing, as most of us do, something about the magnitude and the operative principles of the electric furnace, we naturally wonder how Mr. Schoop provides an unfailing supply of molten metal within the compact compass of his electro-pistol. Needless to say, he does not use a crucible from which the fluid mass can be drawn and then sprayed by comprest air. He has evolved far simpler and much more positive means. He realized that a crucible would not do, because trouble would be invited if its outlet became choked or constricted thru the likely accumulation of solidified metal. Again, it was apparent that there would be difficulties if the outlet were originally so large as to offer passage for an undesirable volume of molten metal. These matters are mentioned merely that we may appreciate how he solved his problem.

In the electro-pistol, every tendency of the fluid metal to heat the surrounding parts of the instrument has been effectually checked by so controlling the fused metal that it cannot come in contact with nearby walls or surfaces. Within the barrel of the pistol is axially placed a blowpipe connected with a comprest-air line, and just forward of the blowpipe tip the two wires of an electric circuit are brought close enough together to induce arcing. These wires are made of that metal which the operator wishes to spray; and they are continually fed forward and held the right distance apart by an air-impelled mechanism. This mechanism is driven by a small pneumatic turbine which makes about 25,000 revolutions a minute.

The stream of comprest air fulfills a two-fold function: it projects and diffuses the minute particles of melted metal with sufficient force to drive them against the receiving surface, and the expanding air serves, besides, to keep the muzzle of the pistol cool and thus to prevent the radiation of heat from the arc to the frame of the pistol. This latter action is one of practical importance, for otherwise the pistol would become hot quickly and unbearable to the worker. As it is, the pistol can be used uninterruptedly.

The two wires are fed to the pistol from separate spools; and the size of the wire is determined by the character of the metal to be sprayed. Generally, the wires are of zinc, aluminum, brass, bronze, iron, copper, etc.; but silver, gold, platinum, molybdenum, and tungsten in wire form can be effectively melted and sprayed by the electro-pistol. The speed, with which the wire is fused, depends upon its composition and may be at a rate of from 6 to 16 feet a minute. In spraying zinc, for instance, it is possible to cover an area of nearly 11 square feet with a sufficient coating of metal in the course of 4 minutes. Experience has revealed that such a zinc veneer on exposed steel or iron work, under weather conditions prevailing in Switzerland, has a life of from 18 to 20 years.

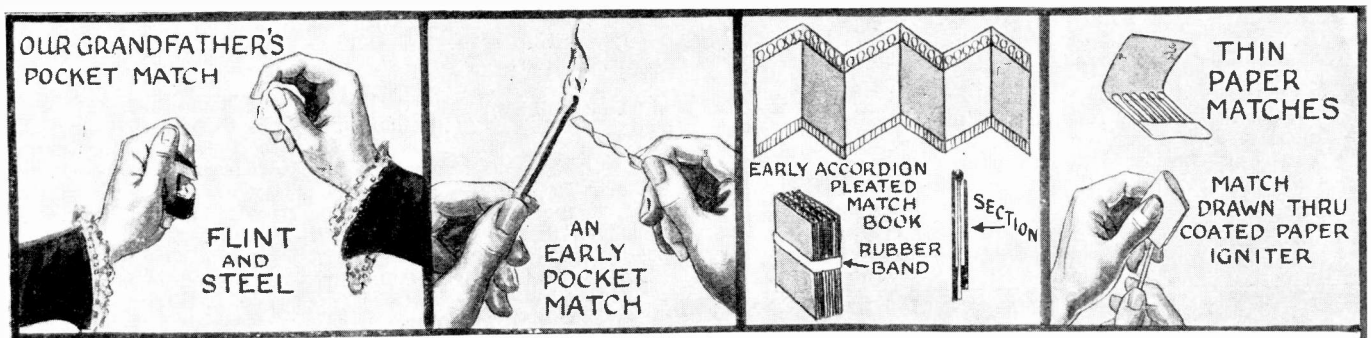
Besides protecting the metal structure of bridges, the under bodies of coal and other cars, the transmission towers and spreaders of electric systems, etc., the process is used to copper certain parts of porcelain insulators, to cover with brass the iron calendar rolls of textile plants, to aluminize and copperize the surfaces of iron and steel apparatus for chemical establishments, and for many other purposes. In the realm of decorative arts, the Schoop method is employed to gild, to silver, to bronze, and even to enamel a wide variety of commodities. The basic substance, upon which the sprayed material is deposited, may be of metal, or it may be of wood, textile, plaster or paper.



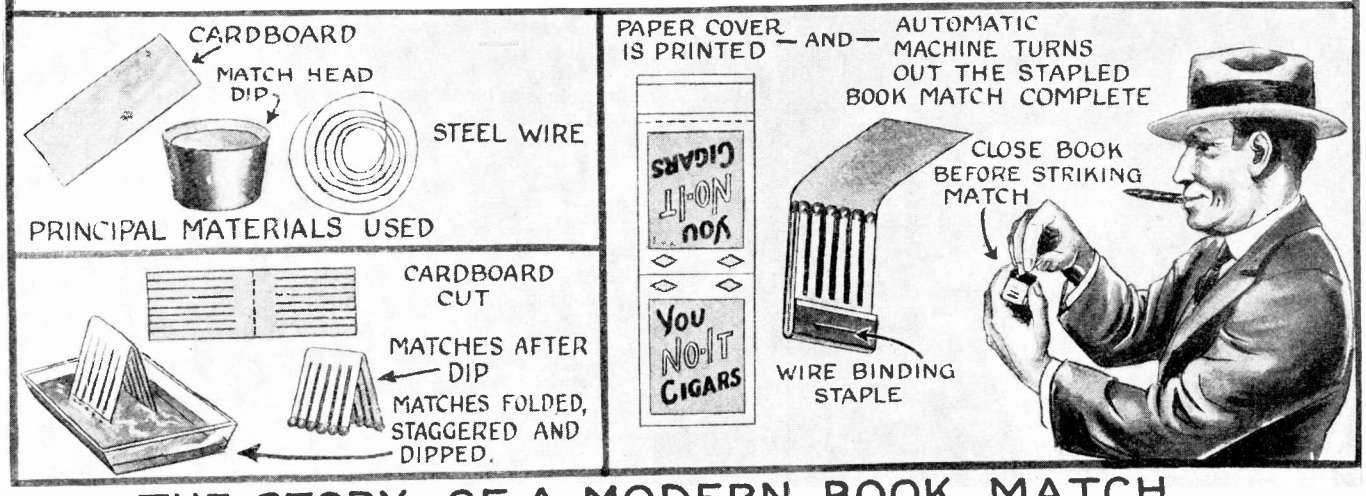
The Diagram Above Shows the Simple Elements of the New Electric Metal-Spraying Pistol Here Described, and Shown in the Photos Above. Any Metal May be Sprayed and Coated on to Metal as Well as Non-metallic Objects With This Device. The Metal Wire is Melted By the Electric Arc While a Blast of Compressed Air Sprays it On the Objects.

Fortunes from Little Things

By CHARLES FREDERICK CARTER



Our Forefathers Used to Light Fires With a Piece of Flint, Across Which a Piece of Steel Was Struck. An Early Pocket Match Had a Paper Strip Wound Around It; Unwrapping the Paper Exposed the Head, Which Ignited. The Third Picture Shows an Accordion Form of Pocket Match, the Match Being Ignited by Pulling It Downward Between the Two Paper Wrappers, Coated at the Bottom With Some Chemical Substance. Our Doughboys in France Had Trouble With European Pocket Matches Made of Thin Paper, the Match Being Lighted by Pulling It Between a Paper Folder Containing a Chemical Coating.



THE STORY OF A MODERN BOOK MATCH.

The Book Match, Which Thousands of Smokers Are Using Everywhere Today, Has an Interesting History. The Early Pocket Matches Were Quite Unsatisfactory, but They Have Improved Marvelously. The Successive Stages in the Making of a Book Match, From the Dipping of the Cardboard Strips to the Printing of the Covers, is Shown in the Series of Drawings at the Bottom, While the Upper Row of Pictures Shows the Forerunners of the Modern Book Match.

PER capita consumption of matches in the United States is 9 per diem, amounting to a grand total of 346,253,212,735 per annum. With such an incomprehensible demand as this you can readily see that there is a handsome profit in giving matches away. At least, there is a satisfactory profit for the manufacturers of book matches, constituting somewhere near one-eighth of the total, most of which are given free of charge to the ultimate consumer.

The management of a chain of cigar stores is willing to pay about $3.00 per thousand books, each of which contains 20 matches, for these little conveniences which are handed out free to customers because not merely the book cover but each individual match bears an advertisement of the cigar stores or one of the company's products. The customer is satisfied for he gets his matches free and in convenient form to carry in his pocket, while the cigar company certainly ought to be satisfied because this form of advertising is about 16 per cent. cheaper per thousand circulation than an equal sum expended for a page in a well known weekly. The advertisement on the match book is certain to be seen at least twenty times by the smoker, unless the user happens to be a blind man, while the page in the weekly may be seen by him only once.

No. 10 Book Matches

In fact, the advertising value of the book match is rated so highly that few are sold to ultimate consumers. For, in order to meet competition the independent cigar dealers are obliged to furnish free matches also. But instead of having their own ads on the books they are content to purchase those bearing advertisements of ready-made clothing or other commodities at a reduced price. That is, they pay for the privilege of circulating advertisements of other people. Isn't that fine—for the advertiser?

All sorts of things are advertised by means of book matches. In the last municipal election in New York one of the candidates ventured a modest investment in this form of advertising and ran away ahead of his ticket.

According to the United States census of manufacturers the wholesale value of matches produced in 1919 was $15,874,000. As nearly as can be ascertained one-eighth of this total represented book matches, or say $2,000,000 in round numbers.

Like all other notable inventions the book match had a hard struggle to achieve commercial success, for it began life with no intention of becoming a mere advertising novelty; it wanted to be loved for itself alone.

Its troubles were inherent in a commodity in universal use; for pretty much everybody who is anybody has taken out a patent on a match, a match composition, a match making machine, a match box or something connected with matches since the first patent, and one of the earliest ever issued in the United States, No. 68, was granted to A. D. Phillips, of Springfield, Mass., October 24, 1836, for a phosphorus friction match. Not only that, but all Europe has been busy since the beginning of the nineteenth century trying to produce the perfect match.

Some weird contraptions were patented, including some things which may, or may not, have led ultimately to the book idea. For instance there was a roll of paper lapped over at intervals the length of the match. You took hold of one end and pulled, whereupon the lap in pulling apart brought the match head in contact with the igniting substance. Then there was an accordion pleated strip of matches held together with a rubber band, the match being ignited as you pulled it downward from under the band.

A book match in use in Europe during the war caused much bad language in the American Expeditionary Force. It was the familiar book, but the matches were of thin paper. You tore one off and then

(*Continued on page* 1158)

Popular Astronomy

By ISABEL M. LEWIS, M. A.

of the U. S. Naval Observatory, Washington.

IN the midst of the densest star-clouds of the Milky Way may be seen numerous dark holes, lanes and rifts generally considered to be, at one time, vacant spaces thru which we may look into space beyond. The most conspicuous of these is the noted "coal-sack" in the southern constellation of Centaurus,

Dark Markings in the Sky

a true rift in dense star-clouds or is, like the smaller dark markings of the Milky Way, a dark, absorbing medium that cuts off light from regions beyond. The great dark bars and streaks that cross the Milky Way laterally in certain constellations are believed to be masses opaque to light, and it is possible that the great rift in the Milky Way may be similar to these in its constitution. It

This Shows a Great Nebulæ in Orion Photographed by G. W. Ritchie with the Two Foot Reflector of the Yerkes Observatory. Note Sharply Defined Dark Marking Encroaching Upon Luminous Nebulæ at Bottom of Photo; Also Dark Nebulæ to Right of Center.

is a significant fact that many of the spiral nebulæ show this same construction, presenting dark rifts between the spiral arms and lateral bars that are so characteristic of the structure of the Milky Way. See photo of great nebulæ in Andromeda. Spiral nebulæ viewed edgewise are observed to be marked by a sharply defined dark streak lying along their peripheries as clearly cut as a black band or ribbon and one is forced to the conclusion that here is a medium impervious to light that shuts off from our view the light from the central plane of the spiral and, at the same time, deprives the stars within the spiral formation and their possible attendant worlds of the light from our own stellar group.

The undoubted presence of this absorbing medium surrounding the far-distant spiral nebulæ, which are possibly island-universes, leads us to suspect that our own Milky Way, to which the solar system belongs, with its dark rifts and lateral dark bars similar to those seen in distant spirals, is also surrounded by a dark absorbing medium in its central plane that shuts off from our view other stars and star-systems in the space that lies beyond.

Within the past few years it has been found that our solar system belongs to a local group or cluster of stars, one of the numerous star-clouds of which the Milky Way possibly consists, and that this flattened, disk-shaped cluster of stars, as well as all the gaseous nebulæ of the Milky Way, contains numerous dark nebulæ and also gaseous nebulæ of the luminous variety. In our local cluster we have the Pleiades with their enveloping nebulosity which has been shown to be illuminated in the vicinity of the stars Merope and Maia by the reflection of light from these stars rather than by any inherent light. The vast encompassing nebulæ of Orion, condensed around the sextruple star Theta, in the Sword Handle, has its non-luminous as well as its luminous branches sharply defined. It is a significant fact that nebulous stars in Orion and elsewhere frequently are located at the edge of a dark lane or streak that consists apparently of non-luminous gases.

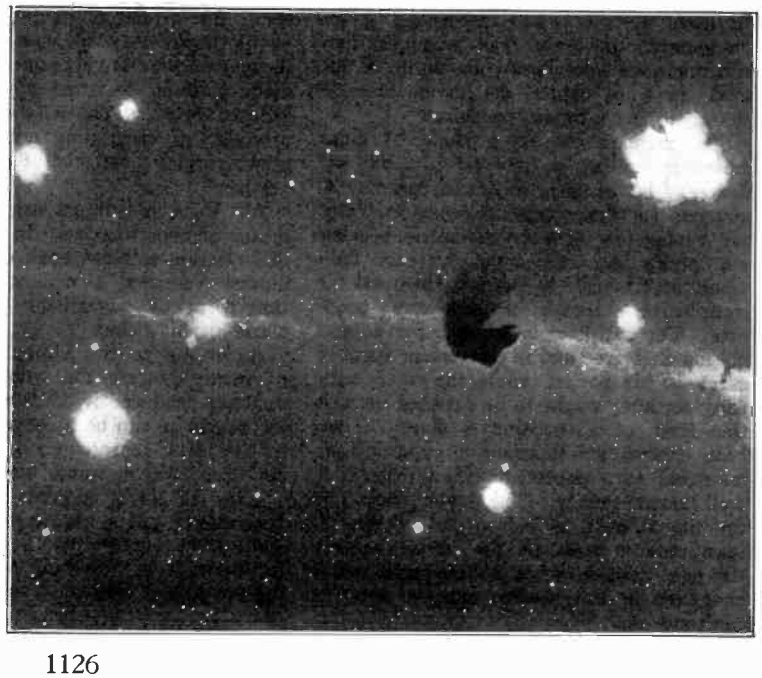
In every instance we find that the hottest of all the stars, the helium and hydrogen stars, are associated with nebulosity and it was formerly believed that these stars were also the youngest stars and were being condensed from the nebulæ with which they were associated.

Since it has been established, however, that the order of the evolution of the stars is from the red giants, which are never associated with nebulæ, to the helium and

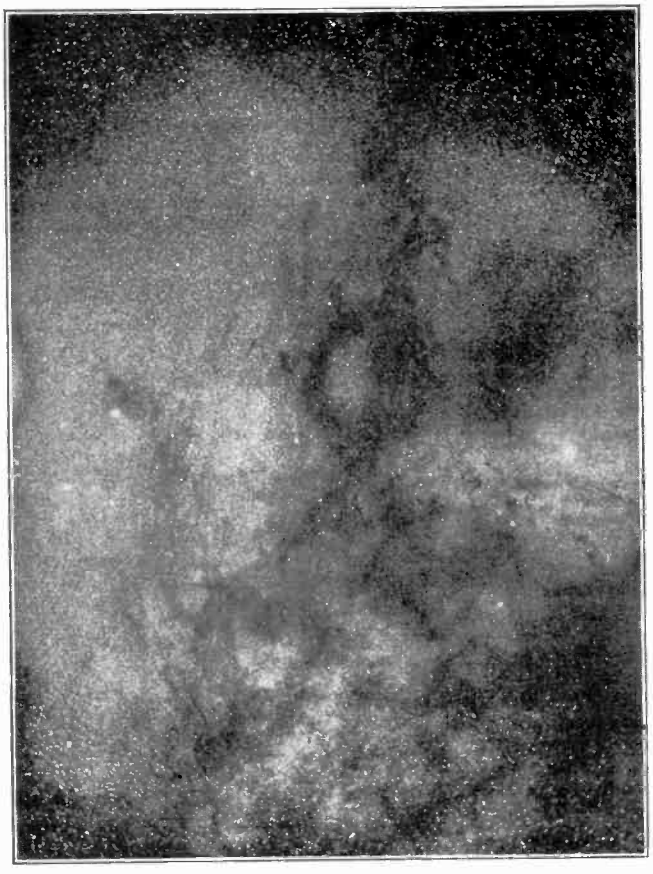
of which the elder Herschel is said to have exclaimed upon viewing it for the first time, "Here is truly a hole in Heaven!"

The difficulty found in accounting for the presence of such rifts or vacant spaces where an absence of stars is least to be expected, as well as the sharply defined borders of these markings and, in many instances, the similarity of form to bright nebulæ, has gradually led to the belief that such objects are not holes or gaps in the star-clouds, but dark nebulæ, consisting of clouds of non-luminous gases or some other absorbing medium, that shuts off or absorbs the light from stars beyond. Seen telescopically many of these objects that appear perfectly black without telescopic aid are observed to be fairly well filled with stars and encroached upon by streamers or crossed by narrow bridges of light from neighboring star-clouds. Particularly is this true of the great dark rift that sharply divides the Milky Way into two branches at one-third of its entire length between the constellations of Cygnus and Scorpio. In such instances the stars lying between us and these non-luminous objects are seen in projection against these dark backgrounds.

It is not certain whether the great dark rift in the Milky Way just mentioned is



The Black Horse in Orion, a Very Mysterious Black Body Which is Believed by Scientists to be Composed of Dust and Other Solid Particles Floating in Space, Obscuring the Light Part of the Nebulæ Behind it.



One of the Most Wonderful Dark Markings in the Milky Way North of Theta Ophiuchi Showing About 13 Degrees of the Sky. Note Peculiar S Shape Dark Marking to Right of Center. Photograph by Mr. Barnard With the Bruce Telescope on Mount Wilson, Calif.

This is a Great Nebula in Andromeda. Note the Presence of Dark Absorbing Matter in the Center as Well as Upper Left-Hand Corner. Photograph by Ritchie with the Two Foot Reflector of the Yerkes Observatory.

hydrogen stars at the crest of stellar development, it appears as if the nebulæ were being evolved from the hottest of the stars rather than the stars from the nebulæ. We might readily conceive of stars so hot that radiation pressure would exceed the force of gravitation and drive forth from these excessively hot bodies streams of luminous matter which might later form the non-luminous gases or dust particles of the dark nebulæ that are drifting thru space in vast clouds.

It has been calculated that if the great nebula in Orion had a density only one-millionth of the density of the earth's atmosphere at sea-level its total mass would be so great that it would draw to itself all of the stars in its vicinity. Evidently, then, the stuff of which the nebulæ are made, whether they are luminous or non-luminous, must be in an excessively rare state if gaseous, or very finely divided if meteoric, or otherwise the total mass of each entire nebulous cloud would be so tremendous that its gravitational effect on neighboring bodies in space would tend to convert them all into satellites revolving in orbits around the nebula as the planets revolve around the sun.

Dr. A. Pannekoek, of the observatory at Leyden, Holland, has recently been making some researches in regard to the dark nebulæ in the direction of the constellation of Taurus. He finds that these nebulæ are not among the far distant star-clouds of the Milky Way, but belong to our own local group of stars. From a study of the photographs of Wolf and Barnard and from other considerations, he comes to the conclusion that they are about four times more distant than the Hyades in Taurus, or about 450 light-years distant from the solar system, and that they have a lateral extent of 225 light-years. One strongly absorbing oblong portion, he finds, has an extent of about 65 by 23 light-years. Dr. Pannekoek finds that three small black objects in this region, which were catalogued by Prof. E. E. Barnard, who has made a detailed study of dark markings in the sky, have diameters of 500,000, 40,000 and 30,000 astronomical units, the astronomical unit being the distance from the earth to the sun, or 93,000,000 miles. Light travels, we recall, about 63,000 astronomical units in a year, so light would take about six months to cross the smallest of these small black objects, and over eight years to cross the largest.

Considering these dark nebulæ in Taurus to be enormous gas-clouds, Dr. Pannekoek is led to the conclusion that the total mass of the cloud is so great that the solar system would be compelled to describe an orbit around it in a period of two or three million years, owing to the powerful gravitational attraction of such a mass. Assuming, however, that these dark nebulæ consist of minute meteoric particles or dust-clouds such an enormous mass is not obtained.

It seems impossible in the present state of our knowledge to determine the true nature of these vast obscuring mediums that are floating thru space like great cosmic clouds, tho further astronomical research may disclose a way.

The dark or obscuring nebulæ, as well as the luminous kind, appear to cluster along the central plane of our local disk-shaped cluster of stars, as well as along the central plane of the Milky Way. They vary in size from small black spots to vast dark "holes," such as the coal sack and great dark bars crossing the Milky Way. Certain bright nebulæ such as the Trifid nebula in Sagittarius are divided by dark lanes, and many dark lanes or rifts also appear in spiral nebulæ. There are also the peculiar ring nebulæ with their central stars. Whether the dark inner portion of these ring-formed nebulæ consist of dark nebulous matter or simply represent the interior of a luminous nebular shell formed in some mysterious way about a central star is a matter of conjecture. The central stars frequently appear to be variable and the dark interior of the ring appears in some instances to be faintly illuminated by the central star. There are no more unique and puzzling objects in the heavens than these ring nebulæ, of which the ring nebula in Lyra is the best known example.

As bearing on the existence of clouds of non-luminous gases in space it is a most remarkable fact that many novæ show in their spectra certain lines of calcium in the normal position of these lines, whereas the lines of other elements are greatly distorted by the abnormal conditions that exist in the atmospheres of these stars. A similar effect has been noted in the case of certain double-star systems where a displacement of all other lines in the spectra of the two stars exists owing to the orbital motions of the stars about their common centre of gravity. Why the lines of calcium should be unaffected in both instances when all other lines show the expected displacement is difficult to explain, unless it is assumed that there exists a cloud of calcium gas between us and the star that throws its absorption lines upon the spectrum of the star as a background. According to one theory there must be between us and the star a dark nebula composed of calcium gas that is almost quiescent with respect to the rest of the stellar universe, and that has no physical connection with the star in question. The star, according to this theory, simply serves as an indicator of the presence of the calcium cloud somewhere between us and the position in space occupied by the star itself. The calcium cloud may be in actual distance many light-years away from the star under observation. According to another theory the calcium cloud may have no physical connection with the star in question, but may be in its immediate vicinity or possibly surrounding it. According to a third theory the calcium cloud is physically associated

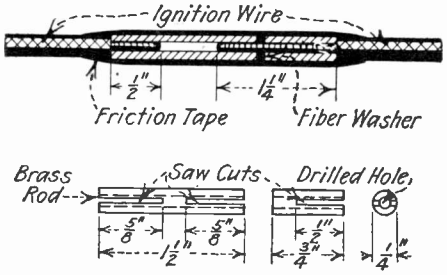
(*Continued on page* 1170)

MOTOR HINTS

First Prize $25.00

PHONEY SPLICE FOOLS AUTO THIEF

Make a break in the ignition wire at the most desirable place and cut the insulation off one wire one-half inch, and off the other for one and one-quarter inches. Chamfer ends of wires to facilitate easy operation. (If the wire is a cable, twist



This Phoney Electric Cable Splice Fools 'Em. When Reversed and Put in Position the Cable is Not Continuous.

small wires together and solder them, thus forming a solid wire.)

Take a piece of one-quarter inch brass rod two and one-quarter inches long and drill a hole lengthwise thru the center of the same, so that the wire will slip into it easily. Cut off a piece of it three-quarters of an inch long and saw a slot in the end one-half inch deep. Take the one and one-half inch piece and likewise make a saw cut down in each end five-eighths of an inch deep. Pinch the saw cuts together a little.

To assemble the splice, place a fiber washer between the two pieces of brass rod, thus insulating one piece from the other, and then wind friction tape over them tightly, allowing tape to project over ends of brass so that it will appear to have been wound on insulation of wire.

When you leave the car, pull the wires out of the splice and reverse them, thus breaking the ignition circuit, for the wire with the one-half inch end will not be long enough to pass thru the three-quarter inch piece of brass rod to complete the circuit.

Contributed by

CHARLES Z. SMITH.

Second Prize $15.00

TWO SECRET IGNITION TRICKS

The illustration, Fig. A, shows how a brass screw may be arranged to form a

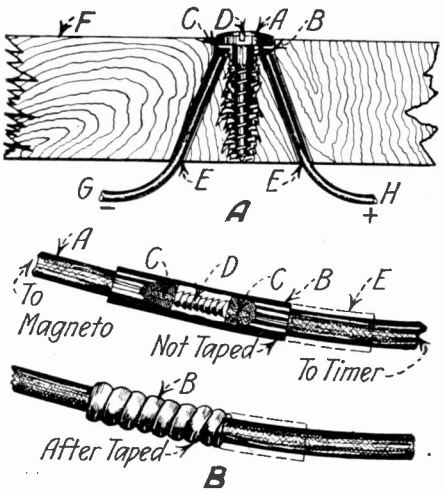


Fig. A Shows Secret Circuit-Closer Formed By Wood Screw. Fig. B Another Phoney Cable Joint.

NOTICE TO CONTRIBUTORS

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

ELECTRICITY ON THE CAR

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

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

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

The following prizes will be paid:

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

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

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

switch for the auto which will fool most thieves. This screw can be put anywhere on the car. A is the brass screw; B is the wire coming thru the holes EE. These holes are drilled from the bottom. The wires B and C are pulled thru the holes, then a knot is put on the end. Put the screw between the wires, screw it tight and the circuit is closed. One turn to the right will open the circuit.

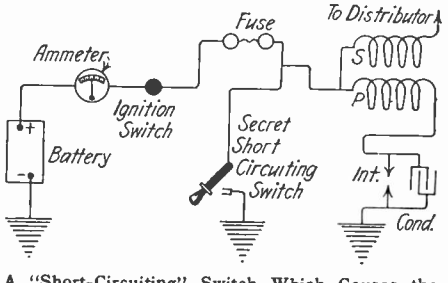
Contributed by

J. ARTHUR BREMERMAN.

Third Prize $10.00

SECRET "SHORTING" SWITCH

Herewith is illustrated an idea that I think will make an automobile practically



A "Short-Circuiting" Switch Which Causes the Fuse to Blow if a Thief Starts the Car.

thief-proof. The first thing that a thief or anyone else would do to start a car, would be to close the ignition switch. As soon as this is done, a fuse will blow out under the hood or in some other obscure place.

When the owner leaves the car he throws in the *short-circuiting* switch placed under the dashboard or in some other out-of-the-way place. In fact this switch can even be placed on the front of the dashboard because a thief would turn on the ignition switch first. Once the fuse blows out, the secret switch cannot start the car again unless a new fuse is inserted.

Contributed by

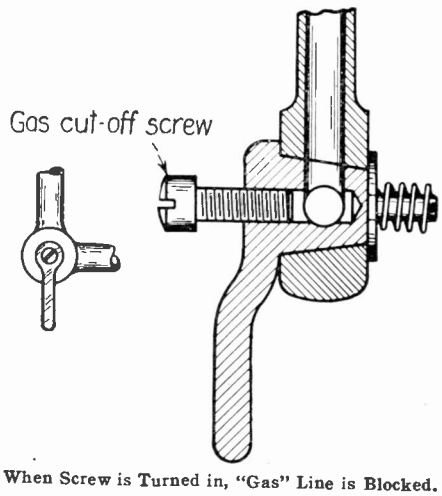
SIDNEY WEISBERG.

THEFT-PROOF VALVE

This scheme is to drill and tap a hole thru the center of the shut-off valve, so that a screw inserted into this hole stops the flow of gas. When half way out, the flow is free.

Contributed by

T. HARTLEY HALSTEAD.

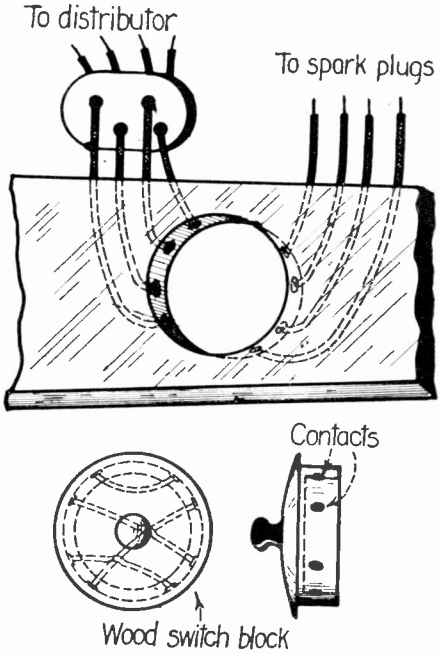


When Screw is Turned in, "Gas" Line is Blocked.

HIGH TENSION COMBINATION SWITCH

The device shown in the illustration can be put any place on the car, but preferably on the dash or back of it. Each of the wires from the distributor is cut and attached to a terminal on one side of the hole; on the other side are terminals with wires, each connecting a spark plug. An attachment is made containing wires which fit each terminal according to the combination used, so that a complete circuit is made for each cylinder corresponding to the timing of it. A phoney plug is also made that fits the cut-out section. This plug has no connecting wires, but should have an innocent looking dial on top, a clock, meter or gage, for instance, to mislead the thief. When the owner gets out of the car he simply takes out the real plug and inserts the false one.

Contributed by J. J. MAKOVICH.

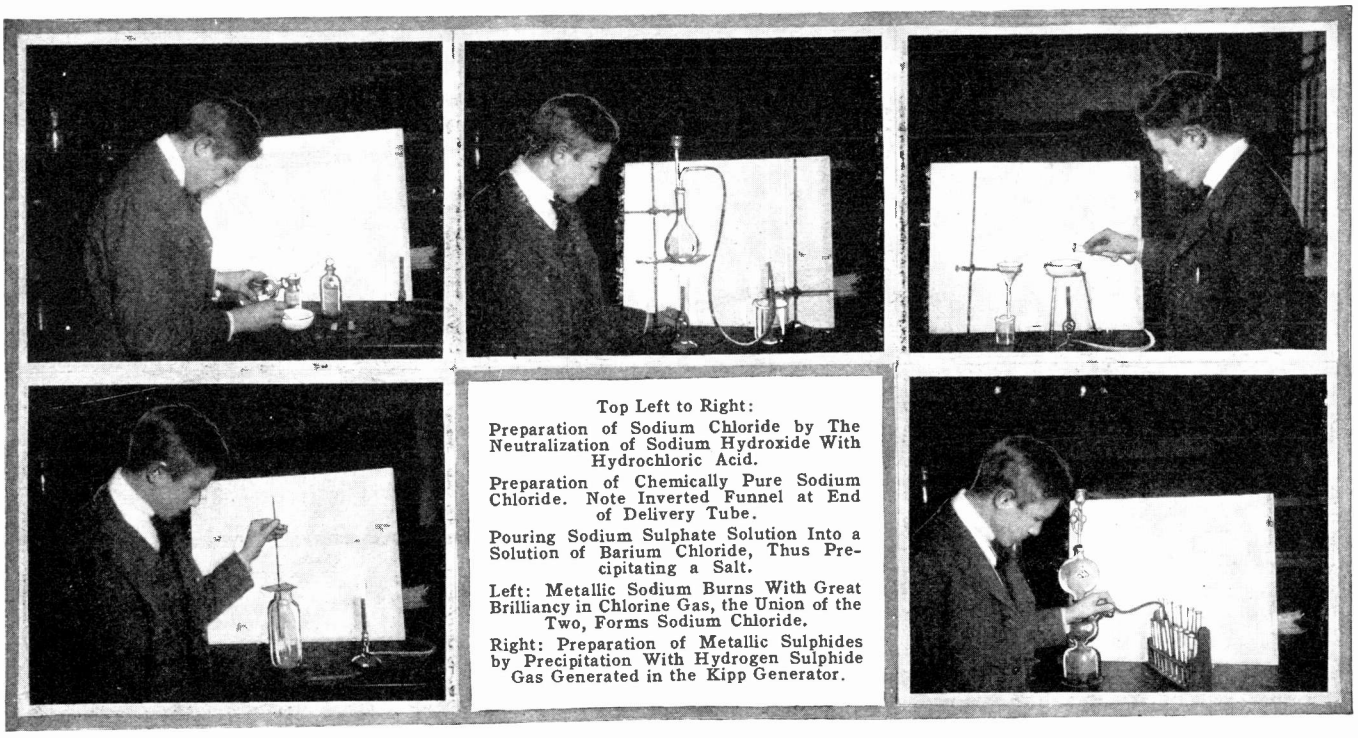


This High Tension Combination Switch is Susceptible of Many Different Designs.

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

(Concluded from March Issue)



Top Left to Right:

Preparation of Sodium Chloride by The Neutralization of Sodium Hydroxide With Hydrochloric Acid.

Preparation of Chemically Pure Sodium Chloride. Note Inverted Funnel at End of Delivery Tube.

Pouring Sodium Sulphate Solution Into a Solution of Barium Chloride, Thus Precipitating a Salt.

Left: Metallic Sodium Burns With Great Brilliancy in Chlorine Gas, the Union of the Two, Forms Sodium Chloride.

Right: Preparation of Metallic Sulphides by Precipitation With Hydrogen Sulphide Gas Generated in the Kipp Generator.

POTASSIUM Hydroxid may be prepared in the same manner as sodium hydroxid. The metal seems to take fire as the escaping hydrogen burns. This is due to the great energy with which potassium unites with oxygen and is evidence of its great chemical activity, it being the most active of all of the metals. The lavender color is the characteristic color of the potassium flame. Use a very small piece of potassium.

Ammonium Hydroxid: This is one of the most common and useful of the bases. Being a weak base and evaporating rapidly it finds many household uses for which the stronger sodium and potassium hydroxids cannot be used.

Place in the palm of your hand a small quantity of dry ammonium chlorid and mix with it an equal quantity of slaked lime. Rub the two together vigorously and then, cautiously smell of the escaping gas. You will at once recognize it as ammonia. Hold in the gas a moistened piece of red litmus paper and it will turn blue, showing that the gas with water forms a base.

Preparation of Ammonia: Arrange apparatus as shown in Figure 1. In the flask place a mixture of about 10 grams each of ammonia chlorid and slaked lime. Heat the flask *gently* with a small flame and collect the gas by downward displacement of air, i. e., the gas goes up and the air goes down.

When the inverted bottle is full of gas, which can be told by holding a piece of moist red litmus paper near its mouth and noting the blue color, immediately thrust it mouth downward in a basin of water. Because of the great solubility of ammonia, the water will begin to rise and will soon fill the bottle.

A Fountain in a Vacuum: A beautiful and very striking demonstration of the great solubility of ammonia as well as its basic properties can be shown in the following way.

Arrange apparatus as shown in Figure 2. It may be found more convenient to prepare the ammonia gas by heating a strong solution of household ammonia than to use a mixture of ammonium chlorid and slaked lime, altho that may be done. In the small medicine dropper thrust in the 2-holed stopper of the inverted flask place a little water. In the glass jar below place a strong solution of litmus, i. e., water deeply colored with litmus. Then add two or three drops of strong sulfuric acid so as to give a red color to the water in the jar.

Now heat the flask of ammonia water and fill the inverted flask with it. Quickly insert the stopper in the inverted flask and inject into it the water in the medicine dropper. Immediately the gas will begin to be absorbed by this small quantity of water and the diminished pressure resulting will draw water thru the glass tube from the jar below. This will come with a rush when it reaches the top of the tube and will immediately turn to a deep blue in the flask above. The change of color is of course due to the fact that ammonia water is a base and neutralizes the acid.

The Test for an Ammonium Salt: Evidently the test for an ammonium salt is to heat it with a base and see if ammonia gas is given off. In a test tube place a pinch of any ammonium salt, the sulfate or chlorid for example. Cover this with a solution of sodium hydroxid and heat the tube carefully. In the escaping vapor hold a piece of moist red litmus paper. It will immediately turn blue. For the sodium hydroxid, potassium hydroxid may be substituted.

SALTS AND THEIR PROPERTIES

In the articles immediately preceding this we have dealt with acids and bases, the fundamental substances from which salts are made. To one unacquainted with chemistry a salt is simply the familiar sodium chlorid, commonly called just "salt." But to the chemist salts are many in number and of various types. Of course most people know something of the properties and uses of Epsom Salt, or simply "salts," as they are called. But very few think of blue vitriol, baking soda, soap, water glass, washing soda, saltpeter, alum, asbestos, plaster of Paris, and a host of other no less important and familiar substances as belonging to this same class of chemical compounds.

Preparation of a Typical Salt: There are a number of general methods for the preparation of salts. For our illustration we shall take sodium chlorid and in the following paragraphs describe its preparation by each of the important methods.

Direct Union: Where possible the simplest method for the preparation of any compound is by direct union of the constituent elements. By methods already described in this series of articles prepare a bottle of chlorine gas. (You must, of course, remember that this gas is poisonous and experiment with it under a hood or in a good draft.) Cover the bottle with a glass plate and set it aside. Then cut a piece of metallic sodium the size of a pea, carefully remove the adhering kerosene with a filter paper and place the sodium in the bowl of a deflagrating spoon half filled with sand.

Now heat the deflagrating spoon very strongly in the flame of the Bunsen burner and thrust it quickly into the bottle of chlorine. The sodium will take fire and burn in the chlorine with great brilliancy. Here we have an illustration of combustion in which no oxygen takes part.

The inside of the bottle will be covered with a layer of white sodium chlorid. Taste it and you will find that it is identical with common salt. It is a remarkable fact that from a very bright and active metal on the one hand and a poisonous gas on the other we obtain a substance essential to life.

Neutralization: The most general method for preparing any salt is by the combination of its acid and base. Place 10 cc. of a moderately strong solution of sodium hydroxid in an evaporating dish.

Put beside it upon the desk pieces of red and blue litmus paper. Dipping a clean glass rod into the solution, touch it to each kind of test paper. Of course the red litmus paper will turn blue and the blue will be unchanged.

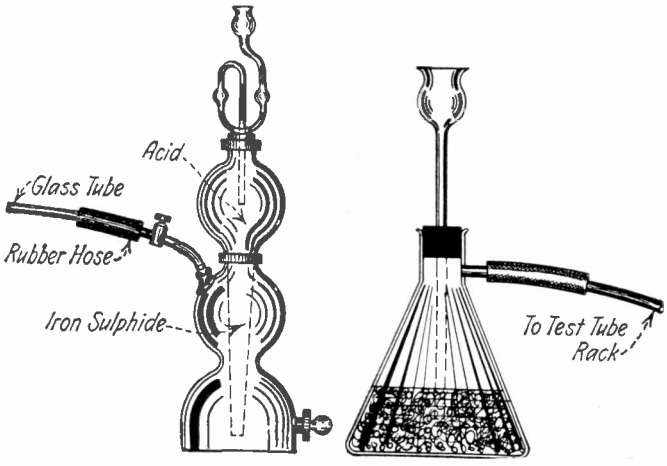


Fig. 1 at Left Illustrates the Triple Bulb Kipp Gas Generator and the Ordinary Home-Made Hydrogen Gas Generator, Either of Which May be Used in Producing Hydrogen Sulphide.

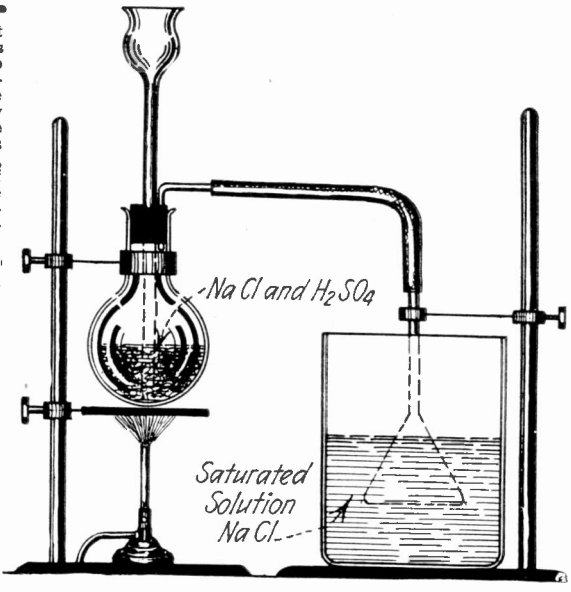


Fig. 2. Apparatus is Shown at Right Set up in the Laboratory, for the Preparation of Chemically Pure Sodium Chloride. This Action is Effected by Heating Sodium Carbonate and Hydrochloric Acid Over a Bunsen Flame.

Now add slowly and with constant stirring hydrochloric acid until upon touching the glass rod to the test paper the red will no longer turn blue. The neutralization or end point has now been passed. So taking the sodium hydroxide bottle add base drop by drop until upon stirring you find that the solution obtained will neither turn red litmus blue nor blue litmus red. The neutralization point has then been reached. Dipping the glass rod into the solution, place a drop of it on the end of your tongue. The characteristic taste of sodium chloride will be at once noted.

Evaporate the neutralized solution and a residue of solid sodium chloride will be obtained.

Precipitation: Although sodium chloride, since it is soluble, cannot itself be precipitated, yet it may be formed in connection with the precipitation of another salt.

Prepare a solution of sodium sulfate, using 7.1 grams of the uncrystallized salt or 16.1 grams of the crystallized salt to 100 cc. of water. Prepare a solution of barium chloride by dissolving 6.1 grams of the crystallized salt in 100 cc. of water.

Place 10 cc. of the sodium sulfate solution in an evaporating dish and heat over a Bunsen burner. Then add an equal volume of barium chloride solution, stir and allow the mixture to stand for a few minutes. A white precipitate of barium sulfate, one of the most insoluble compounds in inorganic chemistry, will form. Filter and catch the filtrate in a clean beaker. If it is not clear pass it through the filter again.

Place a drop of the filtrate on your tongue and note that you have sodium chloride in solution. As the barium sulfate precipitates, sodium chloride is at the same time left in solution and can be obtained by evaporation.

Preparation Using Volatility of One Product: Place 2 grams of sodium carbonate in an evaporating dish and add slowly with constant stirring dilute hydrochloric acid as long as there is any effervescence. Taste of the solution and you will again discover that sodium chloride has been formed.

These are the typical methods for preparing all salts. It will be observed that in the method of precipitation a second salt, barium sulfate, was formed, and this is a frequent method of procedure. Many salts are insoluble and may thus be precipitated.

General Precipitation: Arrange a generator as shown in Figure 1. In it place some lumps of ferrous sulfide and thru the thistle tube pour dilute sulfuric acid. If the action does not proceed vigorously add a little concentrated acid. Very shortly you will observe the characteristic odor of hydrogen sulfide. Have at hand a test tube rack containing test tubes with solutions of lead nitrate, copper sulfate, cadmium nitrate, mercuric nitrate, arsenic trichloride, antimony trichloride and stannous chloride.

Place the end of the delivery tube into the first test tube and allow the gas to bubble thru the solution. Immediately a heavy black precipitate of lead sulfide will form. Rinse the delivery tube off each time and pass the gas in turn thru the various metallic solutions. In each case a sulfide will be formed, the color of which is characteristic. These salts may be separated by filtration.

As we shall see a little later when we come to take up systematic qualitative analysis, this precipitation of metallic sulfides with hydrogen sulfide is of very great importance. For generating hydrogen sulfide and always having it on tap, a Kipp generator is highly desirable.

Precipitation of Sulfates: Place in test tubes solutions of barium, strontium and lead nitrates and add to each a solution of sodium sulfate. White precipitates of the sulfates of these metals will appear.

In like manner a number of chlorides, carbonates and phosphates may be precipitated.

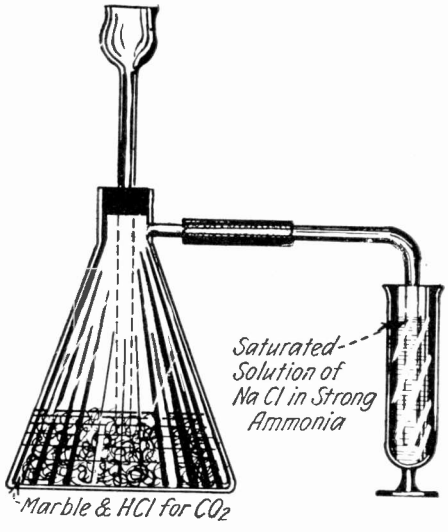


Fig. 3. Apparatus Set up for the Preparation of Sodium Bicarbonate (Common Baking Soda). Marble Particles Are Acted Upon by Hydrochloric Acid in the Larger Flask, Carbon Dioxide Gas Passing Over into the Beaker Containing a Solution of Sodium Chloride and Strong Ammonia. Sodium Bicarbonate is Formed.

Classification of Salts: There are three general classes of salts—normal, acid and basic. The normal and acid salts are the more important. A normal salt is a neutral salt. All of the salts so far prepared are normal salts. They will not turn red litmus blue nor blue litmus red. They are the result of the complete neutralization of acids and bases. An acid salt, on the other hand, has all the properties of an acid as well as those of a salt.

Dissolve a little cream of tartar in a test tube of water and test it with litmus. Mix a little of the dry salt with dry sodium bicarbonate, or baking soda, and add water. The vigorous action and the effervescence of carbon dioxide show the presence of an acid. This combination is, of course, baking powder. Cream of tartar is an acid salt obtained from the inside of wine casks.

Preparation of an Acid Salt: Prepare a 1 to 5 solution of sulfuric acid by pouring very slowly and with constant stirring 20 cc. of concentrated sulfuric acid into 100 cc. of water. Then dissolve 20 grams of potassium hydroxide in 100 cc. of water. Allow the solutions to cool.

Place in a beaker 25 cc. of the dilute sulfuric acid and exactly neutralize it with the potassium hydroxide, using litmus paper as before to determine the end point. Then evaporate the solution to one-third its original volume and set it aside to crystallize.

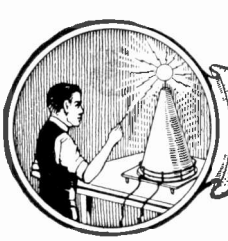
Again exactly neutralize 25 cc. of the acid and then add 25 cc. more of the dilute sulfuric acid. Evaporate this to one-third of its volume and set it aside to crystallize.

When the solutions have thoroly cooled and the crystals have formed, pour off the remaining solution and dry and examine the crystals. You will observe that the crystals do not appear to be of the same substance. Dissolve a little of each in water and test with litmus paper. One gives a neutral reaction and the other an acid reaction. In the second case not enough base was used to neutralize all of the acid. Just half of it was neutralized, the second half entering into combination with the salt upon crystallization. This formed potassium acid sulfate.

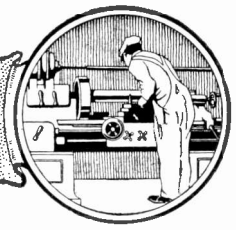
Hydrolysis Action of Salts: Many salts, although perfectly normal in their method of formation and in their formulæ, nevertheless give either an acid or a basic reaction.

Action of Copper Sulfate: Place a strip of sheet zinc in a test tube of copper sulfate solution. The zinc will, of course, replace the copper, but you will also observe the evolution of a multitude of bubbles.

(*Continued on page* 1162)

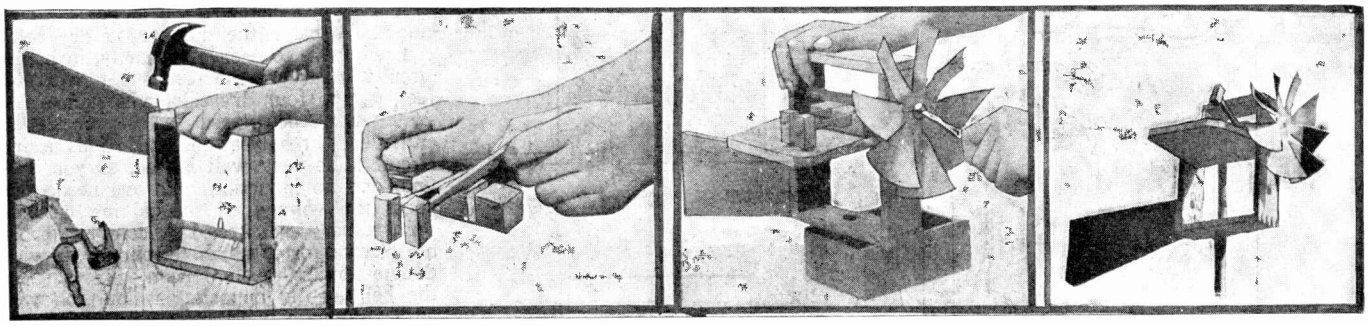


THE CONSTRUCTOR



Garden Windmill Keeps Birds Away

By DR. E. BADE



Nailing the Windmill Supporting Frame Together.

Fitting the Noise-producing Hammers in the Guide Bar.

Screwing the Propeller Blade to the Shaft of the Garden Windmill.

The Windmill Complete. One of the Hammers is About to Drop on the Sounding Board.

A HAMMERING windmill is instructive because it is based upon one of the five simple machines of the physicist—the screw, and it is useful in the garden because it will keep all birds away from the fruit trees by its noise, when it is placed among the branches.

A small garden windmill can be made from a piece of tin and a few strips of wood. The wood is used for the frame which consists of four slats, each seven inches long and three inches wide. These strips, before they are nailed together, receive two holes which will later hold the shaft of the wheel. The shaft is eight inches long and has two projecting wires (staples) fastened to it. These engage two hammers when the shaft is turned.

The hammers are made from wood and are balanced on a nail fastened to a block which is nailed to a larger board seven inches long and five inches wide, and this in turn is fastened to the frame.

The wheel, which is made from thin tin, is six inches in diameter, and is firmly fastened to the shaft by a screw. A tail must now be made from a board ¼ inch thick and 10 inches long. It is three inches wide in front and six inches wide in the rear. If two holes are now bored into the two lower horizontal bars and if a round stick is loosely placed in it so that it can turn easily, the mill will always face the wind.

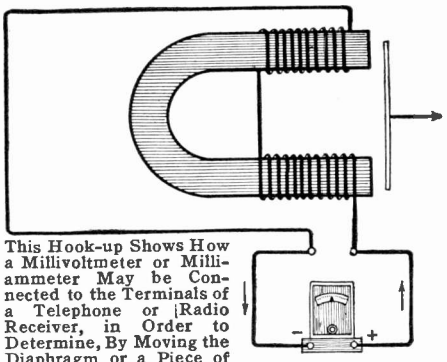
Keeping Your Telephone Receivers "Alive"

By HOWARD KARG

SINCE the sensitivity of permanent magnet type telephone receivers depends to a large extent upon the strength of the permanent magnetic field in the core, it is desirable to prevent this field from decreasing in value thruout its life. The influence of this factor upon the sensitivity of a telephone receiver is of even greater importance, as the receiver grows older and the magnetism has naturally decreased to some extent. Any loss of flux then results in even a *greater* decrease in sensitivity.

The first method tried by the writer was to bring the receiver, with diaphragm removed, up and near enough to a sensitive compass to cause a deflection of the needle from the natural north and south position of about 45 degrees. The receiver terminals were then connected at random to a battery of two or three dry cells and the terminal which was connected to the positive pole when the deflection of the compass needle was increased still further from the north and south position, was marked as "positive" simply by tying a string to it. By this method the correct direction of current flow through 75-ohm receivers was readily determined, but the results with a pair of 2,000-ohm radio receivers were inconsistent. A more reliable method was therefore needed, and the one that suggested itself is here described.

As shown in the accompanying diagram, a millivoltmeter, a milliammeter, or the element of any d'Arsonval type instrument, or even a galvanometer (USE CARE) is connected at random to the receiver terminals. When the diaphragm or keeper is quickly removed and the meter shows a small momentary deflection in the reverse direction, the receiver terminal then connected to the positive meter terminal should be marked as "positive" and should always be connected to the positive pole of the battery with which the receiver is used. By this method the correct directions of current flow through the 75-ohm receivers previously mentioned were again determined and were found to agree in every instance with the determinations made with a compass.



This Hook-up Shows How a Millivoltmeter or Milliammeter May be Connected to the Terminals of a Telephone or Radio Receiver, in Order to Determine, By Moving the Diaphragm or a Piece of Iron To and From the Pole-Pieces, Which Terminals the Positive and Negative Wires From a Battery Should be Connected to, in Order to Preserve the Life of the Permanent Steel Magnet in Such Receivers.

This method is based on Lenz's law, which states that any change in the value of the flux threading a coil sets up an electromotive force in the coil and causes a current to flow if the circuit is closed, which tends to oppose the flux change. When the diaphragm or keeper is quickly removed, as explained above, the flux is decreased, due to the removal of a quite permeable component of the flux path and the current which flows tends to prevent this slight momentary demagnetization. This, therefore, is the direction in which a direct current should always flow through the windings.

It is not considered necessary to mark the terminals of Baldwin telephone receivers, because the current through the windings of these receivers does not exert an appreciable effect upon the permanent magnetic flux. Extremely loud signals should be guarded against because of the delicate mounting of the armature in this type of receiver.

Some of the leading manufacturers are now marking their receivers to insure the proper direction of current flow. Certainly no precaution which can be taken as easily as this to preserve your "mechanical ears" ought be disregarded.

CASH FOR ARTICLES

Beginning with the present issue of SCIENCE AND INVENTION, we have made a considerable change in the editorial policy, thanks to the thousands of votes which our readers gave us on the ballots published some time ago in this journal, in deference to which we are herewith enlarging the "Constructor", as well as the "How-To-Make-It" and the "Wrinkles" sections. We pay well for articles of various kinds, and constructor and similar articles do not have to be accompanied by finished mechanical drawings, but clear pencil or pen and ink sketches will do; the manuscript or text of the article being typewritten if possible. Sketches should always be made on separate sheets and never on the same pages as the story. All sorts of electrical and mechanical devices are of interest to us, so long as they are new and novel. Thus a wide field of opportunity is opened up to everyone. Address all manuscripts and drawings to Editor, SCIENCE AND INVENTION.

Practical Telephonics

By HENRY JOHNSTONE

THE technical periodicals nowadays are pretty well filled up with radio diagrams and stories, and we do not hear very much about the practical everyday things which are often very important to us; the author of the present article has thought that a few practical diagrams and hints on how to connect telephones, including the loud-speaking phones and dictagraphs, might prove of interest. The loud-speaking telephone circuits here described will often prove valuable where the radio telephone receiving set is located in an out-of-the-way part of the house, and the radiophone talk is to be relayed to another room or another floor. The loud-speaking telephone is also useful in transmitting phonograph music to other rooms or floors of a house, and the author has used all of the arrangements here described with excellent success at different times.

A few simple circuits of interest to the telephone experimenter are shown in Fig. 1. At "A", Fig. 1, is a circuit composed of bell wire or other insulated conductor, or even with one wire and an *earth return*, employing two ordinary Bell type telephone receivers. A battery may or may not be used and the receivers are used as transmitters also, first talking to the receiver and then holding it to your ear to listen. When a battery comprising a few dry cells is used in such a telephone circuit, the polarity may have to be reversed, or the terminals of the phones changed around until best results are obtained, as actual experience will dictate.

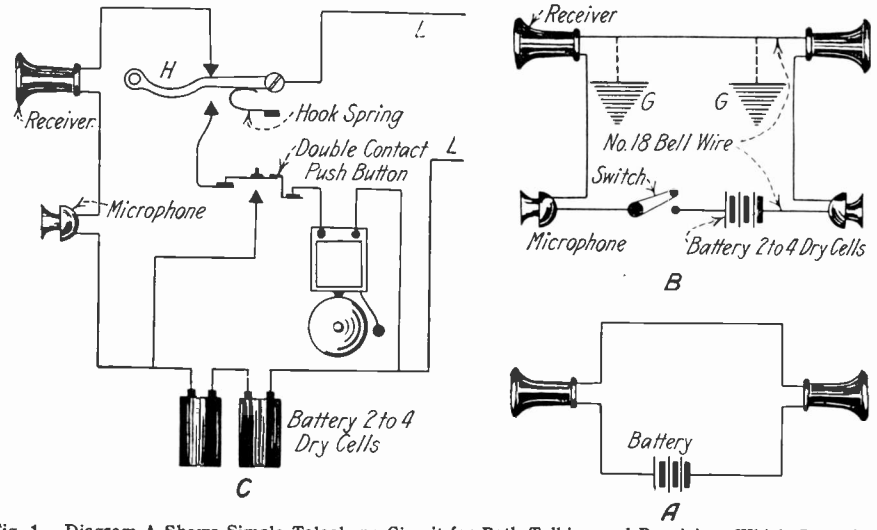


Fig. 1. Diagram A Shows Simple Telephone Circuit for Both Talking and Receiving, Which Comprises Two Telephone Receivers With or Without a Battery. Diagram B Shows Simple and Efficient Series Telephone Hook-Up. Diagram C Shows Wiring for Series Telephone Instrument With Call Bell and Ringing Button.

At Fig. 1 "B" a simple series telephone circuit is outlined, and one of the wires may be eliminated by using a *ground return*, connecting one of the line wires at either instrument to the water pipe or to a metal plate buried in the ground, as shown at G and G. This simple circuit, comprising two standard microphones or transmitters and two 75 ohm receivers, will talk over a goodly distance, the longer the circuit the greater the number of dry cells you will have to use. Ordinarily, in house circuits, or where the run is not over 100 feet, two to four dry cells will suffice. A switch may be placed in the circuit at either end, or only at one end. This series circuit talks very well indeed, as you will find, and no induction coils are needed to boost the voltage of the talking current for ordinary distances. A complete cabinet circuit for a series telephone set with double-contact push button for ringing the bell at the opposite station, together with automotic hook switch, on which the receiver is hung when thru talking, is outlined at Fig. 1, "C." The double-contact push button can be made from any ordinary button by simply adding a top contact spring, which normally keeps the circuit closed thru the bell when the hook switch is depressed by the weight of the receiver hanging on it. The hook switch itself may also be home-made, or else picked up at a second-hand electrical shop for a song, as may also the telephone transmitter and the receiver, a considerable quantity of army telephone apparatus being available now at bargain prices in many cities.

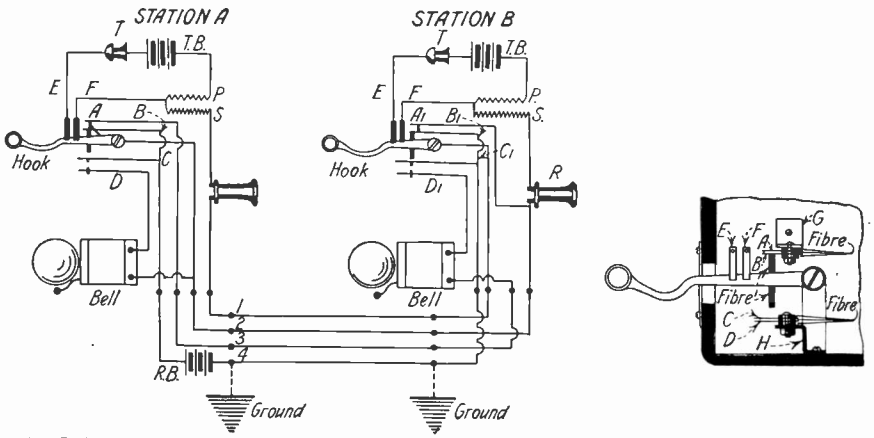


Fig. 2. It is Frequently Desirable to Have Ordinary House and Garage Telephones to Ring Automatically When the Receiver is Lifted From the Hook, the Same as the Commercial Telephones to Which We Are Accustomed, and This Diagram Shows a Special Circuit Arrangement Which Will do This. Two Insulated Contact Springs Are Placed Above and Below the Receiver Hook, These Springs Being Opened and Closed Alternately By the Fibre Block Mounted on the Receiver Hook.

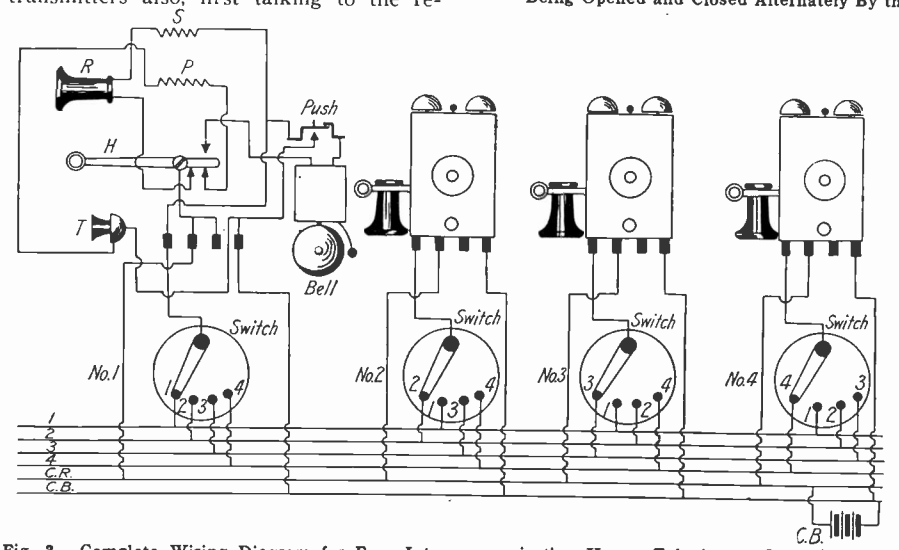


Fig. 3. Complete Wiring Diagram for Four Intercommunicating House Telephones Operating on a Single Common Battery, Which is Used for Both Ringing and Talking Circuits. In this System Two More Wires than the Number of Stations is Required in the Cable of Bell Wires Connecting the Instruments. To Call a Certain Station, the Switch is Moved to the Proper Number, and the Calling Button Depressed, Which Rings the Desired Party's Bell.

Automatic Ringing Battery Telephone

With the simple house telephone operating on a few dry cells, the party wanted has to be called by pressing on the push button, as becomes evident from the diagram, Fig. 1, "C." The author once worked out a handy automatic calling scheme which rings the other party's bell when you lift the receiver from the hook, the same as when using the regular Bell telephone system, and this diagram is reproduced at Fig. 2. All that is required beyond the usual hook switch and its contacts are two sets of extra contact springs arranged as shown, which are opened and closed by two fibre strips or blocks resting in two slots cut on either side of the hook switch lever. For ordinary work these contact springs, which are held between fiber washers so as to be insulated from one another, need not have silver, platinum

or tungsten points, but it is preferable to use small silver contact points at the ends of the springs, or else purchase hook switch springs having such silver points on them already. These may be picked up from some old telephone apparatus, or else from a telephone supply company. In some cases your local Wire Chief at the telephone exchange can fix up your wants.

Intercommunicating Battery Phone System

It is often desirable to connect more than two telephone instruments on a system in the house or else between house and garage, et cetera, and Fig. 3 shows one of the best methods of doing this, as well as the internal connections of the telephone instrument itself. The cabinet circuit shown is for a telephone set containing an induction coil with primary and secondary connected to the talking and receiving circuits, but a simple series telephone set of the type shown at Fig. 1 "C," may be used equally as well, of course.

In the intercommunicating telephone system here shown, there is required in the cable of bell wires connecting the stations, two more wires than there are telephones. Thus a six wire cable is necessary for four stations, an eight wire cable for six stations, a fourteen wire cable for twelve stations, etc.

To call party No. 4 on this system from station No. 1 for example, the multiple point switch lever is changed to contact No. 4. Instrument No. 1 is now ready to call party 4, and this is done by pushing the button of the double contact push. Any other party on the system is called in the same way, i. e., the party switch is turned to the corresponding number desired, the calling button depressed, the telephone receiver removed from the hook, and conversation carried on.

The system here shown in Fig. 3 is very commendable for a number of reasons, one of them being that the ringing and talking battery of four to six dry cells is centralized and may be placed in the basement or cellar. It can be connected to the common ringing and common battery wires (marked CR and CB in the diagram), anywhere along the cable, but preferably in the center of the system if the total length of the cable is very great so as to minimize and equalize the voltage drop along the circuits. Telephones suitable for use in this system can be purchased on the market for about $3.00 apiece, or they may be assembled using 75 ohm watch case receivers, standard microphones selling anywhere from 75c. to $1.25, together with a buzzer or bell worth about 40c. or less, a double contact push button and a multiple point switch, together with switch hook, which latter three items should not cost more than $1.25.

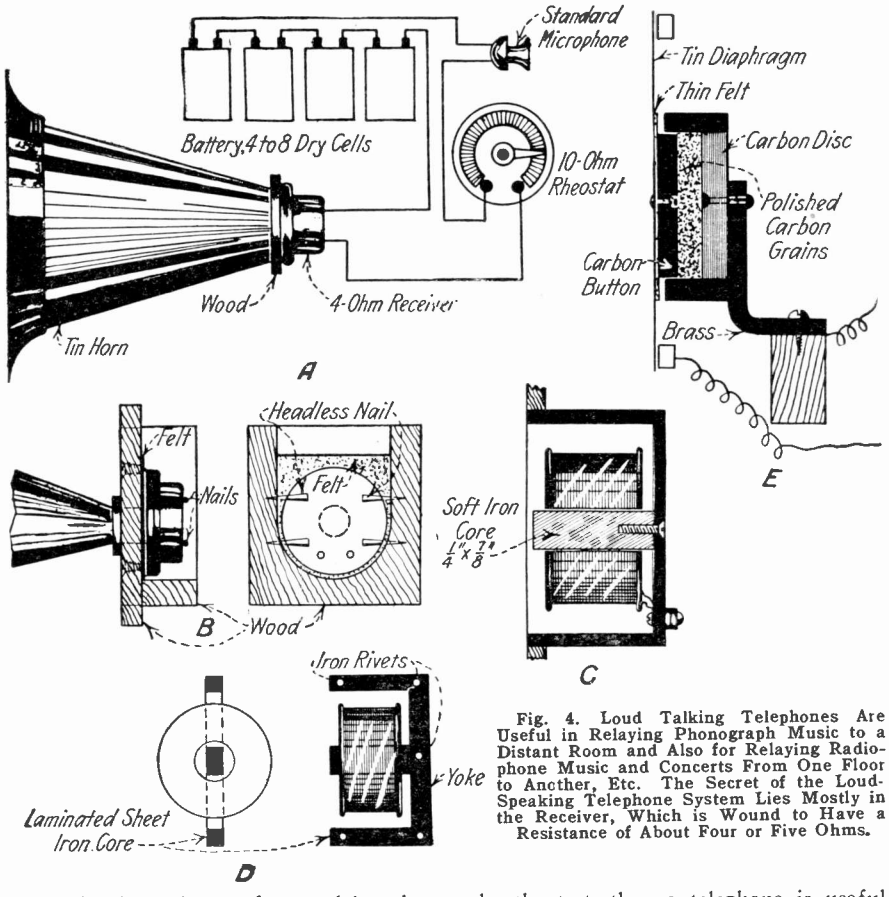


Fig. 4. Loud Talking Telephones Are Useful in Relaying Phonograph Music to a Distant Room and Also for Relaying Radiophone Music and Concerts From One Floor to Another, Etc. The Secret of the Loud-Speaking Telephone System Lies Mostly in the Receiver, Which is Wound to Have a Resistance of About Four or Five Ohms.

The cable is made up of several lengths of wax insulated bell wire bound together with friction tape at intervals, or else wrapped the entire length with black friction tape, to make a really good job. Much time will be saved in hooking up the apparatus correctly by using different colored wire for each number, such as red for No. 1 wire; green for No. 2, red and white for No. 3, etc. The practical telephone man will not care if the wires are all of the same color, however, and will quickly ascertain his correct wire numbers at each station by testing with a buzzer or telephone set, the particular wire in each instance being grounded for example, thru a battery to the water or steam pipe system. Then by connecting one wire of the buzzer or bell to the nearest water or steam pipe at the particular station which he is testing out at the moment, and touching each of the wires one after another, he will know that he has No. 4 wire for example, if the bell rings, because the battery at the master testing station (usually in the cellar), is connected to the water pipe and to the end of No. 4 wire in the cable, as previously arranged, either by himself or his assistant. If two people make the test, then a telephone is useful to call back the numbers as found to the man at the master station.

Loud-Talking Telephone

Loud-speaking telephones are frequently very useful, and the electrical and radio bug can rig up one of these outfits himself at small cost. The author has used the scheme here shown, with a standard microphone, such as used in regular telephone experiments, the principal novelty or change in the usual apparatus employed, being that the telephone receiver has a resistance of about four ohms or slightly more. This receiver was made from a regular watch case type model, but the permanent steel magnet was removed, and after stripping the fine 75 ohm winding off of the bobbin of the single soft iron core, it was rewound with No. 22 wire. The exact gauge of wire that should be used, will vary somewhat with the dimensions of the bobbin, but a little experimenting or calculation with the aid of a wire table, will give you the results you are after. The secret of the loud-talking telephone is similar to that of a dictagraph, and lies in the use of a heavier current thru the receiver than is the case in the normal telephone instrument. A tin horn or else a wooden one about sixteen inches long will give good results, and Fig 4 "B" shows how the horn may be fastened into a hole bored thru a piece of wood, also a simple wooden block for supporting the telephone receiver tightly against the opening at the base of the horn. It is desirable usually to place a piece of thin felt between the receiver and the board supporting the horn, so as to make this joint good and tight. The receiver is retained in place by four nails, the heads of which are cut off after being driven in place.

Fig. 4 "C" shows the elements of a simple loud-speaking telephone receiver with its soft iron core. At Fig. 4 "D" is shown a type of low resistance phone which has been used successfully by one concern, the soft iron core being made up of laminations or punchings, which the amateur could, of course, imitate with a pair of

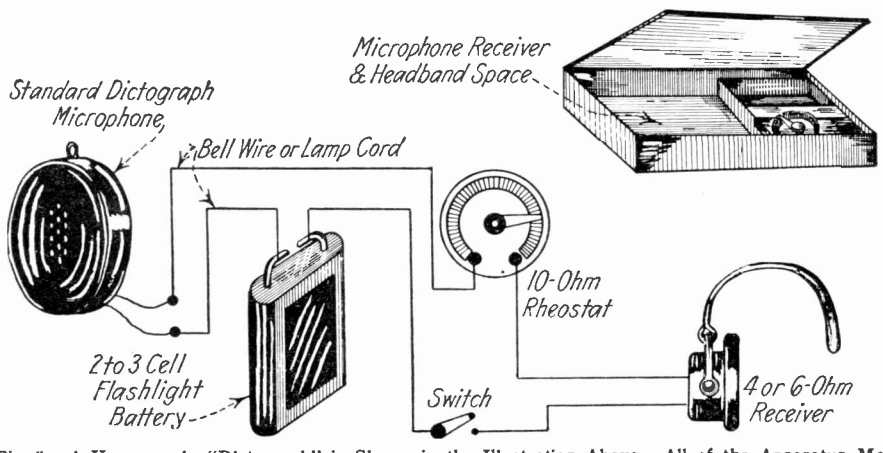


Fig. 5. A Home-made "Dictagraph" is Shown in the Illustration Above. All of the Apparatus May be Arranged to Fit Into a Cigar Box, and a Cheap Watch Case Receiver Having a Bobbin Wound to Four to Five Ohms Resistance Does the Trick, Together With a Flashlight Battery, a Rheostat, and a Sensitive Microphone. It is Best in Most Cases to Purchase a "Dictagraph" Microphone.

snips and a sheet of stovepipe iron, or what is sometimes called *Russian sheet iron*, procurable from any tinsmiths. The central pole measures about one-quarter inch square, while the end poles have a cross section of one-half this value. The yoke has a cross section of one-quarter inch by one-quarter inch also. The bobbin made of two fibre disks on a piece of very thin fibre tube, all glued together, is wound with heavy insulated magnet wire to give a resistance of four to six ohms. The pole pieces should be carefully filed off and trued up in line, the distance separating them from the sheet iron diafram of the watch case receiver being about 1/32 inch.

For those who care to experiment in making their own microphones, a diagram is given at Fig. 4 "E" showing the general arrangement of a good microphone of the sensitive type. The diafram may be of tin, ferrotype, iron or mica, and thin fibre or hard rubber have been used as well as tightly stretched silk, celluloid, etc. Mica is one of the best materials for diaframs in either microphones or receivers. The main thing to learn about home-made microphones, is to forget the old how-to-make-it books, which tell you to take one nice looking chunk of old arc lamp carbon and pound it up into fine particles; the writer learned long ago that this makes about the worst microphone imaginable. If you want results spend a few cents and buy some honest-to-goodness polished carbon granules. Electrical or telephone supply companies will sell you the right size, and it is advisable also to purchase the polished carbon buttons for the front and back electrodes of the microphone, but these may be made by the amateur, or even salvaged from some old telephone apparatus, which has been discarded. One of the electrodes may be of brass and the front one of carbon. A piece of very thin felt is placed behind the carbon button in some microphones before the latter is riveted to the tin or mica diafram. The inner end of the rivet rests in a little depression in the face of the carbon. The same is true of the rivet or screw if one is used in the rear electrode. The diameter of the tin or mica diafram should be about two and one-quarter inches, which is the standard size for practically all telephone apparatus. The diameter of the carbon disks may be three-quarter inch, and the space between them about one-sixteenth inch, or a little more, which is to be filled with carbon grains. Before placing the carbon grains in place, a pocket is formed for them by binding a piece of thin felt around the rear disk electrode, as becomes evident from the diagram, Fig. 4 "E." The carbon grains should not be handled with the fingers, but with a piece of creased paper or else with a small spoon. The adjustment of the distance between the electrodes and the quantity of carbon grains may prove a little difficult, but once you find the right adjustment, the instrument will work very nicely.

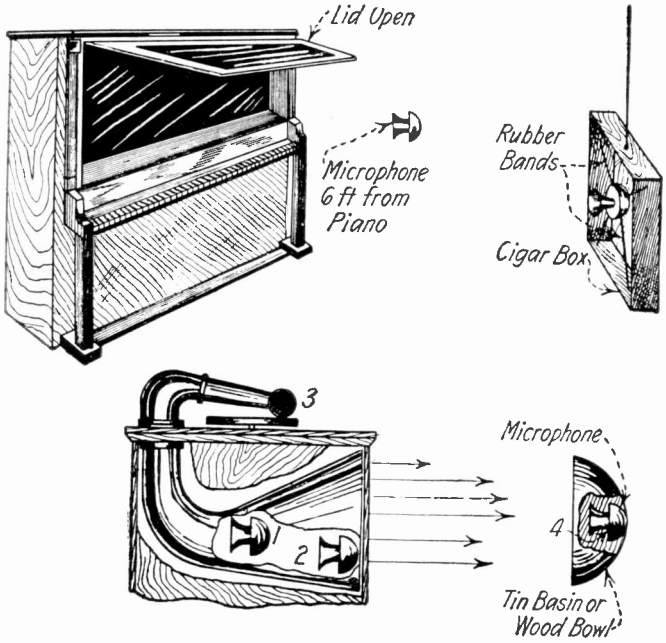


Fig. 6. The Upper Illustration Shows Arrangement of Microphone and Best Position in Front of Open Case of the Piano. The Lower Diagram Shows Several Good Positions for Transmitting Phonograph Music Over a "Loud-Talker" Circuit. The Microphone May be Placed at Positions 1 or 2 with Doors Shut, or Else Arranged at 3 with Stylus Lever Attached Directly to the Center of the Microphone Diafram; or it May be Placed in the Focus of a Bowl or Basin a Few Feet From the Phonograph Doors.

With a loud-talking telephone of the type shown at Fig. 4, the number of dry cells to be used will depend upon the length of the circuit, but for circuits not exceeding 40 to 50 feet in length, about four to six cells will usually be sufficient. It is desirable to place a ten ohm rheostat in series with the circuit as shown, to regulate the strength of the current and to eliminate frying noises.

Dictagraph or Detectiphone

The so-called *dictagraph* is used very extensively nowadays by detectives for listening to a conversation in a room by secreting the sensitive microphone behind a picture frame or other piece of furniture, and wiring it up by hidden wire conductors to another room in which there is a stenographer or detective. It will be found that fair experimental results are obtainable by using an ordinary microphone. A similar receiver to that constructed for the loud-talking phone, has been employed by the writer very successfully, using a head-band to hold it against the ear. A two or three cell flashlight battery will usually supply all of the current necessary and it is a very good idea to place a ten ohm adjustable rheostat in series with the circuit as shown, together with the switch. In my case, the dictagraph outfit is placed in a cigar box, a suitable compartment being made from cigar box wood to hold the battery and rheostat. A head band was made from some thin steel wire. Now that you have the cabinet, the rheostat, the battery and the low resistance receiver, which is every bit as good as the one supplied with the regular dictagraph sets, you can make a first-class outfit of your little set by spending a few dollars for a good sensitive dictagraph microphone, such as the Boissonnault type. The writer is using this circuit for a dictagraph outfit at present with fine results, the microphone being one of those supplied with instruments to aid the deaf, and which costs about $5.00.

There are many different applications for dictagraphs and loud-speaking telephones. At Fig. 6 a novel application is shown where phonograph music was successfully transmitted to a room on another floor. The microphone of the loud-talking outfit shown in diagram Fig. 4, was placed inside the wooden amplifying horn of the phonograph, and the doors of the instrument closed. This gave very good results. Other positions for the microphone are shown at 1, 3 and 4. The position 3 calls for a combination microphone and reproducer, the stylus or phonograph needle holder and lever system are attached directly to the center of the microphone diafram. An arrangement which was found to give very clear reproduction without the usual harshness or rattling, caused by sounds in the amplifying chamber, is position 4, where the microphone is placed in the focus of a wooden chopping bowl or tin basin, this arrangement being tried at distances of one to two feet from the open doors of the phonograph. In transmitting piano music via the loud-speaking telephone, the best results were obtained in one case, when the microphone was placed about six feet from the piano strings, with the front lid of the piano raised, as shown in Fig. 6. In this case the microphone was supported by rubber bands in the center of a cigar box, which latter acted as a partial sound collector and resonator.

Fig. 7 shows how two telephone receivers of the 75 ohm watch case or standard Bell type, and two microphones may be used to relay an incoming call from a standard telephone company instrument, on which they, the company, will not tolerate any attachments or wire connections. The regular company's receiver rests on two blocks having notches cut to fit it, and fits firmly against a piece of felt around an opening in the upright board, to the rear side of which is your experimental microphone, strapped or clamped in place. This microphone is connected with one of the 75 ohm telephone receivers, together with battery of two or three dry cells, as here shown. Both circuits may usually be employed with a common battery, but if they do not work well, use a separate battery for each circuit.

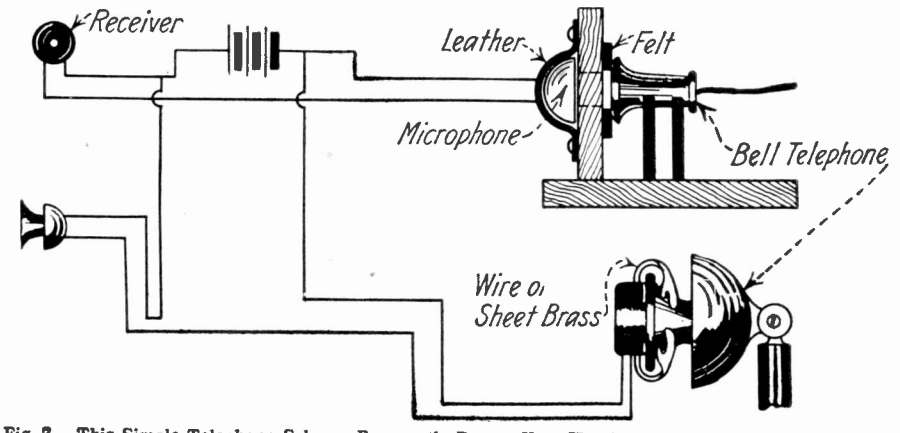


Fig. 7. This Simple Telephone Scheme Frequently Proves Very Handy, Especially When an Incoming Telephone Message is to be Relayed to a Sick Room, Etc. The Telephone Company's Instrument is Not Wired Up or Attached to Anything Rigidly, the Receiver Simply Resting on a Wooden Block Up Against the Microphone as Shown, While a Watch Case Receiver Belonging to Your Set is Snapped Over the Mouthpiece of Their Microphone by Means of Wire or Spring Brass Clips, as Shown in the Lower Part of the Picture. Two Watch Case Receivers of Good Quality and Two Microphones Are Necessary. If This Circuit Does Not Work Well With a Common Battery, Two Separate Batteries May be Used.

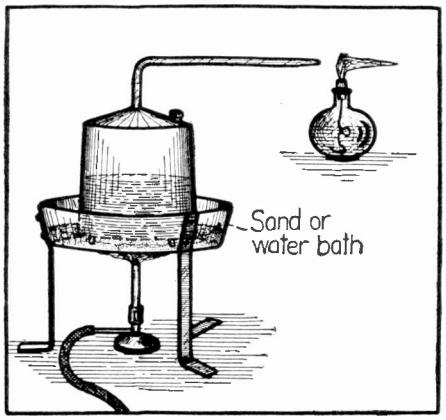
HOW-TO-MAKE-IT

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

FIRST PRIZE, $15.00

Automatic Blow-Pipe

A blow-pipe being necessary, I constructed the apparatus here shown, which



This Automatic Blow-Pipe Gives a Good Hot Flame for Soldering or Heating Glass Without Having to Blow Thru a Tube With Your Mouth or Resorting to a Foot-Operated Bellows.

gave very good results. A small tin can was half filled with alcohol. A bent piece of copper tubing was first soldered to the screw top of the can. After the cap with tube was in place the can was placed in a water or sand bath and the entire arrangement was placed on a tripod over a Bunsen flame. An alcohol torch held a little distance away furnished the heat for the blow-pipe work and the alcoholic vapor from the generator being directed toward the flame, burned, developing tremendous heat.

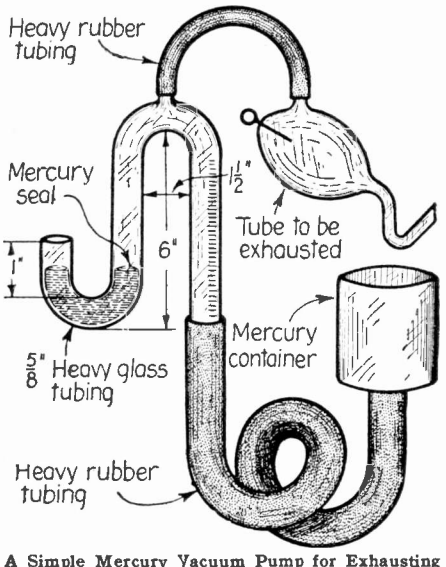
Contributed by DOUGLAS TOUGH.

SECOND PRIZE, $10.00

Simple Mercury Vacuum Pump

Sometime ago I had several small Geissler tubes which I wanted to exhaust, but having neither the means to purchase a vacuum pump or the apparatus to build one I constructed the device here shown that answered the purpose admirably. An ordinary glass tube curved as shown in the illustration was connected at one end to a container of mercury by means of a heavy rubber tube. A small opening in the elbow was connected to the tube to be exhausted and some mercury was poured into the trap-like arrangement in the glass tube. by lifting the mercury container higher than the glass tube the mercury flowed out at the trap opening. On lowering the container again air from the tube to be exhausted separated the mercury column. Repeated liftings and lowerings of the container resulted finally in an almost infinitesimal break in the mercury column, after which the vacuum tube was sealed off and found to be exhausted fairly well.

Contributed by C. S. CIERPIK.



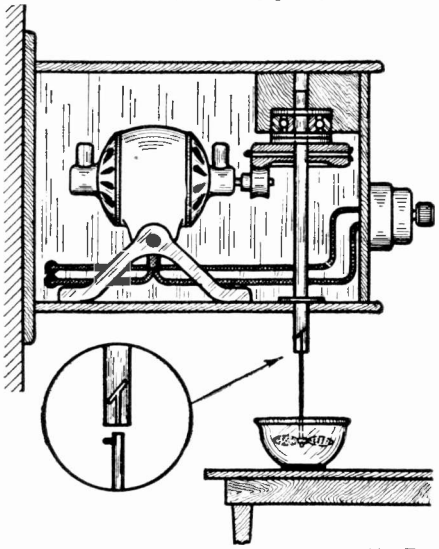
A Simple Mercury Vacuum Pump for Exhausting Geissler Tubes or Other Apparatus.

THIRD PRIZE, $5.00

How to Make an Electric Beater

The beater proper or dasher is a separate piece, so it can be cleaned.

Referring to the diagram a wooden disk is fastened to a ⅜-inch pipe by means of a stout wire passing thru it and the pipe. The outer, lower surface of the wooden disk should be shaped to fit the pulley of the motor. Because of the end thrust, due to the upward push of the motor, a ball bearing should be used. The diagram shows how this is constructed by boring a hole in the oak block into which a washer fits. The balls are ordinary steel balls such as used in the ball bearings of bicycles. The shaft is kept from dropping, when the motor is removed, by a cotter pin inserted thru a hole in its lower end. The projecting end of the shaft is slotted with a hacksaw as shown, to hold the beater or dasher. A steel pin shown in detail is forced into a hole in upper end of beater shaft to hold it in place.



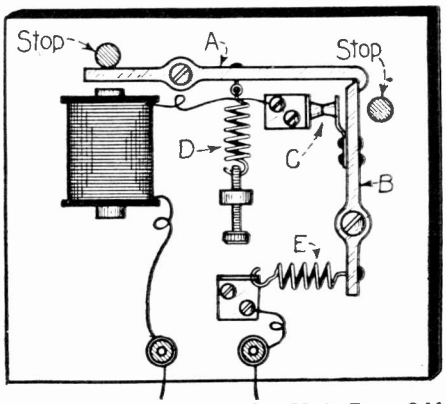
A Fan Motor is Employed to Drive This Egg Beater by Means of a Friction Wheel. The Vertical Shaft is Mounted in Ball Bearings Preferably, to Reduce the Friction Losses.

A Handy Circuit-Breaker

With the circuit-breaker here described on the control board, the experimenter need not worry about his fuses. The breaker will open immediately on an accidental short or an overload. It is very reliable. On a hardwood base six inches square an electro-magnet wound with four layers of No. 18 B. & S. gauge copper wire is mounted. As shown in the illustration; there is a pivoted iron armature "A" with a hook at one end. This hook holds the bar "B" in contact with point "C."

The breaker is placed in series with the line and when the pull of the magnet gets greater than spring "D," the armature is pulled down, the hook releases the bar, and spring "E" opens the circuit at contact "C." To reset the circuit-breaker the armature is lifted at the hook end and the bar is pushed back. Spring "D" can be adjusted to open at any desired current.

Contributed by E. ZIMMERMAN.

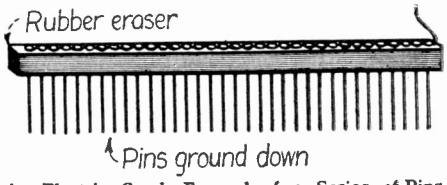


An Automatic Electric Cut-Out Made From Odd Parts to be Found About the Home Work-Shop, and Which May be Used in the Place of Fuses. The Spring Attached to the Pivoted Iron Armature is Carefully Adjusted, so That the Cut-Out Will Not Release the Switch Lever, Except When the Current Passing Thru the Circuit Exceeds the Normal Amount.

A Pin Comb

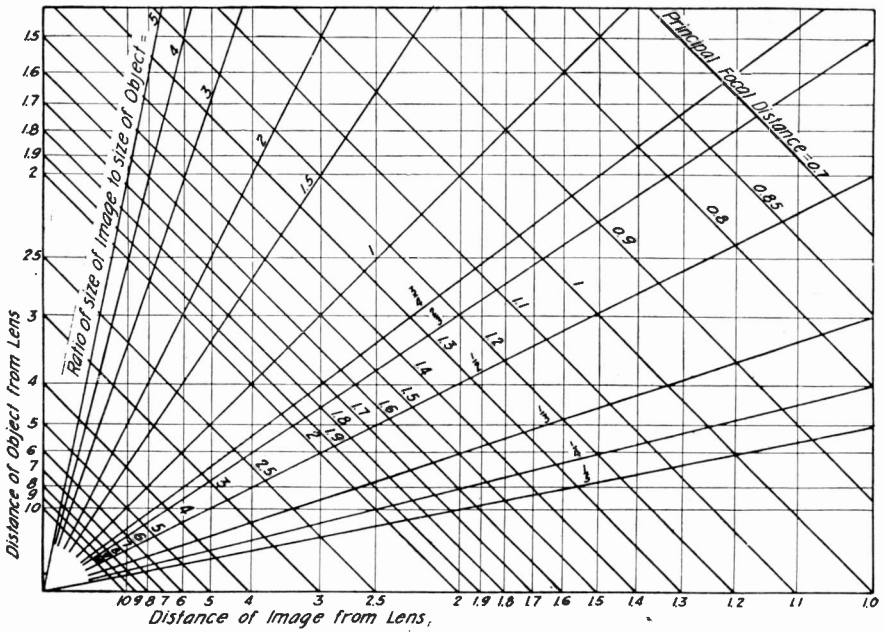
I hit upon the idea of inserting a row of pins in a small stick of wood and grinding the ends of the pins smooth by rubbing a small wet-stone over them. So effectively did these combs work that later I forced these pins thru a long rubber eraser, ground them down in the same manner and connected the heads to a wire. This wire was then conducted to a source of faradic current supply and the comb was used for applying electricity to the scalp.

Contributed by S. RADCLIFFE.



An Electric Comb Formed of a Series of Pins Pierced Thru a Long Rubber Eraser or Strip of Rubber, the Heads of the Pins Being Connected Together with a Piece of Bare Copper Wire, as Shown. This Wire May be Attached to One Terminal of a Faradic Coil While the Other Terminal of the Coil is Connected to a Metal Handle Held in the Hand.

Photo Chart Solves all Problems



This Photo Computing Chart Should be Cut Out and Pasted in Your Note Book, for it Will be Found Very Valuable and Useful for Solving Many Different Photographic Problems. This Chart Makes it Easy to Determine the Size of Enlargements, Reductions, Focal Lengths, Position of Objects, Position of Images, Etc.

In the illustration herewith is shown a chart for the determination of the principal focal distance of a lens and also the ratio of the size of image to the size of the object for any lens, and for any distance of the object from the lens. This chart is intended for use in photocopying work, such as enlarging, reducing and copying full size. It can be used to determine the principal focal distance of a lens; the principal focal distance being known, to determine at what distance an object at a known distance in front of the lens will be in focus on the ground glass; the focal distance being known, to determine at what distance from the lens an object must be placed in order to obtain a certain degree of enlargement or reduction, and at what distance from the lens the object will be focused on the ground glass.

To determine the principal focal distance of a lens, place an object, a white piece of paper, etc., in front of the lens and focus it on the ground glass. Then measure the distance from the object to the lens and from the lens to the ground glass, always measuring from the center of the lens. Suppose the measurements taken are 3 ft. and 1½ ft., respectively, then as seen from the chart the focal distance of the lens is 1 ft. Suppose the distances are 25 inches and 23 inches, respectively, then from 2.5, which is 25/10, on the left side of chart, follow the line to the right until it intersects a line drawn upward from 2.3, which is 23/10. It is seen that they intersect at the diagonal line marked 1.2 for principal focal distance. Then the focal distance of the lens is 12 inches and not 1.2 inches, since both the 25 and 23 were divided by 10 in order to obtain the result on this chart.

If the focal distance of a lens is known, the correct position of the ground glass can be found from this chart by measuring the distance between lens and object, following a line horizontally to the right until the diagonal representing the focal distance of the lens is intersected and then downward and reading the position of the line on the bottom scale. Suppose the focal distance of the lens is 12 inches and distance between lens and object 20 inches, then the chart shows that the ground glass must be 30 inches away from the lens in order that the object be in focus.

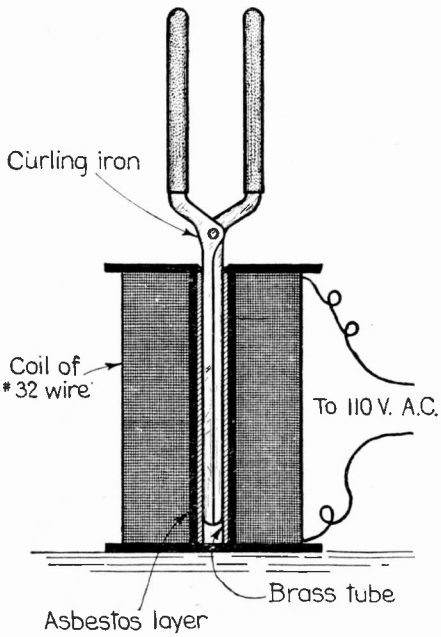
If the focal distance of the lens is known and the distance between object and lens and between lens and ground glass are known, the number of times the object is enlarged or reduced can be found by means of this simple graphic chart. For example, if the focal distance of the lens is 12 inches and the distances between object and lens 18 inches and between lens and ground glass 36 inches, the ratio of size of image to size of object is seen to be equal to 2:1, while if the above distances are 40 and 17¼ inches, respectively, the image is a little less than half size. Also, if you have a lens having a focal length of 12 inches and you desire to enlarge a picture to three times its original size, the chart shows that it is necessary to place the picture 16 inches in front of the lens and the ground glass 48 inches behind it.

It should be remembered in measuring any of the above distances, the center of the lens is the point to be measured from and the measuring stick should be held perpendicular to the plane of the lens.

Contributed by H. R. STEIGER.

A. C. Curling Iron Heater

An excellent curling iron heater may be made by securing a small brass tube which will fit closely over a curling iron. This is now covered with asbestos and wrapped with one pound of No. 32 D.C.C. copper wire. A 110-volt alternating current is needed for operation. When the current is passed thru the wire, the curling iron becomes the core, and the brass tube becomes a sort of closed secondary of a step-down transformer. It heats quickly because of currents set up in it and transfers the heat to the curling iron. The iron must always be left in the heater when the current is on.



Who Said Electric Curling Iron Heaters? Here's How to Make One in a Simple Manner Out of Material to be Found About the Home Work-shop or Junk Box.

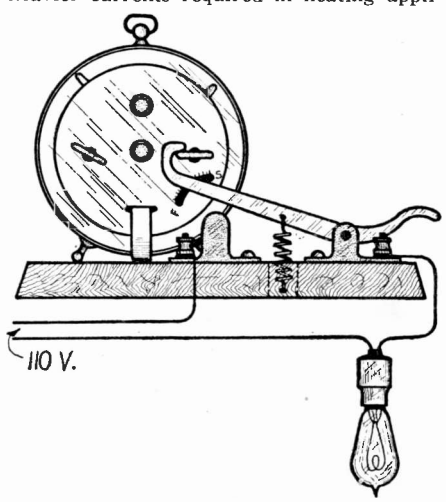
Contributed by C. E. GERHARDT.

Automatic Lighting or Heating Switch

There is no doubt but that chickens lay more eggs when their "working hours" are increased by artificial illumination it seems. By actual experiment a friend of mine discovered this "egg" fact some time ago, and it necessitated his getting up very early in the morning in order to turn on the lights in the hen roost. Up here in Canada, where we have such short days, artificial illumination was found particularly satisfactory, but waking up in the morning in order to turn on the lights bored him, until one day he set me to work upon the task of constructing a switch to do the heretofore manual work. I contrived the device here illustrated, which not only is remarkable for its efficiency, but is capable of handling quite heavy currents. For that reason it may be employed not only in lighting circuits, but also to actuate either machinery or heavier currents required in heating appliances. A knife switch was changed by adding a sort of hooking arrangement and a spring.

Contributed by H. E. CLARKE.

Automatic Clock Switch

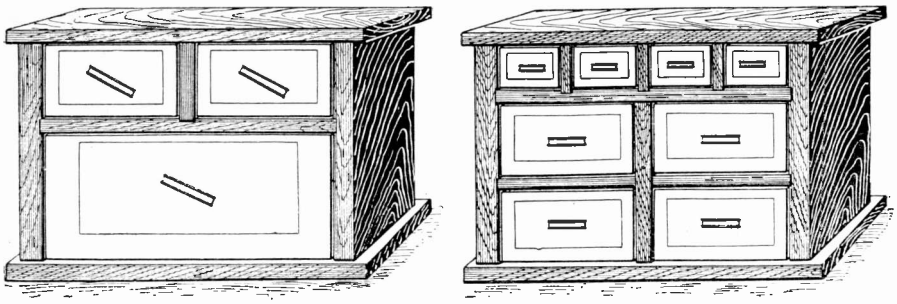


Alarm Clocks May be Used in Many Cases for Opening and Closing Circuits Controlling Lighting and Heating Apparatus. When the Alarm Sounds, the Spring Winding Handle Starts to Turn, Thus Releasing the Spring Actuated Switch Lever, as Illustrated in the Above Diagram.

Cabinet From Varnish Cans

The accompanying drawings show how good tool and odd parts cabinets may be constructed from discarded varnish and oil cans. The substantial tin handle is already on the cans and all that the builder has to do is to take a heavy pair of tinsnips and cut out one side of the can so as to form a drawer. It is advisable, but not absolutely necessary to bend over the edge of the tin about ½" and hammer it down flat with a wooden mallet or hammer. The cabinet as well as the tin drawers may be painted any color desired and numbers or titles may be lettered on the drawer fronts, indicating what materials or tools are in each one. One of these cabinets has actually been built and it is surprising how strong the drawer compartments are.

Contributed by T. S.



This Respectable Looking Tool and Odd Parts Cabinet Which May be Built Much Larger if Desired, is Made From Discarded Varnish Cans, the Reenforced Metal Handles Being Already Riveted and Soldered on to Them. One Side of the Can is Cut Out with Tin Snips, Leaving a Little Stock All Around, Which Can be Bent Over and Hammered Down, so as Not to Leave a Jagged Raw Edge on the Tin. At the Right is Shown a Larger Cabinet with Eight Drawers

Code Learning Hints

I am sending you herewith a suggestion for a short cut in learning the Continental Code. If one will look at the code for a minute he will see that several letters are opposite. What I mean by that is that "N" is opposite "A". "A" is (.—), "N" is (—.). Following a list of letters and numerals that are "opposite."

A . —	N — .
B — . . .	V . . . —
D — . .	U . . —
E .	T —
F . . — .	L . — . .
G — — .	W . — —
I . .	M — —
K — . —	R . — .
O — — —	S . . .
P . — — .	X — . . —
Q — — . —	Y — . — —

Numerals

1 & 9 are opp.	. — — — — — — — — — .
2 & 8 " "	. . — — — — — — — . .
3 & 7 " "	. . . — — — — — . . .
4 & 6 " "	. . . . — — — — . . . .
5 & 0 " "	. . . . . — — — — —

The following letters will have to be learned separately.

H	C — . — .
J . — — —	Z — — . .

Contributed by PHILIP BILISOLY.

A 200-Year Calendar

THERE are few questions more frequently asked than what is the date, what date was the last Saturday of last month, or on what day will such and such a date fall, and few are more important. Two of the most interesting of the many efforts which have succeeded in giving all calendarial information that can be required without calculation, are described herewith. They are the work of Prof. Leon Lansberg. In the first we have a regular monthly calendar for every month in every year from 1800 to 2000. This calendar requires absolutely no calculation, not even for leap years, and presents an answer to practically every question and the solution of all problems that arise concerning calendar dates. It could be extended indefinitely beyond the period thereon indicated, but in view of the fact that we may change the calendar by the year 2000, to perhaps a better form, the figures beyond that period are not given.

Referring now to the large chart, suppose we wanted to determine the day in the week upon which Washington's Birthday, February 22, falls this year. We will look for the year 1922 in the table of years. Finding this year in the last vertical column we proceed downward in that column to the chart of months. Here we locate two Februarys, the first marked with an asterisk. We disregard this one because it refers to leap years only. The second February is the one we want. Now checking in the table of days, we find that the 22 will meet the February, if carried down, in the space marked W, representing Wednesday. Hence February 22, 1922, falls on Wednesday. Let us take a few more examples.

On what day of the week will February 22, 1924, come? Looking for the year 1924, we find it in the third vertical column, it is marked with an asterisk, indicating a leap year. Proceeding down this we come to a February marked with an asterisk, also a leap year indication (the months of January and February show this marking only and are used whenever the year numeral is marked with an asterisk). Now immediately under the column in which the date 22 appears, we pass downward until we come to F for Friday, where the line from the date and from the month would intersect. Hence Friday is the day we were looking for.

If we want the full calendar for the month of May, 1923, we proceed down column 1923 in the same manner until May is reached. Then turning to the right we find a complete calendar for the month, showing that the first day is Tuesday, and all the other Tuesdays in the month are 1, 8, 15, 22, 29. In the next we have the Wednesdays occurring on 2, 9, 16, 23 and 30, etc.

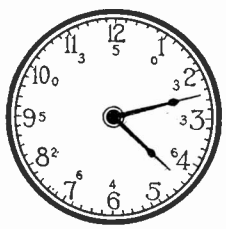
In what years will March 4 fall on Sunday? Reversing the order, we begin with the day of the month, the fourth. We proceed downward in that column until we come to S* representing Sunday. We then proceed in that line to the left until we reach the month March, and we find that in 1804, 1810, 1821, 1827, etc., and 1900, 1906, 1917, 1923, 1928, etc., the inaugural day falls on Sunday.

Suppose we desire to determine the date upon which Thanksgiving Day will fall in the year 1925, Thanksgiving being the last Thursday in November. We locate 1925, proceed downward in that column, until No-

(*Continued on page 1169*)

1900	1901	1902	1903	–	1904*	1905
1804*	1805	1806	1807	–	1808*	1809
1906	1907	–	1908*	1909	1910	1911
1810	1811	–	1812*	1813	1814	1815
–	1912*	1913	1914	1915	–	1916*
–	1816*	1817	1818	1819	–	1820*
1917	1918	1919	–	1920*	1921	1922
1821	1822	1823	–	1824*	1825	1826
1923	–	1924*	1925	1926	1927	–
1827	–	1828*	1829	1830	1831	–
1928*	1929	1930	1931	–	1932*	1933
1832*	1833	1834	1835	–	1836*	1837
1934	1935	–	1936*	1937	1938	1939
1838	1839	–	1840*	1841	1842	1843
–	1940*	1941	1942	1943	–	1944*
–	1844*	1845	1846	1847	–	1848*
1945	1946	1947	–	1948*	1949	1950
1849	1850	1851	–	1852*	1853	1854
1951	–	1952*	1953	1954	1955	–
1855	–	1856*	1857	1858	1859	–
1956*	1957	1958	1959	–	1960	1961
1860*	1861	1862	1863	–	1864*	1865
1962	1963	–	1964*	1965	1966	1967
1866	1867	–	1868*	1869	1870	1871
–	1968*	1969	1970	1971	–	1972*
–	1872*	1873	1874	1875	–	1876*
1973	1974	1975	–	1976*	1977	1978
1877	1878	1879	–	1880	1881	1882
1979	–	1980*	1981	1982	1983	–
1883	–	1884*	1885	1886	1887	–
1984*	1985	1986	1987	–	1988*	1989
1888*	1889	1890	1891	–	1892*	1893
1990	1991	–	1992*	1993	1994	1995
1894	1895	–	1896*	1897	1898	1899
–	1996*	1997	1998	1999	–	2000*
APR JUL JAN*	SEP DEC	JUN	FEB MAR NOV	AUG FEB*	MAY	JAN OCT
JAN OCT	APR JUL JAN*	SEP DEC	JUN	FEB MAR NOV	AUG FEB*	MAY
MAY	JAN OCT	APR JUL JAN*	SEP DEC	JUN	FEB MAR NOV	AUG FEB*
AUG FEB*	MAY	JAN OCT	APR JUL JAN*	SEP DEC	JUN	FEB MAR NOV
FEB MAR NOV	AUG FEB*	MAY	JAN OCT	APR JUL JAN*	SEP DEC	JUN
JUN	FEB MAR NOV	AUG FEB*	MAY	JAN OCT	APR JUL JAN*	SEP DEC
SEP DEC	JUN	FEB MAR NOV	AUG FEB*	MAY	JAN OCT	APR JUL JAN*

At the Left is a Very Simple Perpetual Calendar From Which Any Event Occurring in the Years 1800 to 2000, inclusive, May be Definitely Ascribed to a Certain Day, or Should the Day and the Month be Known and Also the Year, the Date Can be Determined. By Going Over the Calendar Carefully, its Daily Use Becomes as Simple as A B C



1922

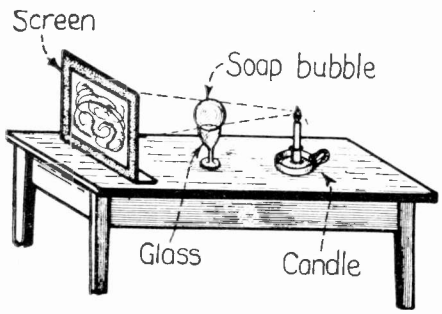
Place the Numbers Immediately Within the Circle of the Hours Upon Your Watch, and You Have a Complete Calendar For the Year 1922. The Twelve Hours Represent the Months, the Numbers are Factors, and the Remainder is the Day of the Week. Its Explanation and Operation is Very Simple and Fully Explained in the Accompanying Article

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				
S*	M	T	W	TH.	F	S
M	T	W	TH.	F	S	S*
T	W	TH.	F	S	S*	M
W	TH.	F	S	S*	M	T
TH.	F	S	S*	M	T	W
F	S	S*	M	T	W	TH.
S	S*	M	T	W	TH.	F

$5.00 Monthly Prize

ILLUMINATED SOAP BUBBLES

A very fascinating experiment to show the effect of sound waves on the film of a soap bubble may be carried out in this way: Prepare a screen for the display by pasting a border of cardboard around the edge of a sheet of thin, white paper. Prop this up at one end of the table and then, a few inches behind, place a wine glass. Smear the rim of the glass with glycerine. Two or three feet from the glass place a candle. Prepare a good soap solution, remembering that the addition of a little glycerine will make this all the stronger. Now light the candle and blow a bubble on the rim of the glass. Extinguish other lights



This Illustration Shows an Out-of-the-Ordinary Experiment Which Will Prove Highly Entertaining as Well as Instructive. The Changing Bands of Color in a Soap Bubble Are Reflected on a Tissue Paper or Other Screen, by the Light From a Candle or Incandescent Lamp in a Dark Room.

in the room and notice the effect on the screen. For a moment or so nothing much is seen but, as the film gets thinner, the most beautiful bands of color are to be noticed on the paper. These represent a wide variation in shades and are most fascinating to watch, but the next stage in the experiment is more interesting still.

Procure a tube, or else make one by rolling up a piece of paper. Hold one end of this tube fairly close to the bubble and then sing down it a variety of notes. Those who are watching the screen will see that the sound waves have a marked effect on the bands of color. These start to wave in a curious manner, sending out little wisps of color which steal about over the surface in a most mysterious way. When the bubble breaks another one may be blown, for there is no end to the variety of beautiful color effects that can be secured in this way. Those who are watching the screen will wish the experiment to be repeated again and again so novel and curious do they find it to be.

Contributed by S. L. BASTIN.

"MODIFIED" ALUMINUM

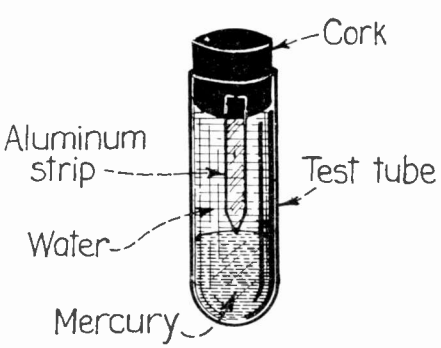
By Raymond B. Wailes

Aluminum, that metal which up to fifty years ago was almost as scarce as radium is today, can undergo transformations which are not characteristic of any other metal. Experiments with *modified* aluminum are weird and mysterious, several of them, together with the preparation of this modified form of wonderfully light metal, being given herewith.

Pour several drops of mercury into a bottle and add a strip of brightly polished aluminum. Shake the bottle and its contents for two minutes and then remove the aluminum and throw it into a vessel of water. The modified aluminum will immediately decompose the water electrolytically, giving off hydrogen and forming white tufts of alumina. Ordinary aluminum does not possess this property, as can be readily ascertained by placing a strip of aluminum polished with steel wool in water, and awaiting developments, which never come.

Pour out the mercury used in the previous experiment. The bottle is now empty, except for minute globules of mercury, or almost invisible tailings of mercury adhering to the inside of the bottle. Drop in a polished scrap of aluminum and shake the bottle vigorously for several minutes. If the aluminum is now removed and dropped into water, it will decompose the water as in the first experiment. This shows that modified aluminum can be prepared with even a small trace of mercury.

If a sliver of aluminum is attached to the small end of a cork and the whole thrust into a homeopathic vial or small test tube filled with mercury, so that the sharpened end of the aluminum is touching the surface of the mercury, decomposition of water poured over the surface of the mercury will begin in about two hours. The figure shows the set-up. It will be seen that the action or decomposition occurs over the entire surface of the aluminum strip. Perhaps the mercury travels invisibly over the surface of the aluminum. A strip of magnesium ribbon will also produce the same effect.



An Interesting Experiment with "Modified" Aluminum. A Strip of Aluminum is Secured to the Cork of the Vial Containing Mercury and Water. Decomposition of the Water Takes Place Along the Aluminum Strip After an Hour or Two.

If a few cc. of mercury and a brightly polished strip of magnesium be shaken with a solution of 1.5 cc. of concentrated hydrochloric acid in 100 cc. of water for two minutes, using about 25 cc. of the solution and several drops of the mercury, the magnesium will decompose water if removed and thrown into it. The mercury globules also have the same property.

Modified aluminum has not as yet had the attention of scientists, but facts are apparent—the aluminum is modified in its properties.

Articles March "Practical Electrics"

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

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

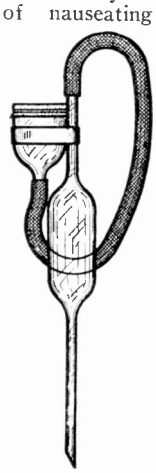
Portable Automatic Traffic Guard.

The Electric Weeder.

Loud Speaking Telephone and Its Practical Applications.

AUTOMATIC PIPETTE

It frequently happens that accuracy in adding small quantities of nauseating liquids or fuming acids is required, but the ordinary pipette, used for such addition unless the attempt is carefully made, occasionally permits some of the liquid to enter the mouth or else in the other extreme the pipette is not filled because of the care exerted. In order to do away with this unnecessary inconvenience I mounted the top of a thistle tube alongside the pipette with friction tape and connected it to the pipette with a rubber hose. The top of the thistle tube was covered with a sheet of very thin rubber, held in place with a rubber band. Pressure on this rubber diafram forced the air out of the thistle tube and when it was dipped into the solution and the pressure on the diafram released the pipette filled up. The same principle is applied in forcing some of the liquid out of the pipette.



Contributed by

EDWARD KEHL, JR.

REFINISHING BRASS BEDS AND CHANDELIERS

The extensive use of brass beds, gas and electric fixtures in our homes has some drawbacks, which is due to the fact that all such articles are lacquered (given a coat of very thin varnish by the manufacturer) in order to protect their surfaces as long as possible from turning black. During the annual housecleaning period every year all such brasswork is cleaned, with the result that this lacquer is soon rubbed off in spots, leaving unsightly patches that make a sharp contrast with the other clean portions.

Fixtures in a kitchen turn black sooner than do those in living and bed rooms, as smoke, steam and grease cause this protecting coating to fail entirely. In order to restore them to their original beauty it is necessary to remove all of the old finish; this can be accomplished by rubbing them with a rag saturated with alcohol, which will take it off easily. Should it fail to do so, it is a sign that the lacquer is made with a base of turpentine, the latter ought then to be used for removal of the old lacquer. Next, get a good metal polish and go over all brasswork thoroly

until it has great brilliancy. Wipe off every trace of polish, using clean rags so as not to leave any grease remaining, as it would interfere with the lacquer's adhesion. Then put on a thin coat of lacquer and let it dry, after which give two more coats. Lacquer can be bought in any paint or hardware store; if unobtainable, the following formula will prove to be very satisfactory.

Take three ounces of gum mastic and dissolve in one pint of spirits of turpentine by shaking; after doing so, strain thru cheese cloth. As the density of gum mastic varies somewhat; it may be necessary to add a little more, the idea being to make it of such a thickness as to spread easily with a common varnish brush. If a more golden finish is desired, add one-quarter dram of turmeric and also one-quarter dram gamboge to it; three coats should be applied and each one should dry before the others are applied. This varnish may be cleaned with a soft sponge, castile soap and water, to be gently applied. If it is convenient, it is better to purchase a lacquer ready made, as the housewife has enough to do in renovating home articles without doing manufacturing work.

For gas and electric fixtures in the kitchen nothing is finer to coat them with than a clear yellow spar varnish containing Chinese wood nut oil. This oil, besides being flexible, gives to a varnish characteristics that enable it to withstand the effects of steam and grease which are encountered during the cooking of foods; it is more difficult to put on than lacquer, but the applied coatings will stand more wear and tear than the thinner lacquers. In regard to choosing lacquers in a paint or hardware store, it is one of the things that the user should carefully look after; in all cases ought the purchaser to get one of the best quality, as it is not infrequent to find an object of beautiful design and good finish spoiled by the use of a poor and cheap quality of lacquer, one unsuited for the purpose.

There are two kinds of lacquers on the market, viz.: Dip and brush lacquers. A dip lacquer is made in such a manner so as to give the best results when articles are dipped into it. Brush lacquers are put on with a brush; they do not give good satisfaction when used for dipping. To produce the best work it is essential to use a lacquer made especially for the metal upon which it is to be applied. As a general rule, a brass lacquer is colored yellow, while one for silver must be colorless, like water. All lacquers and varnishes should not be rubbed on articles like paint, but ought to be flowed on, so as to obtain a smooth finish without brush marks showing. The secret of the fine, even lacquering as done in the electro-plating shop is to heat the object to be lacquered. Cold lacquer or cold object never will give a thin, smooth coat. After the work is done all brushes ought to be rubbed upon old newspapers until they are as dry as possible, then cleaned with turpentine or vaseline followed by soap and water, and put away in a place free from dirt.

Contributed by W. S. STANDIFORD.

THE CANDLE AND THE FUNNEL

This trick consists of snuffing out the candle by blowing thru a funnel as our illustration shows it.

Bet with your friends that they cannot blow out the candle in blowing thru the stem of a funnel at the lighted candle which seems to be very easily done, but which is, in fact, impossible to the uninitiated.

In blowing thru the stem of the funnel, here is what takes place: The air which leaves the mouth of the person blowing, disperses around the conical parts of the funnel, and he can blow until he gets blue in the face, without being able to blow out the candle.

The way the initiated will do the trick, to blow out the candle, is to get the candle in line with the circular border of the funnel and in blowing thru the stem, the candle will extinguish surely any time you try it.

Contributed by POL YOENE.

Did You Ever Try to Blow Out a Candle Flame Thru a Funnel? Try This Trick on Your Friends.

OPTICAL ILLUSION

Take a piece of tracing paper and trace on same parallel lines, spaced about one-eighth of an inch apart. After this trace a second series of lines crossing the first lines at a right angle, and after this trace two other series of lines at an angle of 45 degrees from the first ones.

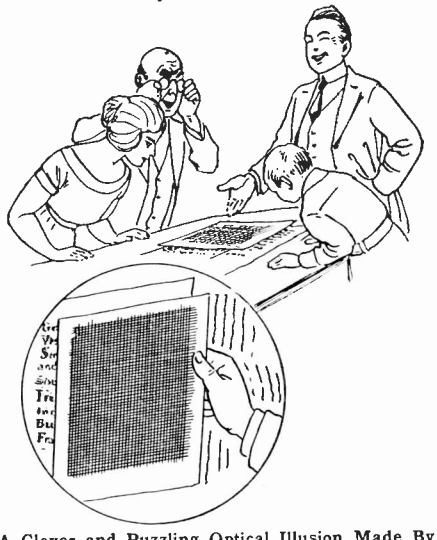
You will obtain in this manner a lattice of such fineness that in placing it on printed or written matter it is impossible to distinguish the characters thru the lattice.

Let anybody try to read thru this tracing paper and they will find it impossible.

Place the tracing paper again on the written or printed matter which nobody could read before and give the tracing paper little rapid jerks. The characters will at once appear very distinctly and you can read them very easily.

This is the same phenomena of Optics which occurs when you ride in a railroad a few yards from a fence having small openings between each board; you can see across behind the fence as if the boards did not exist.

Contributed by BEN ZYL.



A Clever and Puzzling Optical Illusion Made By Anyone With a Ruling Pen and a Piece of Tracing Paper.

SILVERING MIRRORS AND OTHER GLASS SURFACES

Many organic compounds have the property of reducing an ammoniacal solution of silver nitrate to the metallic condition, and under the proper conditions glass surfaces may be very easily silvered by this means. A test tube may be given a coating of silver by the simple process of adding about 5 ccs. of a 1:10 silver nitrate ($AgNO_3$) solution to an equal quantity of a boiling concentrated solution of Rochelle salt in the tube. This procedure, lacking the refinements detailed below, is rather uncertain, but is useful to illustrate the process.

The surface to be silvered must first be cleaned by placing it in a dish of some material not affected by nitric acid (aluminum is quite satisfactory), and scrubbing it with a glass rod on the end of which is a wad of cotton dipped in concentrated nitric acid (HNO_3). Then rinse the glass with distilled water and examine the surface. If it is covered with an unbroken film of water it is clean; if it shows dry spots the scrubbing must be repeated. It should then be left covered with distilled water until silvered.

There are several reducing solutions in common use, of which I shall describe two, one employing sugar and the other employing formaldehyde. The former solution consists of: Sugar, 20 parts; nitric acid, 1 part; alcohol, 30 parts; water, 200 parts.

The silver solution used with this reducing agent is made by dissolving 1 part silver nitrate ($AgNO_3$) in 10 parts of water, adding to this solution ammonium hydroxide (ammonia water, NH_4OH) until the brown color occasioned when the ammonia is first added has disappeared and the solution again become clear, then adding a solution of 1 part potassium hydroxide (caustic potash, KOH) in 10 parts of water, when the solution should again become dark, and finally sufficient ammonia water is added to bring the solution to a straw-colored tint.

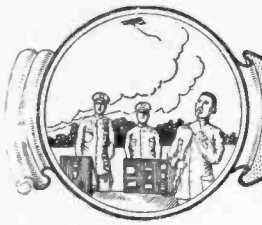
The alternative reducing solution is made by adding 3 parts of water to 1 part formaldehyde (commercial). The silver solution for this reducing agent is made by adding ammonium hydroxide to 100 ccs. of a 10 per cent. silver nitrate solution until the brown precipitate formed just redissolves (avoid excess), and then adding sufficient water to make the total volume 1 liter. In making up these solutions strictly c.p. chemicals (with the exception of the formaldehyde) and distilled water should be used. The sugar solution is best made up some time beforehand, as it improves with age.

There are several ways of doing the actual silvering. One is to place the mirror, face up, in a suitable dish and pour the silvering solution in upon it. Another very satisfactory method is to construct some sort of a dam around the edge of the mirror and pour the silvering solution into the basin thus formed. On large telescopic mirrors this result is achieved by wrapping a wide strip of paraffined paper around the edge, allowing about six inches to project above the surface, and securing the paper by running a soldering iron around the outside.

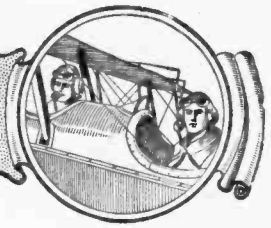
When reducing with the sugar-reducing solution, mix equal parts of the sugar and silver solutions and quickly pour the mixture onto the mirror. The solution is continually agitated during the silvering, which takes from 5 to 20 minutes, and is complete when the bath turns muddy. The solution is then poured off and the glass thoroughly washed with distilled water. The temperature should never be allowed above 21 degree C. (70 degrees F.) when using this process.

When using formaldehyde a mixture of 2 volumes of the silver solution to 1 volume of the formaldehyde solution is used. At common temperatures the silvering will be complete in from five to ten minutes, after which the glass is removed and washed as described above. When dry the coats obtained by either of the above processes may be polished if desired, but the coatings should never be touched when wet, as they are then likely to peel off.

Contributed by F. H. SWEET.



RADIO DEPARTMENT



Results of the $300.00 Prize Contest

"The Simplest Radio Outfit"

IN our January issue we announced a $300.00 prize contest entitled "The Simplest Radio Outfit." What we wanted was an outfit that could be made by anyone without knowing anything whatsoever of Radio or mechanics. We wanted an outfit that could be made from scraps lying about in almost any home, and from things that could be procured readily without making special fittings, etc.

The response to this contest was tremendous. Over 800 manuscripts were received in connection with this contest, showing an unprecedented interest in all things Radio today. Over 100 models of outfits were received, the two photographs below giving a slight idea of the variety and ingenuity used in connection with these outfits.

Not only men in all walks of life were represented, but there were four articles with models received from women as well. We tested these models, and while they were crude, they brought in the messages fairly well. The smallest outfit was wound upon an ordinary thread spool and did not weigh more than one and one-half ounces. It was, however, not considered simple enough by the judges, and it would not "stay put," so no prize was awarded to it.

Many of the models and manuscripts received were not within the meaning of the contest, for the reason that they were not at all simple, but so complicated that it would require a mechanic and someone knowing much about Radio to construct the outfit.

In awarding the first prize to Mr. McLaughlin, a young New York genius of twenty-one, we believe that we are presenting to our readers the simplest outfit that can possibly be made. Its cost is less than 40c. without the telephone receiver, and we have satisfied ourselves that the outfit works well. No condenser is found necessary to be used with it, and as a matter of fact, it works better without the condenser.

Herewith is found Mr. McLaughlin's article in full. The other prize winning outfits will be described in later issues. Be sure to watch for them, as they represent the best in this line ever published.

We hope that those laymen who are still skeptical as to Radio will find time to build the outfit described here, as well as those to appear in future issues.

PRIZE WINNERS

FIRST PRIZE
$100.00 in gold, Mr. James McLaughlin, 259 West 45th Street, New York City

SECOND PRIZE
$50.00 in gold, Mr. H. L. Jones, 28 Marion Place, Saratoga Springs, N. Y.

THIRD PRIZE
$50.00 in gold, Mr. L. Webster, 26 Louisiana Avenue, Detroit, Mich.

FOURTH PRIZE
$25.00 in gold, Mr. J. T. Lansing, 11 Grove Terrace, Montclair, N. J.

FIFTH PRIZE
$25.00 in gold, Mr. Frank L. Copeman, 493 Hudson Street, New York City

SIXTH PRIZE
$25.00 in gold, Mr. E. S. Gunn, Carrier 28, Station E, Kansas City, Mo.

SEVENTH PRIZE
$25.00 in gold, Mr. George Goga, 542 Center Avenue, E. Pittsburg, Pa.

$300.00 Total

FIRST HONORABLE MENTION
Mr. Kenneth M. White, Mooresville, Ind.

SECOND HONORABLE MENTION
Mr. E. A. Jozwick

THIRD HONORABLE MENTION
Miss Elizabeth C. King, 1230 Amsterdam Avenue, New York City

The Two Photos Above Present a Slight Idea of the Vast Array of Models of the "Cheapest and Simplest Radiophone Receiving Set" Which Fairly Snowed the Editors Under. It Was Quite Difficult to Select the Prize Winners, and So Many of Nearly Equal Merit.

A Simple Radiophone Receiver

By JAMES LEO McLAUGHLIN

Winner of First Prize $100.00

With Aerial Wire and Insulators Included, This Complete Radiophone Receiving Set Did Not Cost Over $3.00 and This Covered the Cost of the Telephone Receiver.

THE important points of this set are 1st: It is simple in construction and operation. A knife or razor blade and a small nail are the only tools required to make it. The complete set can easily be constructed in about one-half hour.

2d. It is inexpensive, the total cost, including the 'phone and antenna is less than $3.00, the set itself costing only 21½ cents.

3d. It is as efficient as most of the crystal sets now being sold and in most cases superior to them.

WHAT THIS OUTFIT WILL DO

AN outfit of this kind will bring in radiophone music and radiophone entertainment as sent out by the broadcasting stations providing the outfit is not more than 15 to 20 miles from the station.

The aerial in that case should be at least 60 feet long and composed of four wires.

An outfit of this kind cannot be used for any greater distance than 15 to 20 miles at the most. The further you are away from the broadcasting station the higher and longer your aerial must be.

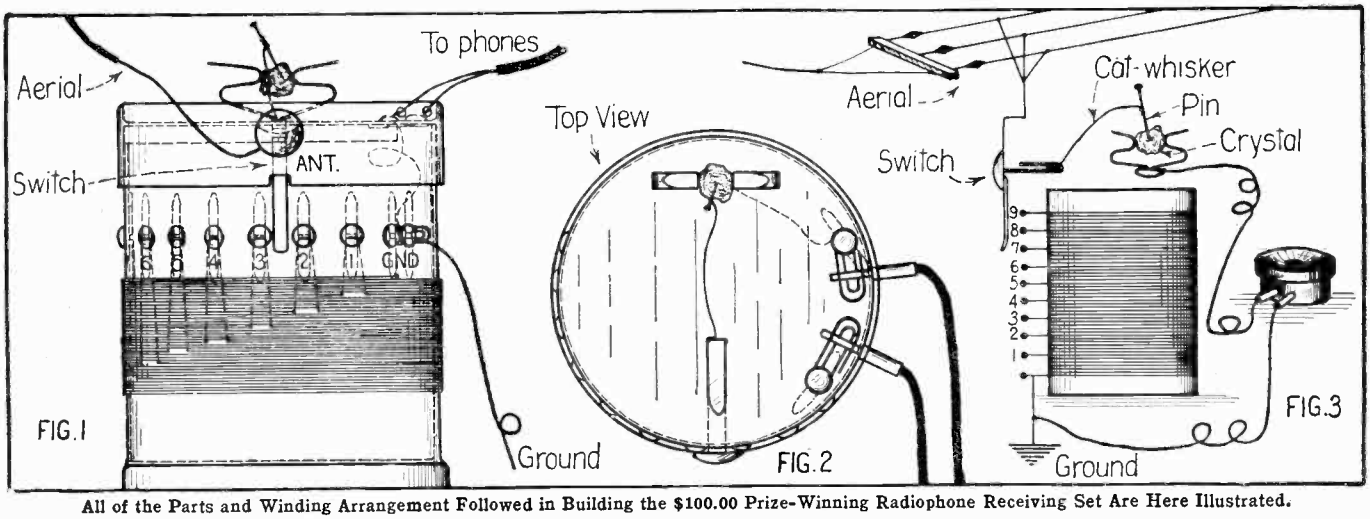
—EDITOR.

The material required is as follows:

1 Paper container (4" in diameter).
13 Paper fasteners (small size).
2 Paper fasteners (large size).
3 Paper clips
2 Oz. No. 26 enameled copper wire.
1 Small piece of silicon or galena.
1 Common pin.

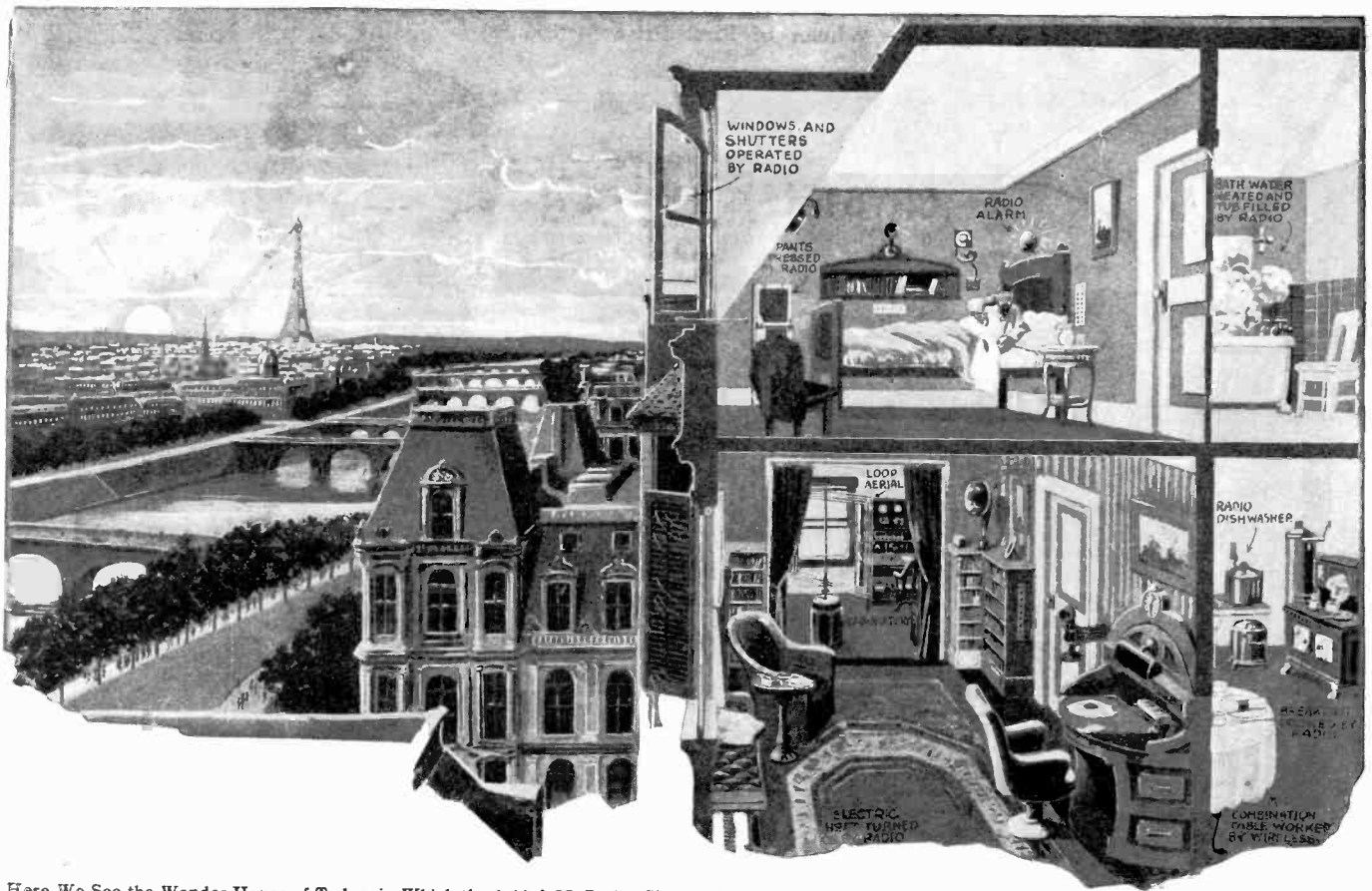
Take the container and punch nine holes one inch down from the top, with a small nail, one half inch apart. Into each hole push a paper fastener. With pen and ink

(*Continued on page* 1172)



All of the Parts and Winding Arrangement Followed in Building the $100.00 Prize-Winning Radiophone Receiving Set Are Here Illustrated.

Radio Controlled House in Paris



Here We See the Wonder House of Today, in Which the 6:00 A.M. Radio Signals from the Eiffel Tower Station in Paris, "Starts Things" in a French Wireless Expert's Home. First the Shutters Fly Open, the Curtains Slide Back from the Windows, and If We Were Inside the House at This Early Hour, We Would See the Breakfast Starting to Cook, Feel the Heat from Electric Radiators, If the Weather Was Cold, Hear Certain Doors Open and Close to Regulate the Heat and Ventilation, and Amongst Several Dozen Other Operations, Tinkle a Bell at the Owner's Bedside Announcing That It Is Time for Him to Get Up and Start the Day's Work. This Expert Has His Radio Research Laboratory Connected with His Living Apartments, as the Picture Shows.

SIX A. M. and all is well in the good city of Paris, France, and while many sleepy-heads are still snoring away to their hearts content, the ambient ether is split asunder by the invisible but powerful radio waves radiating from the Eiffel Tower station. A French radio engineer has rigged up all sorts of automatic devices in his household, so that when the Eiffel Tower starts the day at 6:00 A. M., the incoming radio currents picked up on his antenna are made to start things going.

First we see the shutters fly open, the window curtains slide back, and inside the dwelling many miraculous things happen. Certain doors open and close, electric heaters switch into action, the breakfast is started cooking on the kitchen electric range, the coffee is started on its percolating way, and even a hot glass of—well, you know what I mean, providing you need one. Yes, they never heard of Monsieur Volstead in that dear Paree. *Jamais!*

In the summer time electric fans are controlled by the radio receiving apparatus instead of electric heaters, and certain chandeliers and side wall lights are switched into or out of circuit, as prearranged by the radio expert, who lives in this wonderful Aladdin's house of the twentieth century. The master of the house is awakened by the gentle tinkling of a bell at his bedside, which is also connected with the radio control system.

"WDY" To Have New Station

THE famous radiophone broadcasting station operated for several months by the Radio Corporation of America, at Roselle Park, N. J., station call WDY, gave its last radiophone concert on Friday evening, February 17th, but the tens of thousands of radiophone fans who have grown to know and cherish the clear voice of WDY's operator, Mr. J. O. Smith, will be glad to know that the new station having the same call and operated by the R. C. of A., in New York City, will, it is expected, be ready for service about April 1st. Mr. Smith's picture is reproduced herewith, and it is the first time that his likeness has been publisht, so far as we are aware. Mr. Smith won the hearts of radiophone listeners for a thousand miles and more from Roselle Park—north, east, south and west—by his clear-spoken style and his ready wit when introducing the various artists.

Mr. Smith, in spite of his professional activities, having been a popular radio amateur for some years, continues during his spare moments to carry on radio traffic thru his well-known station 2 Z L, located at Valley Stream, L. I.

Here's "WDY"—Mr. J. O. Smith, Popular Announcer Known to All Radio Fans

The only licensed amateur in Porto Rico, whose station is located at Coamo, a short distance from San Juan, recently sent a report to WDY, in which he included a résumé of every program broadcasted over a period of two weeks. In this report, this amateur remarks that the names of some of the phonograph selections were unfamiliar to him and he was rather uncertain of them, but had included the names as correctly as possible. From a check on this report it was found that he had made no error. He went so far as to give a list of the various artists who performed at WDY during this period, and did not make a single mistake in the spelling of their names. This is really a remarkable record for broadcasting, as Porto Rico is a five-day journey by steamer from New York and is considerably more than 1,600 miles distant.

The Radiophone Now A Household Necessity

By MRS. CHRISTINE FREDERICK

Director, Applecroft Experiment Station, Greenlawn, L. I.

EVERY home its own wireless receiving station! Is this too much to imagine for the home of the future? No, because it is already becoming true in the home of today, if we are to judge by the popular "craze" for home wireless outfits. Never, possibly, has the public so demanded a share in any marvel of applied science: Mr. Brown, the butcher; Mr. Jones, the grocer; and especially Mrs. Smith, the plain housewife, are all clamoring to enjoy the instruction and pleasure offered by the various *broadcasting stations* by means of home receiving outfits.

And, being a homemaker, I can readily see why thousands of homes will desire some type of receiving outfit which will enable the entire family to *listen in* on concerts, lectures, dance music and stories for the younger set. Until I fully understood the idea I could not believe it possible that such instruction and entertainment were offered and available *free* to any user of a receiving outfit. But now that my family has installed a three-stage amplifier with a *loud speaker*, we have proved the delight and pleasure of such an installation, and I have come to the conclusion that the radiophone has become a household necessity.

In This Picture We See a Charming Home Scene in the Parlor Where Several Young Ladies and Gentlemen Are Enjoying a Radiophone Concert. Music is Being Received From the Radiophone Broadcasting Station at Newark—"WJZ." The Radiophone Receiving Set is Rapidly Becoming, We Might Say, a Household Necessity, as Mrs. Frederick Has Pointed Out in Her Article, and in Many Homes Thruout the Land it is the Usual Evening Occurrence to See the Entire Family Grouped About a Radio Receiving Apparatus, Listening to the Various Vocal and Instrumental Selections, as Well as Speeches, Not to Mention Standard Time Signals.

The home wireless outfit goes far beyond the benefits of the phonograph, because it enables the person or family to get the absolutely latest song, orchestral music or speech the moment it is given out—and that, too, without the expense of a record. Furthermore, it transmits the human voice, as in a talk or lecture, with a degree of naturalness never possible to the speaking voice on the usual *record*. This has been proved conclusively by listening to such speakers as former Secretary Tumulty; leaders of Boy Scout organizations, and to certain bedtime story features supplied from the *broadcasting stations*.

Still another reason why such outfits are creating a furore among the public at large is because they offer a news service which puts the most isolated home in touch with metropolitan events. Is a new Pope elected? Does Ireland become a Republic? Does Mrs. Vanderfish get her divorce? The wireless will tell you. Even tho you be living in a lonely little village lost in the hills of Pennsylvania, or the rolling prairies of Illinois, the home wireless outfit will keep you informed of current events, give you the standard time, and let you enjoy a concert given by the best stars in the large city. No family can ever say that the country is "lonely" if they are provided with such a receiving installation.

I believe that there is tremendous educational possibility in the development of wireless in the home and school. It may need some experimentation to bring this about, but the effort will be greatly worth while. As I see it, one reason for greater public interest in such installations, is that it is no longer necessary to use the earpieces to enjoy speech or music. The adaptation of a *loud speaker* such as a Magnavox, or Vocaloud, in connection with the outfit, makes it possible for the family to sit comfortably about the room and listen as they would to a phonograph. The smaller types of outfit, where earpieces are always necessary, would never be as popular with women because of the inconvenience of the ear-pieces on the head and hair. Also, their use limits the enjoyment to one person at a time. With the greater development of the reproducing horn in connection with the receiving set, such limitation is obviated, the speech or music are made the property of the entire family, while they are comfortably seated, and offer the most interesting and unique form of entertainment to guests.

While we have only experimented for a short time, we have already proved the possibility of connecting such a set with the reproducing horn of the typical phonograph. By means of a connector, we have attached the outfit to the sound chamber of the usual phonograph, thus amplifying the sound and throwing it with more force into the room. We are now engaged in still further perfecting this idea so that the volume of sound will be increased, and the voice reproduction more clear.

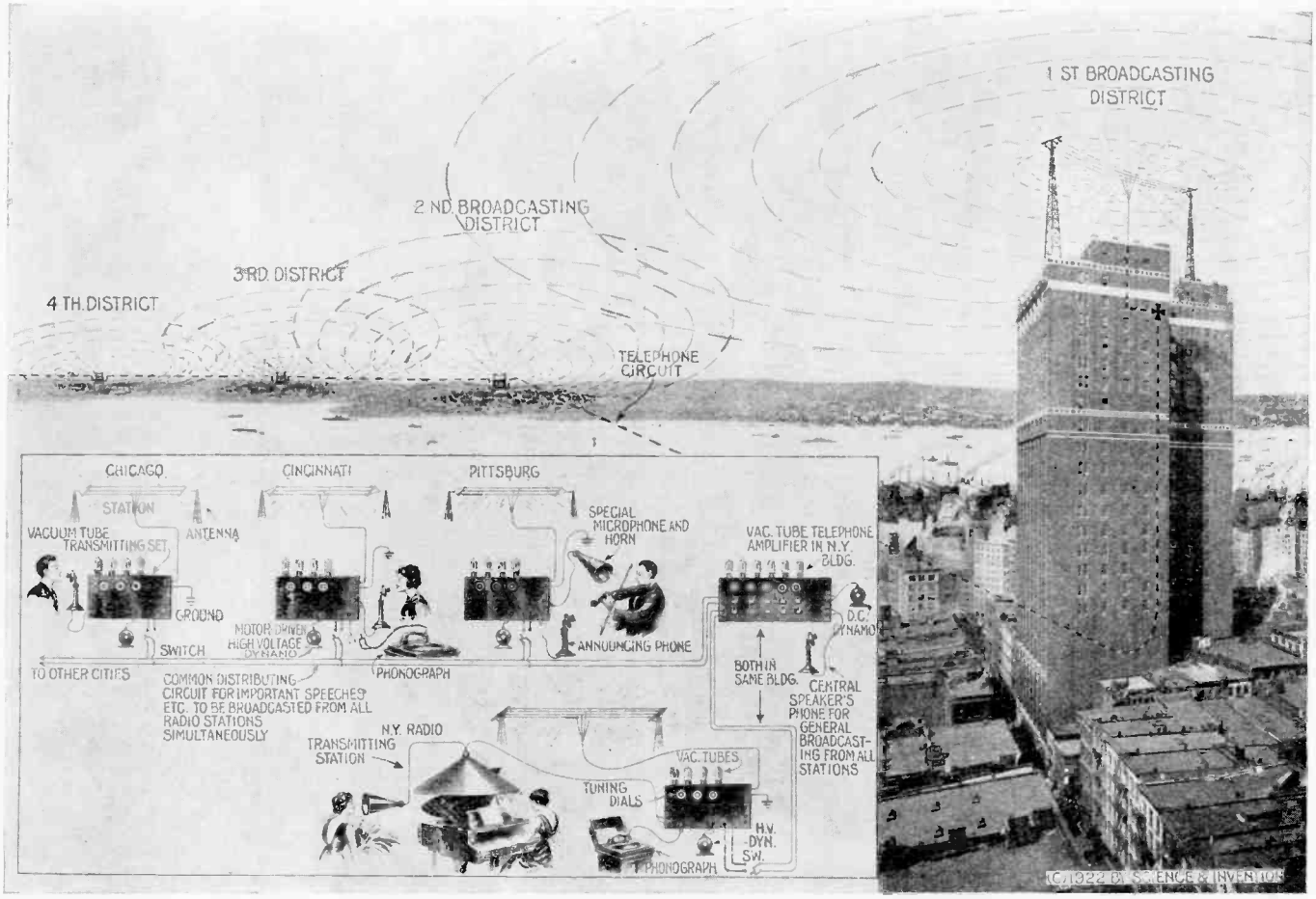
With children in the family, nothing could be more serviceable as a means of training along the lines of interest in mechanics and electricity than such a home wireless outfit. The stimulus to the imagination of a boy is incalculable — and I see no reason why girls should not take to the same "hobby!" So long as only the dash and dot system of signals was available, the child's and boy's interest could not be so great as now when the actual voice, words, song, or dance music is instantly to be heard. It is just this ability to now hear words instead of symbols, that has, in my opinion, taken the matter out of the hands of the amateur and placed it in the hands of the public. The service of the *broadcasting stations* at once permits the home and the family to share what formerly would have been the pseudo-scientific pleasure of the amateur.

It is my hope that the managers of the *broadcasting* stations will look even more seriously on the wonderful service they can offer the public. I trust that they will grasp the educational opportunities which they could supply in addition to their present amusement features. What a wonderful thing if hundreds of schools, outfitted with wireless receiver sets, should be able to listen simultaneously to the speeches of public men on current affairs; if, on certain afternoons, travel talks on faraway lands were given from the broadcasting station, to be received in the school auditorium, while at the same time, colored slides, or even movies, of the scenes and countries described in this lecture were thrown on the screen! This synchronization would accomplish the highest ideals of teaching—namely, to supply ear information and eye or picture information at the same time.

I do not wish to let my imagination run riot—but I can truly see such a three-fold plan; suppose Mr. Burton Holmes, the eminent traveler, lectures on China, over the radiophone, and that his words are listened to by the combined geography classes of the "A" School and hundreds of other schools. Either preceding or following, or simultaneously possibly, pictures, slides or movies, showing Chinese scenes, customs,

(*Continued on page* 1173)

National Radio Broadcast By Bell System



A National Radiophone Broadcasting System is Shortly to be Instituted by the American Telephone and Telegraph Company, or, in Other Words, the Bell Telephone System, Whereby it Will Become Possible for a Speaker or Singer to Broadcast Their Voice Simultaneously From a National Chain of Radio Transmitting Stations. These Radio Stations, Located in Various Cities, Are to be Connected to a Private Telephone Circuit, This Circuit Leading to the Headquarters Station in New York City. The Bell Interests Will Not Operate These Stations Themselves, But Will Rent Them For Use to Private Concerns or Theatrical Companies, etc., at a Certain Price Per Hour

THE most ambitious radiophone broadcasting scheme so far advocated is being rapidly brought to the stage of practical realization by the radio and telephone experts of the American Telephone and Telegraph Company, the owner of the Bell Telephone System. By April 1st it is expected that the powerful radiophone broadcasting station for the eastern district located in this company's twenty-four-story building between Lispenard and Walker Streets, Manhattan, N. Y., will be ready for service. A powerful vacuum tube transmitting set will be employed at this station. An actual photograph of this building, which towers far above its neighbors, is shown at the right of the accompanying illustration, also the great height of the 100 foot latticed steel towers which will be erected on the roof of the twenty-four-story building. These towers will support an antenna of six stranded phosphor bronze cables, each 200 feet long, at a total altitude of nearly 500 feet above the street level, which will undoubtedly give a phenomenal range to this station.

The principal novelty in a business way with respect to this and the chain of other broadcasting stations in various large cities thruout the country, which are to be joined to the Bell Telephone System by a private circuit for use in broadcasting by radio such important national messages as those of the President, is that they are to be leased. The A. T. & T. Co. are not interested in this enterprise for their own personal glory, and they will not have anything to do directly with the sort of concerts or other matter broadcasted via the Hertzian waves. They are going to sell this service to any company or individual who has the price and wants to hire the station for a certain specified time. For instance, John Wanamaker might hire the station on a Thursday night for the hours of 8 to 9 to give a combined advertising and musical program, while some Broadway theatrical company may have hired the station for the hours of 9 to 10 or 9 to 11 to give their show over the radiophone, as did Ed Wynn and "The Perfect Fool" company at WJZ station, operated by the Westinghouse Company at Newark, N. J., on Sunday, February 19th. The only direct interest the telephone company officials will have in the radiophone programs to be broadcasted nightly or daily will be to see to it that these programs are kept up to a certain high class, and that they do not deteriorate to a lot of clap-trap advertising propaganda, such as "Don't buy any other shirts but Jones' shirts; Jones' shirts are the best that money can buy; don't forget Jones when you buy shirts; bla—bla—bla—bla," ad lib, ad infinitum.

This wireless broadcasting station will be unique in many respects. The distributing station is to be equipped with the latest developments of the Bell system, including the use of electrical filters and new methods whereby, as the business grows, several wave-lengths can be sent out simultaneously from the same point, so that the receiving station may listen at will to jazz dance music, opera, lectures, travelogues, etc. The company will provide channels thru which anyone with whom it makes a contract can send out his own programs, just as the company leases its long distance telephone wire facilities for the use of newspapers, banks and other concerns. There have been many requests for such a service, not only from newspapers and entertainment agencies, but also from department stores and a great variety of business houses. The station when completed will cover territory within a radius of from 100 to 150 miles of this city and under particularly favorable conditions may be able to operate over a greater territory. According to the officials of the company, there are about 35,000 wireless telephone receiving outfits in this territory. In this same area are more than 11,000,000 people, so that should such service prove popular, it can be reasonably expected that the number of receiving stations will be greatly increased.

This is a new undertaking in the commercial use of radio telephony, and if there appears a real field for such service, and it can be furnished sufficiently free from interference from other radio services, it will be followed as circumstances warrant by similar service from stations erected at

(*Continued on page* 1173)

Radio Set in a Match Box

By A. N. MIRZAOFF

The Record for Miniature Wireless Receivers is Held By Kenneth R. Hinman of Plainfield, N. J., a Youth of Thirteen. All the Apparatus Except for the Head 'Phones, is Confined Within the Dimensions of a Small Safety Match Box. With it He is Able to Receive Not Only Telegraph Signals, But Music, Stories, and News Items Given Out By Broadcasting Stations Twenty and Thirty Miles Distant. The Photo Shows Kenneth R. Hinman Instructing Two Prominent Girls From Brooklyn, N. Y., Miss Florence Brooks and Miss Madeline Menna, in the Use of His Match Box Radio Set.

THE record for miniature wireless receivers is held by Kenneth R. Hinman, of Plainfield, N. J., a boy only thirteen years old. All the apparatus, except for the head 'phones, is confined within the dimensions of a regular safety match box. With it he is able to receive not only telegraph signals, but music, stories, sermons and news items given out by the broadcasting stations twenty and thirty miles distant.

This youthful inventor has reduced his miniature set to the simplest possible form. Wrapped around the outer shell of the match box is a coil of wire (seen in close-up photo), which serves as a tuning coil. In the drawer of the box is a crystal detector of the cat-whisker variety; the drawer is provided with a spring finger which bears against the coil of wire; the insulation is scraped off along the path of the spring slider, which is moved in or out of the shell more or less. Inductance is thus introduced into the circuit, thus tuning the instrument for different wave lengths. No battery is necessary. The instrument is provided with spring clips which may be connected by lengths of wire to a brass bed or a fence wire.

Almost since the days when he was "knee-high to a grasshopper," Master Hinman showed marked liking for and skill in producing things minute and mechanical. While little more than a baby in his kindergarten days, on his own initiative, he cut out of paper and pasted together without previous drawing, a velocipede, complete as to pedals, handle bars and wheels, on a scale so small as to cause all who saw it to marvel; on another occasion he cut an automobile with steering wheel and headlights out of paper.

As the years went by, to his interest in things minute and mechanical he added an interest in things electrical. Among his early experiments was a microphone so connected by wire as to convey quite audibly at a distance, or upstairs, the ticking of the dining-room clock. He was forever fussing around with bells and buzzers; once surreptitiously running a wire to the house next door, where there lived another small boy. He arranged with this boy to operate a home-made telegraph key which should cause a sounder on the window-sill in his own home to chirp, cricket-fashion, much to the mystification of his elders not quite up to his scientific pranks. The photo shows Kenneth R. Hinman instructing two prominent girls from Brooklyn, N. Y., Miss Florence Brooks and Miss Madeline Menna, in the use of his match box radio set.

Articles Appearing in the April Issue of Radio News

Designs of Radio Receiving Loop Antennæ. By R. R. Batcher.

The Operating Principles of a Radio Compass. By Paul G. Watson.

Resistance and High Frequency Work. By Louis Frank.

A Miniature Wavemeter. By Bernard Steinmetz.

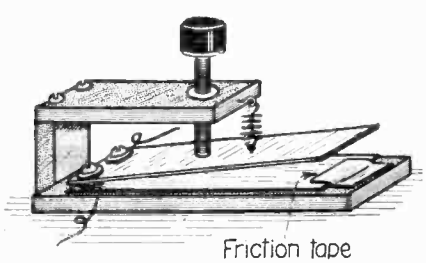
How I Solved My "B" Battery Troubles. By P. J. Faulkner.

An Easily Constructed 180-800 Meter Regenerative Receiver. By John R. Meagher.

And several other interesting articles.

Simple Receiving Set

Among the many diagrams that have been published in your magazine I have seen but very few that employ honeycomb or duo-lateral coils as inductances. Those that were published were generally vacuum tube circuits. A hook-up employing these coils with crystal detector is given here. The coils are wound with 25 turns of No. 24 B. & S. gauge S. C. C. wire on three tubes, two inches in diameter. The variable condensers that I employed in this circuit are likewise shown in the illustration. Two plates, size 2¼ x 4 1/32 inches are coated with tinfoil on one side. These are hinged together with screws at one end and a small piece of adhesive tape is fastened to the very edge of the bottom plate at the opposite end. The capacity is varied by screwing up or down on the screw.

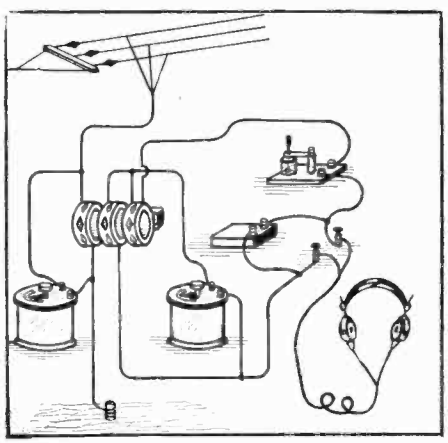


The Construction of the Variable Condenser is Shown Above. It is Advisable That Every Amateur Construct One or More of These Condensers as They Can Always Be Used.

The duo-lateral coils which are shown in the diagram may be replaced by others when it is desired to tune the set to longer wave lengths, and even the pancake type or spider web coils may be successfully employed in this hook-up. Fortunately it is a very simple matter to construct the spider web inductances by taking a piece of cork and inserting tooth picks into it—an odd number is advisable. The wire is then woven in and out around them.

Contributed by

JOSEPH J. HORVATH.



Simple Radiophone Receiving Set Fitted With Honeycomb Coils, Crystal Detector, Phones and Variable Condensers.

Radio Loud-Talkers

By HENRY TOWNSEND, Jr.

LOUD-TALKERS, which are usually nothing more than a specially devised telephone receiver fitted with a horn in some fashion or other, have become a very important topic of conversation among radio bugs everywhere. There is so much misunderstanding about telephonic or radio loud-talkers and so-called amplifying chambers in our phonographs in general, that a few words on this subject as to what actually occurs in such horns may not be amiss. As pointed out in a recent interview by Mr. O. B. Blackwell, the well-known telephone engineer of New York City, and also by Prof. Dayton C. Miller, there is actually no amplification of sound produced in any horn. That is to say, there is no amplification of the energy which is put into the telephone receiver or phonograph reproducer diafram, but the horn simply acts as an acoustic or sound relay, and its function is to connect the vibrating diafram of the receiver or reproducer with the air in the room. There are many erroneous ideas in connection with horns used on such instruments, and one of the greatest fallacies is that the horn is never any good if it is straight, but that it should be curved or coiled into several artistic knots and loops, as are the big brass base horns and the other instruments played by the village band. The reason why such band instruments have a tubular chamber wound around in a coil several times, is not because the sound is any stronger or better in any way, because it has, perchance, to follow around innumerable corners and twists, but due to the simple fact, as pointed out by Prof. Miller, that in order to permit a resonant acoustic or sound chamber to function at maximum efficiency for a certain tone, we must make this chamber of a fair length. The average tone register, let us say, is a baritone, which is between the high and the low notes usually sung or played, and the proper length of horn for an average baritone note is four and one-half feet, which corresponds to the length of this wave or vibration in air. If the horn is a great deal shorter than this wave length, it will vibrate at but a partial tone, or, in other words, our acoustic relay, as it were, will have to set up this note by vibrating a column of air equivalent to one of its harmonics or a partial wave length. Therefore, if I were going to build a first-class horn, says H. W. Secor, I would make it good and solid of some hardwood like mahogany, oak or maple, polish the inside as smooth as possible with sandpaper, and give it a coat or two of good varnish or shellac. "The horn must be tight at every point," said Prof. Miller in a recent interview, "and if we will remember that we are simply vibrating a column of air which is contained within our horn, we will have a clear conception of just how we must build this chamber." In other words, the walls should be sufficiently heavy and solid to insure that only the column of air is vibrating and not the horn itself. Of course, this result is never achieved with a metal or tin horn, unless it is made of drawn or pressed steel, at least one-eighth inch thick. The material forming the horn should not sing or vibrate and the best music Prof. Miller ever heard from a phonograph, he stated, was that produced from a concrete horn with walls four inches thick and over seven feet long. In other words, wood one-half to one inch thick for building such horns from, is better than thin wood, and many of the better class victrolas are now being fitted, it is noticeable, with very substantial sound chambers, having wood at least one-half inch thick.

Of course a loud-talker is of little or no use to those who are using simply a crystal detector or one audion, but where two or more audions are employed, then the loud-talker comes into demand in most cases. It may not be so convenient, perhaps, but as Fig. 1 shows, it is frequently more efficient to separate the individual receivers from two or more head sets, and allow each person to have one receiver, connecting the individual receivers in series as indicated in the diagram. This is done for the reason that usually there is but little current and a relatively greater voltage available at the receiving set output terminals, especially where a crystal detector is in use. The voltage available will thus actuate two to four or more 1,000 ohm receivers in series as readily as it will one, but the current available is so slight, that if the phones were connected in parallel, the increased amperage demanded by this arrangement would be more than the set supplied. It has been found in many cases, however, where multiple stage vacuum tube amplifiers are in use, that multiple phones or head sets can be connected in parallel, owing to the reversal of the foregoing conditions in this case, there being a greater amperage available, which meets the demands of the successive phones connected in parallel. A question frequently asked is, "Will the signals be of the same strength if two receivers or head sets are connected in series instead of using the single receiver or head set?" Usually the strength of a signal is but slightly reduced, and where audion amplifiers are employed, there is invariably sufficient energy in the output circuit to energize from six to twelve phones or more.

This article explains how to build your own loud-talker for radiophone concerts. Several different styles are shown and described as well as the principles on which loud-talkers work. It is not always the highest priced instrument of this type that does the best work, and it is advisable in all cases to experiment a little and see what results you can obtain before investing a large sum of money in such an instrument, which may not be entirely suited to your particular receiving set. To answer about one millon inquiries, which we receive monthly, we may repeat once more—that loud talkers are practically useless with the small amount of energy received on crystal detectors, and at least three audions (detector and two-step amplifier) are usually necessary for good results.

A very good loud-talker, which has been tried out by the editors of this journal with excellent success, is that shown at Fig. 2. This comprises a metal horn, the size of which may vary, but, of course, the larger the horn the more volume of sound produced. A single Baldwin type C amplifying phone is employed. This receiver, which is extra large in size and fitted with a mica diafram, gives a very clear articulation, much better than many of the higher priced loud-talkers now on the market, and it is connected in place of the regular head phones. A very good arrangement is to connect the output terminals of the audion amplifying set to the two blades of a double-pole, double-throw knife switch. To one set of switch jaws the terminals of a 2,000 ohm telephone head set are connected, while to the opposite set of switch jaws, the terminals of the loud-talker are connected. Some radio amateurs have complained to the writer that they had to re-tune their set slightly after throwing the switch over to the loud-talker, having tuned in the station loud and clear in the head phones first, but he has found that if flexible twisted lamp cord not over five feet long is used to join this loud-talker to the switch, no change in tuning has to be done at all, using a detector and three-step V.T. amplifier.

There are a number of different ways in which this amplifying receiver can be held firmly and tightly against the board connecting it acoustically with the amplifying horn, and a very effective method of doing this is given in Fig. 2. The receiver may be wired or held with a leather strap tightly against the board in which the base of the horn is fastened, but the method illustrated and comprising a spring which presses the receiver against the felt covered front board, will be found simple and besides the receiver can be easily removed at any time. Where a large horn cannot be obtained, a smaller one may be purchased and then enlarged in size by purchasing a piece of fairly heavy sheet iron and bending this to fit inside the horn very tightly and to be riveted to the horn, as the writer has done. It will take some careful fitting to bend the sheet iron cornucopia fashion, but if you are a little skilful with a wooden mallet and a wooden block, you can form a flare or bell at the mouth of the horn.

Duplex and Triplex Loud-Talker

One of the editors has successfully used, and is using at the present time, on a four audion receiving set, with a loop aerial three and one-half feet square, the duplex loud-talker shown at Fig. 3. Here two Baldwin wireless phones are used, one for each horn, and the two horns are arranged to face in different directions, so as to distribute the sound around the room in the best manner possible. These horns can face in any direction desired; in a long narrow room for example, they may be placed back to back, so as to face in opposite directions, and thus throw the sound to the respective ends of the room. The horns used in this case measure about twenty inches long and have an opening at the larger end of about ten inches. The 1,000 ohm receivers are held in wooden blocks, similar to the plan shown at Fig. 2. The horns are best suspended by cord or rope from the ceiling, but wire may be used if care is taken to see that it does not sing on certain notes.

In Fig. 3, the arrangement of chairs, apparatus table, and single loud-talker with extra large horn of the type shown at Fig. 2, is outlined. In a small room especially, always place the loud-talker in a corner if possible, as this serves to distribute the sound to the best advantage about the room, and one peculiar fact is that the radiophone talk always sounds much clearer at a fair distance from the loud-talker, this being due in part to the fact that when one sits close to the horn of the amplifier, he usually hears a slight frying noise or hissing, due to the action of the audions. Sometimes a radio-telegraph station interferes, and if this is rather weak, this interference will be lost when the radiophone is sharply and clearly tuned in, and providing you do not sit too close to the loud-talker. Where a large room or auditorium is to be filled with sound from a loud-talker and radiophone receiving set, seven large horns, either of metal or wood, may be placed either in the respective corners of the hall or else they may be grouped in the centre, the large openings of the horns pointing outward,

(*Continued on page* 1174)

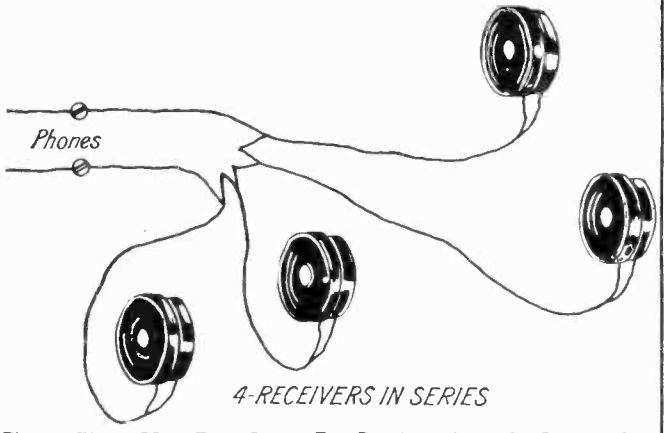


Fig. 1. Where More Than One or Two Receivers Are to be Connected to the Radio Receiving Set, They Should be Connected in Series in Practically All Cases, Especially When a Crystal Detector is Used

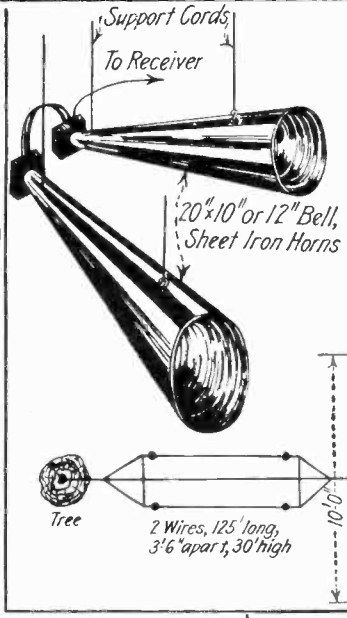
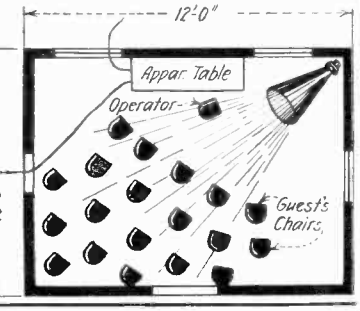


Fig. 3. Where a Pair of Baldwin or Other Efficient Radio Receivers Are Used, Both of These May be Fitted With Horns, as Shown Here, Pointing Each Horn in a Different Direction, so as to Distribute the Sound About the Room With the Greatest Efficiency. The Diagram Below Shows an Arrangement Used by One of the Editors With a Single Amplifying Receiver and Metal Horn Measuring 3 Feet Long With an 18 Inch Opening



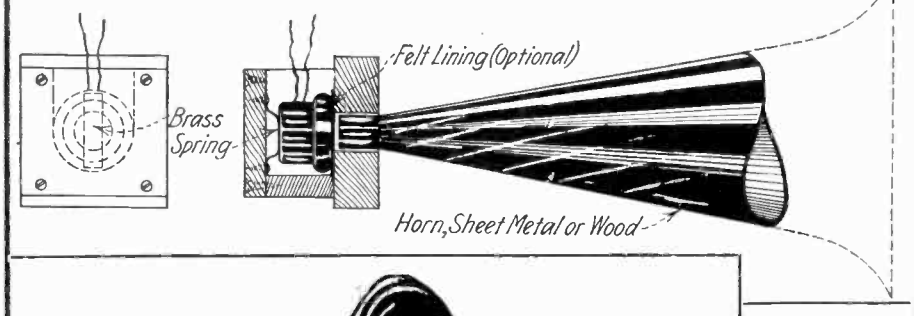
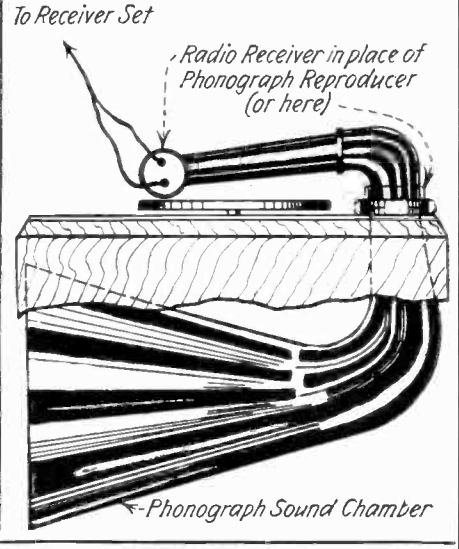


Fig. 2. A Simple and Effective Radio Loud-Talker, Which is in Use by the Editors on Their Own Sets in Several Cases, is Shown Below. The Sheet Iron Horn Measures About 20 Inches Long and Has an Opening About 10 Inches in Diameter. A Single Baldwin Type C Amplifying Receiver is Mounted in the Wooden Block, Cut Out as Shown

Fig. 4. Many People Are Adapting Their Phonograph Cabinet to the Radio-Telephone, and One of the Best Methods of Doing This is Shown Below. The Reproducer is Removed and the Wireless Receiver is Clamped Tightly Over the End of the Tone Arm, or Else Over the Opening to the Sound Chamber, as Shown by the Dotted Lines, Thus Utilizing the Horn in Your Phonograph



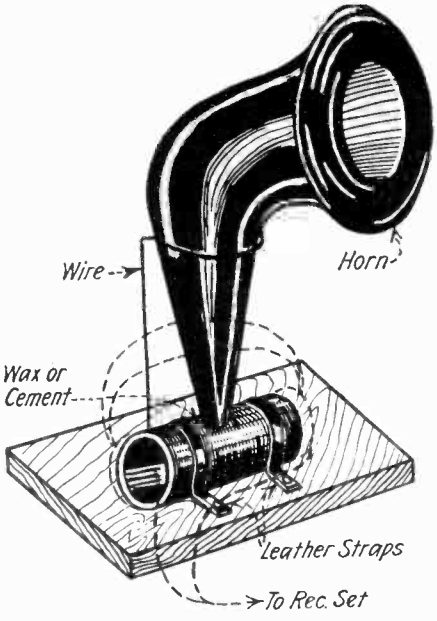


Fig. 5. One of the Successful Loud-Talking Attachments Which Has Been Devised, Comprises a Horn Fitted with Two Openings at the Base, so That a Pair of Standard Radio Receivers Can be Clamped Against These Openings, in the Manner Indicated by the Dotted Lines in the Drawing Herewith. To Make This Loud-Talker Yourself, a Fair Sized Metal or Wooden Horn May be Tightly Sealed to a Phonograph Record or Its Equivalent

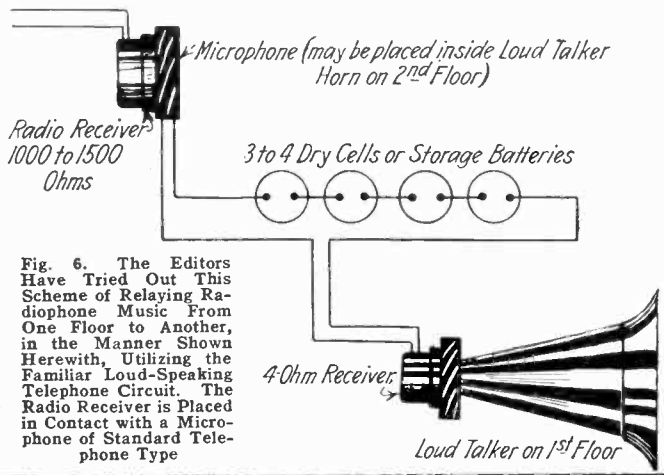
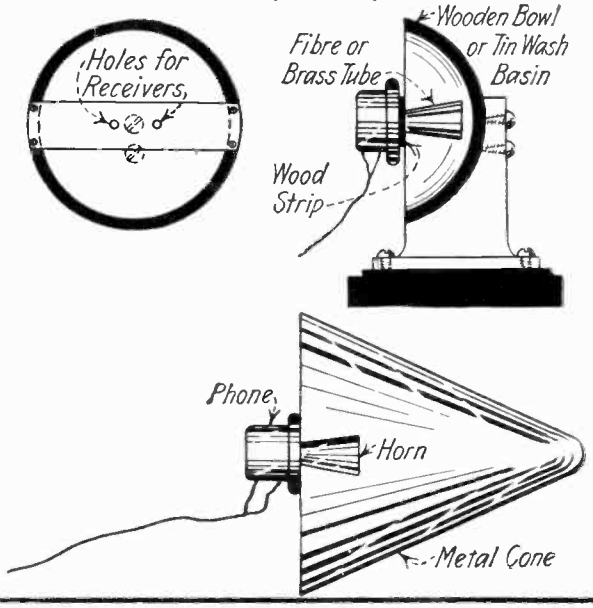


Fig. 6. The Editors Have Tried Out This Scheme of Relaying Radiophone Music From One Floor to Another, in the Manner Shown Herewith, Utilizing the Familiar Loud-Speaking Telephone Circuit. The Radio Receiver is Placed in Contact with a Microphone of Standard Telephone Type

Fig. 7. Speaking of Loud-Talkers, We Give Below Two Suggestions Which Have Been Tried Out with Marked Success. The Wooden Chopping Bowl Trick Shown in the Upper Illustration, Works Beautifully, as One of Our Editorial Staff Has Found. The Metal Cone Stunt Corresponds to One of the Successful Loud-Talkers Now Sold on the Market. The Bigger the Bowl or Cone, the Better, of Course



The Radio Broadcast

WITH this issue we are inaugurating a new department entitled "The Broadcast." Since last December a great change has come into radio, due mainly to our radio telephone broadcasting stations, which now supply the public of this country with free entertainment of all sorts, such as lectures, vocal music, phonograph music, instrumental, band music and speeches.

For instance, recently in Newark, N. J., the WJZ station broadcasted an entire musical comedy, namely, Ed. Wynn's "Perfect Fool," which is now running on Broadway. The entire cast, almost 100 people, participated in the first radio show given.

We are in receipt of thousands of letters from radio enthusiasts who wish to know all about this broadcasting service, where it originated, how far the station can be heard, and news of other important questions. In this department, hereafter, we will give accurate information on all broadcasting topics, and we would ask our readers to keep all copies containing broadcasting information for further use.

The map which we print herewith is a general one and simply shows the location of the present stations, which number over seventy. Readers can readily compute their distance from these broadcasting stations, and the following rule, which is only a rough one, holds good: If you have a good crystal detector outfit and a four-wire aerial not less than sixty feet long, you should be able to receive the entertainment from these broadcasting stations if you are located not further than twenty-five to thirty-five miles from them. With a vacuum tube outfit this distance would be increased quite a good deal. If you have a VT detector and a two step amplifier, you should be able to receive the entertainment quite loud anywhere from 300 to 1,000 miles away from these stations.

As mentioned elsewhere, our special supplement map, which will be published with our May issue, will give a great deal of data not shown on this first general map. This supplement will be of great importance and will be an unusual feature of our next issue.

This department will contain a monthly list of broadcasting stations, with full particulars for each station, and we invite all new stations that are either contemplated or are in operation to send to the editor full particulars as to their station for publication.

We intend to make this department a "live" one, and hope for the full cooperation of everyone concerned.

First Authentic List of Radiophone Broadcasting Stations

(CORRECTED TO MARCH 1, 1922)

Akron, Ohio, Radioart Store Station. Call letters, 8UX. Monday, Wednesday and Friday, 6:30 to 7 p. m., Eastern Standard time. 190-200 meters; normal range, 30 miles; exceptional range, 200 miles.

Anacostia, D. C. Call letters, NOM. 350.

Anticosti, N. S. Call letters, NSF. 200 to 250 meters.

Atlanta, Ga., Garter Electric Co. Call letters. 4CD. Wave length?

Austin, Texas, State University. Call letters, 5ZU.

Boston, Mass., H. A. Beale's Station. No schedule or call letters on record here.

Berlin, N. H., Y. M. C. A. No call letters or wave length yet. Broadcasting program of interest to the public.

Chicago, Ill., Westinghouse station. Call letters, KYW. Music, opera.

Chicago, Ill. Call letters WBU. Station and wave length wanting.

Cleveland, Ohio, Cleveland Radio Association. Friday evening concerts. No call letters or wave length obtained.

Cleveland, Ohio. Call letters, WHK. Station and wave length wanting.

Cleveland, Ohio, station of the Cox Manufacturing Co. Call letters, 8ACS. 200 meters. Sunday, 7:30 or 8 P. M., Eastern Standard time. Music and voice. Can be heard with mineral detector receivers in Cleveland and suburbs. With amplifiers it is heard clearly at distances up to 50 or 60 miles, and has repeatedly been heard at distances of several hundred miles. Thursday evenings, concerts under auspices of Cleveland Radion Association. Different members give these concerts. They are heard thruout Greater Cleveland and sometimes at greater distances.

Cincinnati, Ohio, station of Precision Equipment Co. Call letters, 8XB. 375 meters. Music, vaudeville, baseball scores, and other information.

Columbus, Ohio. The station of Ohio State University. Call letters, 8YO. 275 meters. No schedule. Time signals, market reports and other useful information.

Columbus, Ohio, station of Electrical Specialty Co. Call letters, 8BYV. 200 meters. Monday, Wednesday, Friday, 7:30 P. M., Central Standard time. Music, football scores, baseball scores, and other news.

Dallas, Texas, Police Dept. Call letters WRR. 450 meters. Weather forecasts, Police Bulletin, local news and other information. 8:30 to 9 P. M. at some station concerts.

Dayton, Ohio. McCook Army station. Call letters, WAL.

Dayton, Ohio. Call letters, WFO. Station and wave length not recorded.

Deal Beach, N. J., American Telephone and Telegraph station. Working with KDOW. Call letters, 2XJ.

Denver, Colo. Y. M. C. A. station. Daily time signals, weather report and news. Thursday. 8 to 9:30 P. M., Fitzsimmons Hospital Station. Concert. Daily, 8:30 A. M., station of Reynolds Radio Company, Inc. Weather forecast. Radius 1,000 miles. Sundays, 8 to 10 P. M. Same station, concert. Radius, 1,000 miles. This music is used for dances in Wyoming, Nebraska and Kansas.

Detroit, Mich., Detroit News. Call letters, WBL. No schedule.

Fairfield, Ohio, U. S. Army station. Call letters, WL2. No schedule. Wave length wanting.

Gridley, Calif. Call letters KFU. Station and call letters wanting.

Hamilton, Ohio, Doron Bro. Electrical Co. 200 meters or over. No schedule.

Hartford, Conn., C. D. Tuska Co. Call letters WQB. 360 to 485 meters. No schedule.

Hollywood, Calif., Electric Lighting Co. Call letters, KGC. Wave length, 360 meters. No schedule.

Indianapolis, Ind. Call letters, WOH.

Indianapolis, Ind., station of Hamilton Mfg. Co. Call letters, WLK.

Jefferson City, Mo. Call letters, WOS. Station and wave length wanting.

Jersey City, N. J., Wireless Telephone Co., of Hudson County. Call letters, WNO. 360 meters. No schedule.

Jersey City, N. J., Jersey Review. Call letters, 2IA.

Kansas City, Mo. Call letters, WOQ.

Kansas City, Mo., Western Radio Co. Call letters, 9ZAB.

Lansing, Mich. Call letters WHW. Station? Wave length?

Lincoln, Neb. University of Nebraska. Call letters, 9YY. Wave length? Range, several hundred miles. Noon and 7.30 P. M.

Los Altos, Calif., Colin B. Kennedy Co. Call letters, KGB. Wave length?

Special Broadcast Supplement

WITH our May number, we will issue a special radiophone broadcasting map in two colors, size 15 by 12 inches. This map will contain all important data of every broadcasting station in the country in existence at the present time. The map will be arranged in such a way that it can be mounted by the reader and new stations can be inserted by means of a special key printed on the map.

Inasmuch as our new Radio features have made an unprecedented demand for SCIENCE AND INVENTION, be sure to reserve your copy with your news dealer now, as otherwise, you may not be able to obtain it. It costs nothing to do so, and places you under no obligation.

Los Angeles, Calif., Western Radio Electric Co. Call letters, KZC. Wave length?

Los Angeles, Calif. Call letters KOG. Station? Wave length?

Los Angeles, Calif., Leo. J. Meyberg Co. Call letters, KYJ. Wave length? Another station at San Francisco.

Los Angeles, Calif., Arno A. Kluge. Call letters, KQL. Wave length?

Los Angeles, Calif., Hamberger's Dept. Store. Broadcasts program of interest to the public. Range 1,000 miles.

Medford Hillside, Mass. Call letters, WGI. 350 meters. Daily, 8 P. M. Boston City Police Reports, first in International Morse Code ten words per minute, then by radio telephone.

Wednesday, 8:15 P. M. Same station, Concert.

Tuesday and Thursday, 8:15 P. M. Same station. Burgess Bed Time Stories.

Monday, 8:15 P. M. Same station. Publicity and information of general interest.

Friday, 8 P. M. Amateur Night. Code instruction; new licenses announced.

Saturday, 8:15 P. M. Football, baseball, other sporting events and general news.

Special broadcasts. Same station. United States Public Health Service Lectures. Detailed reports of World Series. Concerts by high class artists. Sermons on Sundays. Addressed by prominent speakers. Business reports.

Medford Hillside, American Radio Research Co. Call letters, WGI. Wave length, 360 meters. A report from the American Radio Co., claims that WGI formally 1-XE was the first radio broadcasting station in this country. Its radius is 1,000 miles. This station reports that due to geographical conditions the station at Springfield, Mass., cannot be heard at Worcester, so that the New England population is practically dependent for its broadcasts upon WGI.

Mexico City, Mexico. Call letters, XDA. 5,500 meters. Daily, 7 P. M.

Minneapolis, Minn. University of Minnesota station. Call letters, WLB.

Montreal, Canada. Station of the Marconi Telegraph Co. of Canada, Ltd. 1,200 meters. Radiophone concerts. news bulletin, notices of wireless, society meetings and other information. Range about 200 miles.

New Haven, Conn. A. C. Gilbert Co. Letters, WCJ.

Newark, N. J. L. Bamberger & Co. Call letters, WOR.

Newark, N. J. Westinghouse test station. Call letters, 2-SAI. 360 meters.

Newark, N. J. Station of the Westinghouse Electrical & Manufacturing Co. Call letters, WJZ. 360 meters. Broadcasts daily Arlington signals at 12 noon and at 10 o'clock.

New York City, N. Y. Ship Owners Radio Service. Call letters, WDT. Wave length? Schedule?

New York and vicinity. Ship of American Telegraph and Telephone Co. Call letters, KDOW. This ship is sometimes 1,000 miles at sea and communicates to the stations of the Radio Corp. of America. This station has communicated with the land station (2-XJ at Deal Beach), at a distance of 1,600 miles.

Oakland, Calif. Preston D. Allen. Call letters, KZM. Wave length, 360 meters.

Oakland, Calif., Atlantic & Pacific Radio supplies. Call letters, KZY. Wave length 360 meters.

Pasadena, Calif. J. J. Dunn & Co. Call letters, KLB. 360 meters.

Pawtucket, R I. Raymond F. Farnhans station. Call letters, IOJ. Wave length?

Pawtucket, R. I. Thomas Gihline Station. Call letters, 1XAD. No schedule. Wave length?

Philadelphia, Pa. Call letters, WCL. Station? Wave length?

Philadelphia, Pa. T. F. Z. Howlette station. Call letters, 3-AWI. Wave length? No schedule.

Pinehluff, Arkansas. Call letters, WOK. Station? Wave length?

Pittsburg, Pa. Call letters, KQV. Station? Wave length?

Pittsburgh, Pa. KDKA. Westinghouse Station. 360 meters has been heard 2,000 miles. Concert and schedule similar to WJZ Newark varied program.

Pittsburg, Pa. Hamilton Mfg. Co. Call letters, WPB. 360 meters.

Pomona, Calif. Call letters, KGF. Station? Wave length?

Richmond, Ind. Call letters, WOZ. Station? Wave length?

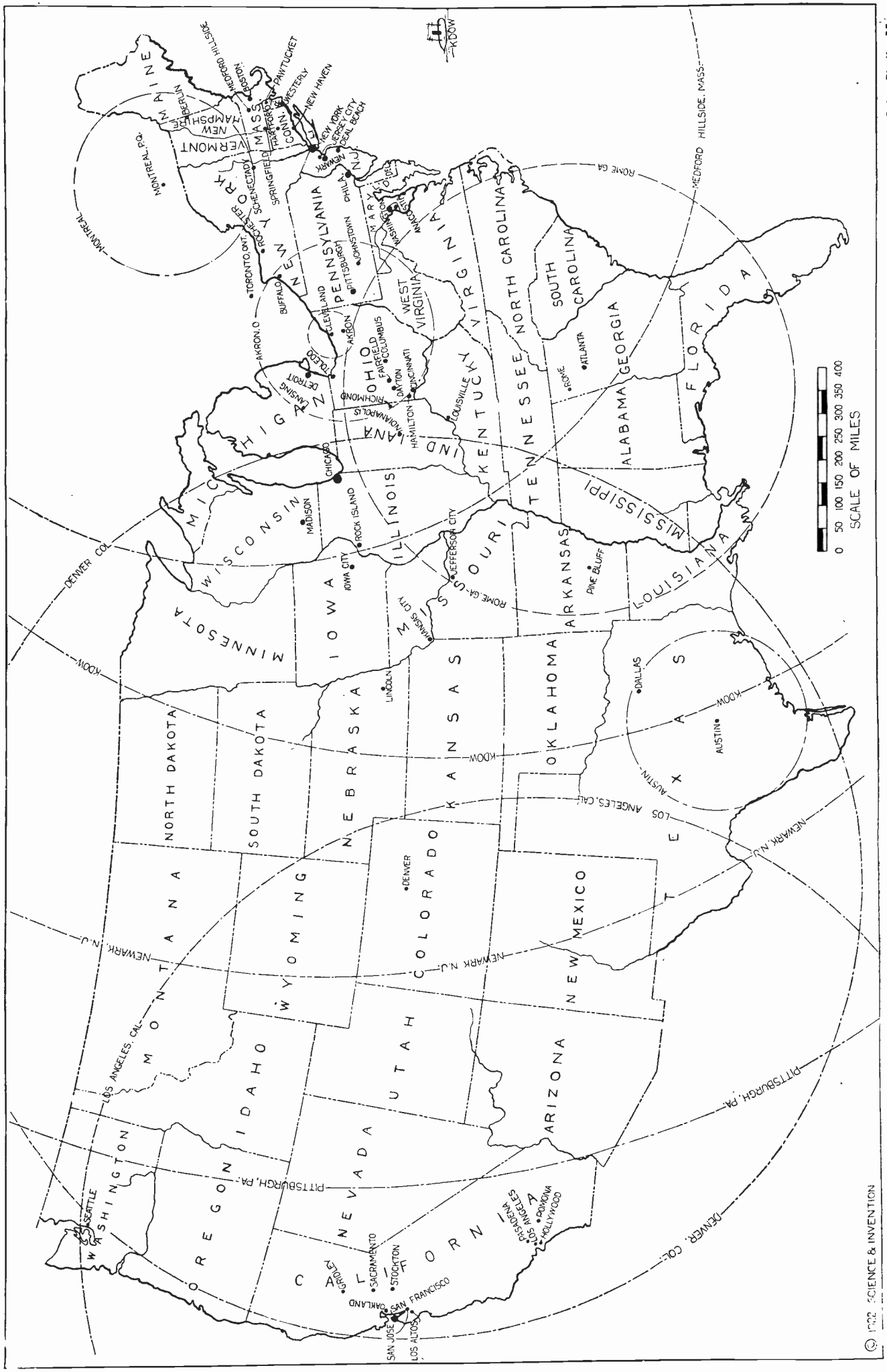
Rochester, N. Y. Call letters, WHQ. Station? Wave length?

Rock Island, Ill. Call letters, WOC. Station? Wave length?

Rome, Ga. Amateur station. Call letters. 4-BQ. Wave length? Range 500 miles.

Roselle Park station of the Radio Corporation of America. Call letters, WDY. 360 meters. Station temporarily discontinued.

(*Continued on page* 1171)



This Radio Broadcasting Map, Specially Drawn by Our Own Artist, Has Been Brought Up-to-date and Shows Many of the Broadcasting Stations Thruout the United States Which Have Not Been Indicated on Other Similar Maps. In the Next Issue a Special Map, in Two Colors Will Be Given in the Form of a Loose Leaf Supplement, Suitable For Framing and Hanging in Your Radio Station. It Is Best, However, Not to Place Glass Over These Maps, so That Colored Pins, Obtainable From Your Stationers or Map Shop, Can Be Inserted as New Broadcasting Stations Are Opened, the Range of Each Station Being Indicated by a Colored Cord or Ribbon Run Out to a Radio Terminal Pin. Each City Indicated On This Map Has a Broadcasting Station.

Radio for the Beginner

By ARMSTRONG PERRY

NO. 2. HOW TO OPERATE A SIMPLE RADIO RECEIVER

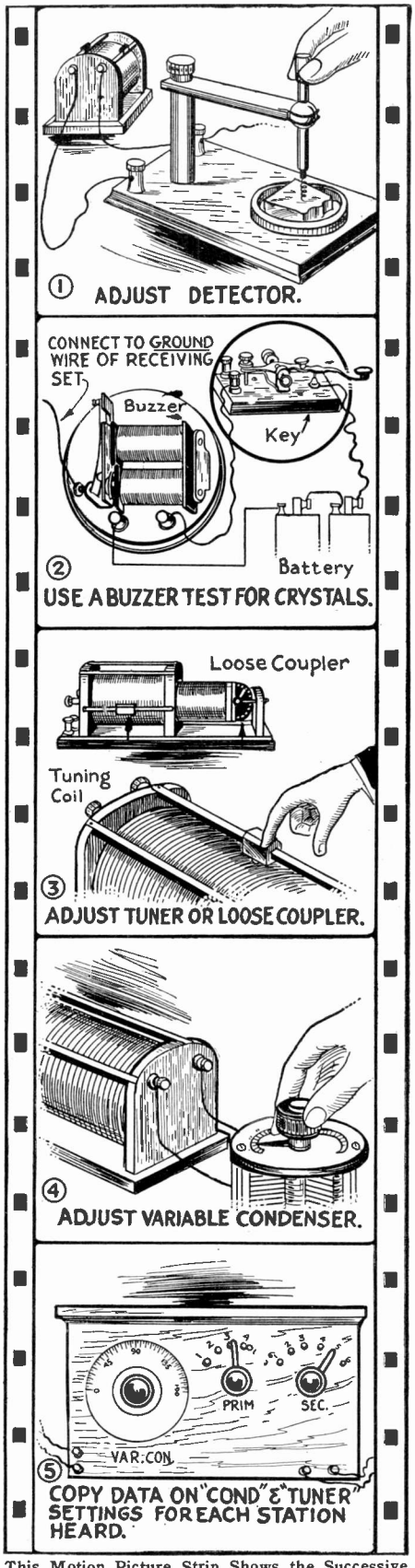
IF you hooked up that mineral detector set the way I told you to in the last issue you ought to be hearing all sorts of things now. But I have a hunch that you have had troubles the same as I have.

There are three troubles that are common to all beginners: (1) He does not hear anything. (2) He does not hear what he wants to hear. (3) He does not hear it loud enough. The first trouble can be overcome. The other two, like leprosy before the discovery of chaulmoogra oil, seem to be incurable. The reason they are chronic is that human desire is a progressive ailment. The beginner who hears a New York station to-day wants to hear Chicago tomorrow, San Francisco the next day, then Honolulu, then Mars. Radio goes further than any other hobby toward satisfying the natural desire to do something bigger and better every day than you did the day before, and Mars may yet be heard from. The beginner who masters his mineral detector outfit is well on his way to the bigger achievements.

The simple receiving outfit consists of: (1) The aerial or antenna, which picks up the radio waves. (2) The tuner, which enables the operator to choose the station he will listen to. (3) The detector, a valve that reduces the radio waves to vibrations slow enough to make sound that can be heard by the human ear. (4) The phones, which change electrical oscillations into sounds. (5) The ground wire, which completes the path by which the electric currents pass on their way after producing the sounds that you hear. After these parts are set up and connected, the tuner and the detector are the only parts to be adjusted.

The detector, as of course you have noticed, consists of a piece of mineral and a piece of small wire mounted in such a way that they can be brought into contact. Sometimes there are two pieces of mineral instead of a piece of mineral and a piece of wire. The wire, or the smaller piece of mineral, whichever the detector has, should be touched to the larger piece of mineral at different spots on its smooth surface, while the operator listens attentively with the phones. When the operator hears a signal, which very likely will sound like the buzz of a mosquito, he very gently adjusts the wire or mineral to see if he can make the buzz louder. The more he works at this the more he will find out. He will discover that there are certain spots on his mineral that give him a louder sound than others. Remembering these spots saves time for him when further adjustments are necessary. Also he discovers that even the slightest variation of pressure on the mineral makes a great difference, and that the wire may slip off the tickle spot and have to be readjusted.

There is one impulse that must be sternly resisted. Every human being has an itching desire to rub his hand over a nicely polished surface. Sometimes it is done unconsciously, as in the case of a gentleman who descended the stairs at the home of his host and permitted his hand to slide from the smooth banister right on over the shoulder of a lady in evening dress who was leaning on the post at the bottom. The beginner who gets no buzz from his radio receiver often assumes that a vigorous polishing of the surface of the mineral with his thumb will rid it of dust and enable the signals to come through. The fact is that one touch of the thumb, even when it is as clean as it is after you use the nail for a screwdriver, deposits enough



This Motion Picture Strip Shows the Successive Operations, from Top to Bottom, to be Followed in Tuning the Radio Receiving Set Either for Radiophone Concerts or for Regular Radio Telegraph Signals. If a Crystal Detector is in Use, it Will Prove a Great Time Saver to Employ the Buzzer Test Here Shown, as Otherwise You May Spend Several Hours Listening for Signals on a "Dead" Crystal. Adjust the Detector, then the Tuner and the Variable Condenser.

natural skin oil on the surface of the mineral to insulate it from the wire or the other mineral and destroy its sensitivity. If your detector does not detect, take a course on thumb prints and find out who smeared it. Remedy: Clean crystals occasionally with benzine, carbona, or better, carbon bisulfid.

The tuner, unless you know that you have it adjusted to the station that you want to hear, should be manipulated in conjunction with the detector. It may be a coil of wire on which a metal spring slides back and forth; or it may have two coils of wire, one inside the other, that open and shut like a telescope and have semicircles of tack heads or bolt heads on the side or end, and a brass tongue that is turned with a knob and brought into contact with one bolt head after another. A recent type of tuner that I have used has just one handle that swings back and forth and moves a pointer over the face of a dial on which are numbered scratches with unnumbered ones between. The swinging of the handle, the sliding of the metal spring or the turning of the knob all have the same purpose, which is to adjust your receiver so that you can hear the station you want to hear. The beginner knows, or should know, that the radio station KDKA for example is located at East Pittsburgh, Pa.; that he is near enough to hear it with the apparatus that he has, and that it transmits on a wavelength of 360 meters or whatever it uses at 8 P. M.

If he does not know exactly what he is trying to hear, of course the beginner just explores the ether to find out what he can hear. That is like fishing blindfolded in the middle of the ocean. He may catch anything from a flying fish to a whale.

When the beginner knows the hour at which the station he wants will be transmitting, and what wavelength it employs, he touches the wire of his detector to some spot on his mineral which he thinks is sensitive, then slowly tries his tuner over its whole range of motion. In case the tuner has two knobs, each with its semicircle of contact points, the game is to put one brass tongue on its first contact point, turn the other knob as far as it will go each way, move the first tongue to the next contact point, repeat the operation of the other knob, and continue until every possible adjustment has been made, including the working in and out of the telescoping coils if the tuner is the kind that has them. If the operator knows approximately how to adjust his tuner for the station he wants to hear, he tests it in that position very thoroly by slight changes. If he does not hear what he wants to, he changes the wire or movable mineral of his detector to another spot and repeats the exploration with his tuner.

There are "buzzer testers" which will show when the detector is on a sensitive spot. When these are used, the detector can be adjusted accurately and the entire attention of the operator given to the tuner, but most radio amateurs start their careers without them. In spite of that, they do not use such awful language!

Sometimes a tuner has a variable condenser in addition to the apparatus described above. That means one more knob to turn. The process then is: Tickle the mineral, shove the slider over another wire, or turn the knob or swing the handle another notch, turn the condenser knob as far as it will go in each direction, slowly, and push the sliding coil back and forth if you are using a tuner that has one. Then

(*Continued on page* 1186)

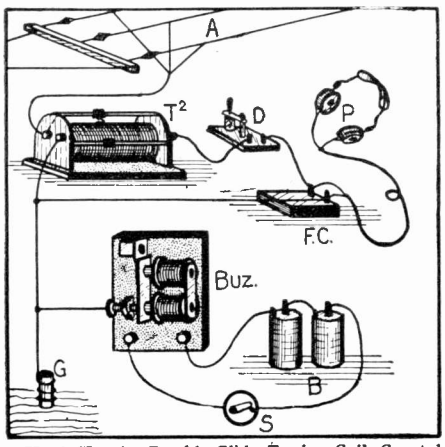
Radio Oracle

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

Receiving Troubles

(1) Jack Pomret, of New York City, asks:

Q. 1. I have a double slide tuning coil, a crystal detector, a fixed condenser and a pair of 2000 ohm 'phones. I have never heard the Westinghouse Station. My aerial is a single wire about 70 feet long and 50 feet from the ground, strung out from a wash-pole. Only on rare occasions have I been able to receive telegraphic messages.



A Hook-Up of a Double Slide Tuning Coil, Crystal Detector, Fixed Condenser and Phones, is Shown Above. The Method of Connecting a Buzzer for Testing Crystal Detector is Also Illustrated. A-Aerial, T2-Two Slide Tuner, D-Detector, F. C.-Fixed Condenser, P-Phones, Buz-Buzzer, G-Ground, B-Battery, S-Switch.

A. 1. Your 'phones are of the regulation type and have been employed by many amateurs very successfully. The reason you are probably not getting the proper results is that you are not adjusting your detector to its point of maximum sensitivity and you are not tuning sharply enough. We would advise that you change your hook-up to conform with the circuit here shown and employ a buzzer test as often as you think necessary.

Miles and Wave Length

(2) Burton Hays, Philadelphia, Pa., asks:

Q. 1. Arlington Station is rated at 2500 meters. How many miles is that?

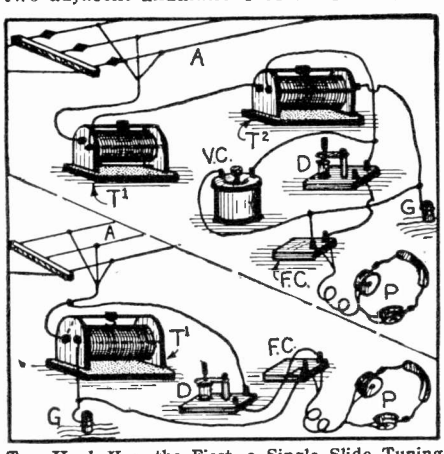
A. 1. This "rating" which you speak of does not refer to distances in receiving ranges. It is a unit of measurement used to denote the length between the peaks of two adjacent undulations of the same wave and even tho a station may be rated at 2500 meters it does not necessarily imply that you will be able to hear that station even ten miles away unless your apparatus is so arranged that it can tune up to that wave length.

Q. 2. Please give the hook-up of a single slide tuning coil, a detector, a fixed condenser, and a pair of 'phones.

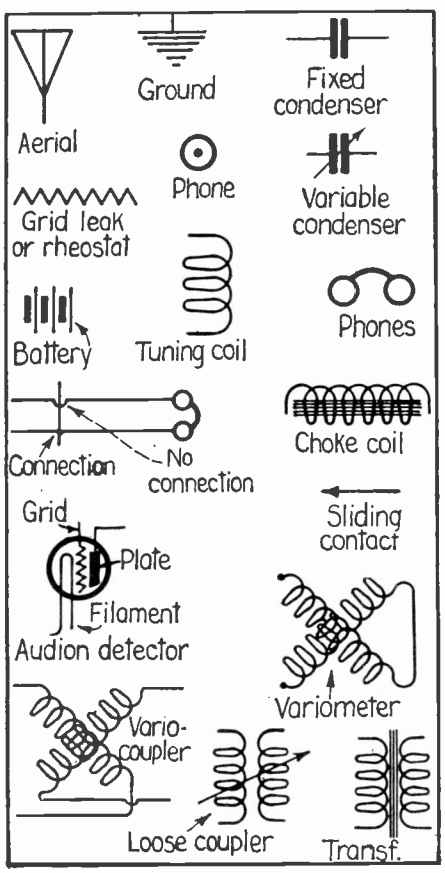
A. 2. The hook-up is given herewith.

Q. 3. Also furnish the hook-up of a two-slide tuning coil, a variable condenser, and the other apparatus mentioned above.

A. 3. Assuming that you intend to use in addition to the single slide tuning coil a two-slide tuning coil, the hook-up is here shown with the single slide tuner used as a loading inductance.



Two Hook-Ups, the First, a Single Slide Tuning Coil, Detector, Condenser and Phones. The Second, in Addition to the Above Apparatus, a Two-Slide Tuner and a Variable Condenser. A-Aerial, G-Ground, T1-Single Slide Tuning Coil, T2-Double Slide Tuning Coil, D-Detector, F. C.-Fixed Condenser, V.C.-Variable Condenser, P-Phones.



Making Radio Symbols Simple to Understand. The Above Chart of Radio Symbols With the Names Alongside of Each, Shows What the Various Signs Represent.

Radio Symbols

(3) Raymond Pomfret, Miami, Fla., asks:

Q. 1. I see so many diagrams of wireless apparatus and they are all Greek to me, will you please give me the names of the various instruments and the symbols used to designate them.

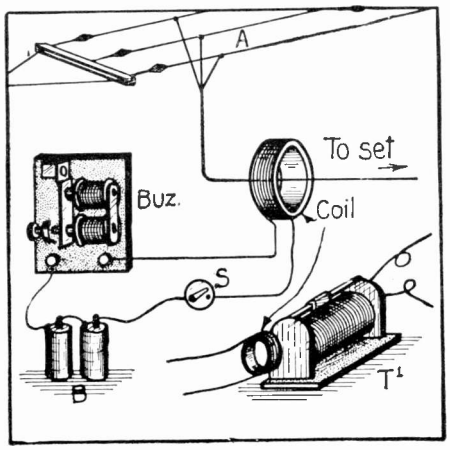
A. 1. We are publishing the symbols usually employed here and with each of them the name of the actual apparatus.

Buzzer Test for Crystal Detector

(4) John Hay, of Kansas City, asks:

Q. 1. I have heard that there are other methods of employing a buzzer for testing a crystal for sensitivity besides connecting the wire directly to the ground lead. Can you give me a circuit diagram for this method?

A. 1. There are several methods of doing this depending upon induced currents. One way is to wind several turns of wire around the aerial lead before connecting this to the buzzer; another method is to wind several turns of wire around a cardboard tube 2 or 3 inches in diameter and then pass the aerial lead either thru or around the cardboard tube or else permit this coil to approach the loose coupler or tuner so as to react upon it. The buzzer is placed in series with this coil.



In Case of Objections to the Use of the Buzzer for Testing a Crystal as Shown in Question No. 1, the System Indicated Above May Be Employed. Buz-Buzzer, T1-Single Slide Tuner, S-Switch, B-Battery, A-Aerial.

Q. 2. Are there any advantages in using these methods?

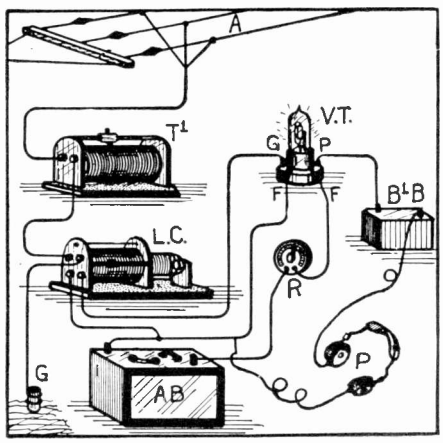
A. 2. The advantages are slight, but users of this system claim that the sensitive spots so found on crystals are not apt to be lost or burnt and that more sensitive spots are generally found.

Hook-Up

(5) R. M. Gross, Maybell, Colo., requests a hook-up of a loose coupler, loading coil, variable condenser, 'phones and an audion detector for reception of undamped wave signals, and asks:

Q. 1. Will I be able to hear Arlington on this set.

A. 1. You may have considerable difficulty in receiving Arlington time signals on the west side of the Rocky Mountain range, but there are plenty of government stations transmitting time signals nearer your immediate vicinity than Arlington, which would come within your range. Hook-up is given herewith.



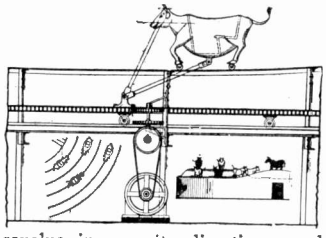
A Simple Audion Circuit Which Will Receive Damped Waves. T1-Single Slide Tuner, L.C.-Loose Coupler, V.T.-Vacuum Tube, B1B.-"B" Battery, H.B.-Six Volt Storage Battery, R-Rheostat, P-Phones, A-Aerial, G-Ground.

LATEST PATENTS

Amusement Device

(No. 1,399,582 issued to James Sayih)

This rather clever amusement device is of the carousel type. There are an annular series of cars, which

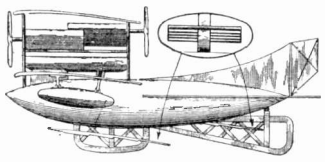


revolve in opposite directions, and are permitted to undulate while so traveling. The speed varies according to whether the rider chooses to travel on the innermost or the outermost circle. The cars travel on rollers and are connected to an endless chain by means of a lever. This permits the cars to rise and fall without shifting the nature of the driving element, or the chain to which this drive is attached. One single motor controls all four chains, and a locking means in the lever prevents the cars from upsetting.

Aerial Apparatus

(No. 1,396,874) issued to Vittorio Pastrengo)

This is an unusually clever landing gear for sea planes, which enables the aviator to alight on quite rough water without shock to the plane, or permits him to descend on land. There are three skids pivoted at the front and free to move within a certain angle controlled by a spring and piston shock absorber. These skids are also provided with fluted planes inclined at an angle, which assist in bringing the vessel down without damage on a rather rough sea. Two of these skids are mounted within the hulls of the sea plane, and the third at



the tail. The plane is further equipped with pontoons at the ends of its wings, which are arranged in a similar pivoted manner to the landing skids.

Shaving Brushes

(No. 1,392,369 issued to Charles F. Stoewsand)

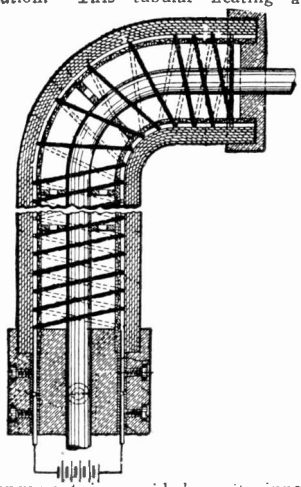
The less dangerous of the species, according to Kipling, uses the shaving brush more regularly and this invention was created for the almost universal demand for such brushes. It consists of a handle which holds the bristles of the brush and acts as the container for liquid soap. Upon pressing the plunger inwardly a ball-valve is operated which permits some of the liquid soap to pass out thru a perforated cap. If the plunger is released the valve closes, preventing the return of the liquid from the end of the shaving brush, and because of the suction thus exerted more of the liquid soap passes into the plunger section. The soap is, of course, sprayed upon the brush. It is then merely necessary to moisten the face with water.

press the button a few times and lather as desired.

Heater for Gasoline Supply Pipes

(No. 1,399,393 issued to Edgar Millner)

Many of us have experienced the difficulty in starting gasoline engines in automobiles on a very cold day, sometimes cranking up "the old bus" as tho we were winding it up as we would a phonograph. This heating device consists of a flexible tube, in the fabric of which the wire is wound. One end of the tube is fastened to an insulating member and the other end provided with a cap. The whole is secured around a supply pipe leading to the carbureter. The wires from the heating element are connected to the battery circuit of the automobile. In this manner it is possible to heat the gasoline sufficiently to insure its proper vaporization. This tubular heating ar-

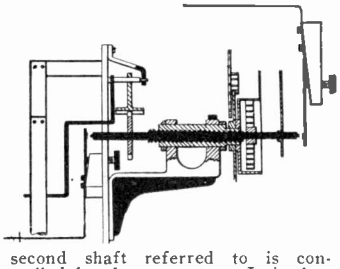


rangement is provided on its inner surface with a coat of flexible sheet asbestos. The air space between the heating tube and the gasoline pipe is the column of air upon which the heating coil acts.

Apparatus for Regulating Frequency

(No. 1,390,318 issued to Henry E. Warren)

Ordinary frequency meters give a fair indication of the frequency at that particular moment, but if the frequency is slightly above normal an instantaneous reading would be of no value. With this device the error in frequency is amplified. Primarily, it consists of a synchronous clock which operates a shaft. This shaft turns within another shaft, both of which are threaded to fit loosely upon each other. The

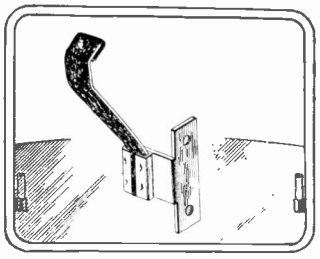


second shaft referred to is controlled by the generator. It is thus obvious that as long as the frequencies of the clock and generator are identical, the shaft will remain in the center, but should the frequency of either vary ever so slightly, the shaft is caused to move in either a forward or backward direction. This shaft being fitted with contact-making devices, closes a circuit thru a wheatstone bridge.

Anti Rattling Device

(No. 1,400,482 issued to Harry E. Ewing)

Anti rattling devices for windows are numerous, but very few of these

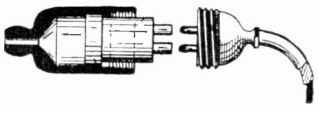


resemble this one recently patented and just placed upon the market. Essentially it consists of a base plate having screw holes so that it can be secured to the window frame, and also a rectangular projecting part to which the window engaging member is secured, so that said member is spaced an appreciable distance from the base. This member is formed of a spring strip bent as illustrated, carrying a strip of felt which is secured at its outer end by means of a rivet and at its inner end by the clamping strip engaging with the window frame.

Thermic Telephone

(No. 1,389,230 issued to Robert Aernout Baron van Lynden)

In order to facilitate the making of heating conductors in thermic telephones, the inventor of this system winds a helical coil of Wollaston wire. This is placed between upright conductors after it has been slightly flattened. The points of union between the conductors and the Wollaston wire are soldered, forming therefore, a multiple series of parallel arcs of wire. The bent portions in this manner project on either side of the two pins. Each half of the Wollaston wire coil is then dipped into acid, where the wire is etched to the desired diam-

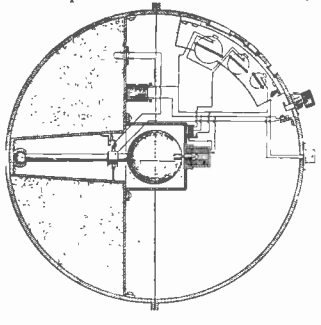


eter. The two pins are fitted into end blocks. This permits the small section to be removed and replaced in case the wire is burnt out.

Submarine Mine

(No. 1,390,768 issued to Herbert Grove Dorsey)

This new submarine mine can be controlled from a shore station without recourse to the usual communicating wires, which have heretofore been used for such control. The mine has contained within it three resonators, all responding to different frequencies. In the mouth of

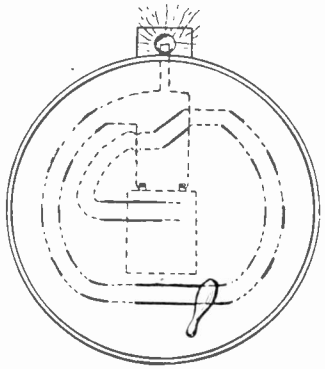


each of these resonators is a vane, which vane, strange to say, when pivoted on a transverse axis in Helmholtz resonator, tends to rotate in a direction to close the mouth when the latter is stimulated by the reception of pulsations of the proper frequency. This closes the circuit to the electrical detonating means, exploding the mine. Hence when the proper code is sent out. all those mines within a definite area whose code signals, of course, are known, may he exploded at will by the operator.

Electrical Game Board

(No. 1,399,712 issued to Samuel Joseph Levi)

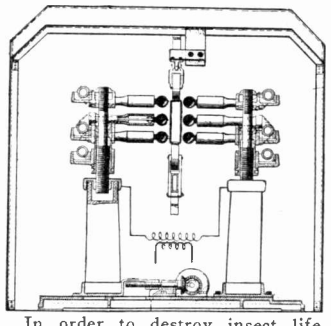
A game board is wired as shown in the accompanying diagram. The dotted lines represent the wires passing through and under the board



and the heavy black lines show the wires above the board. These are sunk in grooves so that they protrude but very little. A visual or audible signal such as a lamp or a buzzer, is placed into the circuit. The battery, which is placed in a suitable receptacle found under the board. is connected to the signal. Nine pins are placed upon the board, one of which is electro-conductive; when it is knocked across the wires a signal is given.

Treating Products by Disrupted Conduction

(No. 1,399,162 issued to Franklin S. Smith)



In order to destroy insect life, the inventor of this device uses electricity, claiming that not only is insect life destroyed, but also their eggs, lava and pupa. This apparatus is used for cereals, dried fruits, books, furs, etc. He provides for a plurality of electrodes and condensers, arranged in groups in opposed relation to each other. An endless belt conveys the products to be treated between these condensers, which are adjusted to fit the boxes or cartons of different sizes. High tension current, either direct or alternating, breaks down the air gap that exists between the electrodes. Most of this voltage is placed on the dielectric of the condensers but a proportional part is placed on the conveyer belt and the passing carton.

THE ORACLE

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

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

Water Rheostats

(1191) Frank A. Simpkins, Brooklyn, N. Y., wants to know:

Q. 1. How to make a water rheostat.

A. 1. Altho the water may be contained in almost anything convenient, it is generally safer to use a vessel of insulating material, such as a wooden box or barrel. The electrolyte may be ordinary water when pressures of 500 volts or higher are to be used. It is customary, however, to improve the conductivity of the water by the addition of a little salt or washing soda, or a little acid of some kind.

When the voltage is 550, a tablespoonful of salt is about enough for a barrel of water. More salt should be used for lower voltages. The conductor terminals are usually plates of iron, altho other conductors will do. The resistance is regulated by changing the distance between the plates, or the amount of surface of the plates, or by changing the density of the solution, the latter, however, not being so easily managed. Rectangular boxes of wood or stone are often used. A barrel containing fifty to sixty gallons will dissipate an equal number of kilowatts. Small rheostats sometimes take care of 20 to 150 watts per cubic inch of liquid. The allowable current varies from .25 to 3 amperes per square inch of surface on the exposed face of one electrode.

A good design for a water-cooled resistor is shown in one of the accompanying illustrations. It consists of a number of pipes fitted into U-shaped couplings and supplied with sliding brass bridges or shunts. With all the shunts at the top the resistor is practically short-circuited; when it is desired to cut out all the resistance the terminals of the rheostat should be short-circuited thru the switch indicated. With all the bridge pieces at the bottom the resistance of the circuit becomes a maximum. The pipe connections are so made that water can be circulated thru the rheostat. The connections to the water mains and outlet should be made thru rubber hose. The heat capacity will depend upon the amount and temperature of the water circulated.

Water rheostats can be worked at higher densities than those of usual design by allowing cool water to circulate thru the tank. It will require $\frac{86.5}{t}$ kilograms or $\frac{190}{t}$ pounds of water per hour to dissipate the heat liberated by the absorption of one kilowatt, wth a temperature rise of "t" degrees Centigrade. This formula also applies to the cooling of metallic resistors submerged in running water.

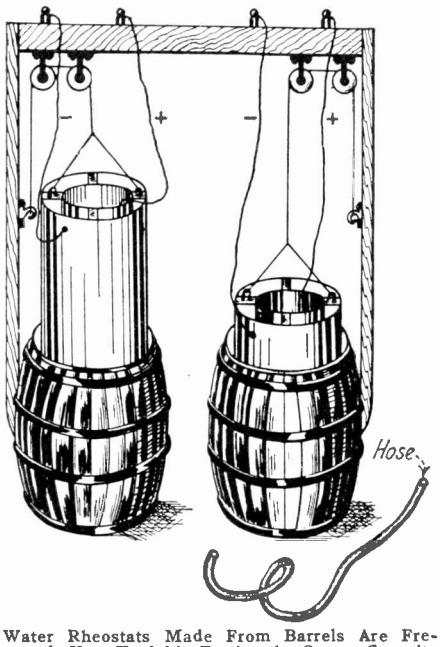
Where high voltage is used the water must be conducted to and from the tank in rubber hose. For potentials up to 2,500 volts a length of 15 to 20 feet is sufficient to prevent grounding, providing the diameter does not exceed one inch. For larger diameters a correspondingly longer hose must be used.

Q. 2. Describe a simple way in which to make an adjustable carbon rheostat.

A. 2. Carbon rheostats have the advantage of fine adjustment together with a large current capacity. Carbon will carry about 125 amperes per square inch. These rheostats are generally made up of plates held in a frame and the resistance varied by changing the pressure between the plates with a screw clamp. A simple and easy method of making a carbon rheostat from old lamp carbons is shown in an accompanying illustration.

One type of laboratory rheostat in considerable use at the present time is made up of about two dozen square carbon plates, not copper plated, of course, each plate being about 2½ inches square and ⅛ inch thick. Sheet carbon suitable for cutting up into such plates can be purchased at any electrical supply house. Another form of carbon rheostat is made up of crushed carbon or carbon granules placed in an insulating tube, one wire being secured to a metal plate at one end of the tube and the second wire being connected to a second metal plate which can be screwed down upon the carbon particles to give more or less pressure. The greater the pressure the less the resistance offered to the circuit by the rheostat, and vice versa. This carbon-granule rheostat works on the same principle as the microphone.

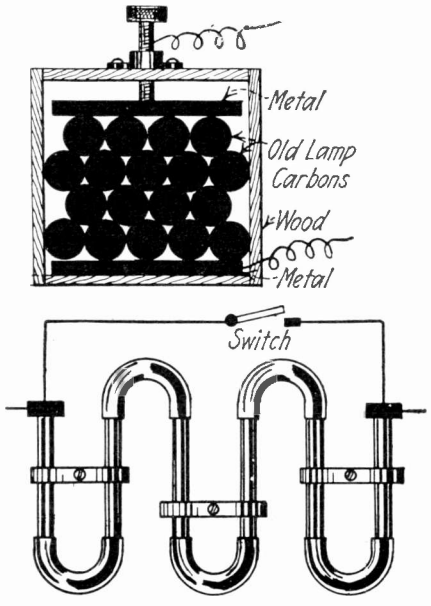
Q. 3. What chemical solution is used for moistening the paper in making a polarity tester?



Water Rheostats Made From Barrels Are Frequently Very Useful in Testing the Output Capacity of Dynamos as Well as for Regulating the Amount of Current Supplied a Motor or Other Apparatus Under Test. The Two Metal Tubes Are Lowered Into a Solution of Baking Soda or Salt Water.

A. 3. The simplest solution, perhaps, is iodide of potassium dissolved in water; when paper is moistened with this, and the terminals of a battery or dynamo are connected to it, a brown spot is left at the positive terminal, or where the current enters; the paper must be damp when the test is applied. To keep the paper moist longer, glycerine should be added to the solution. By moistening paper with a solution of iodide of potassium, to which some starch water has been added, a blue mark is left at the positive pole. Another solution is made by dissolving 15 grains of red iodide of mercury and 20 grains of iodide of potassium in one fluid ounce of glycerine; this must be used moist, keeping the terminals 1 inch apart for each 100 volts; yellow appears at the negative pole. By using a solution of ferrocyanide of potassium and iron terminals, blue appears at the positive pole. If a solution of phenolphthalein is placed in a bottle or tube, corked at both ends, with two wires entering the corks, the positive end turns red. Shake the tube to clear the solution. In applying any of these tests it is desirable to avoid all risk of making a short circuit. For this reason it is best to connect an incandescent lamp in series with the test paper.

A convenient test is to stick the ends of two wires into a potato, keeping the ends an inch or more apart. The potato will boil at the negative terminal, when the wires are connected to a charged circuit, on account of the gas set free by chemical decomposition.



A Simple Variable Resistance Made From Old Lamp Carbons is Shown Above; While Below We See a Water Rheostat Comprising Water Pipes Connected as Shown, and Fitted With Individual Short-Circuiting Jumpers, Also a Switch for Cutting Out the Whole Rheostat.

Polarized Relays

(1192) Samuel Fowler, London, England, writes this Department:

Q. 1. Please explain in a simple manner, together with elementary mathematics, as to just why it is that a polarized relay is not only more useful in most telegraph work, owing to the fact that its armature can be made to close a circuit when a current is past thru the relay in a certain direction, but also how it realizes its much greater sensitivity to small currents as compared to a similar resistance neutral relay. I have heard it said that a polarized relay is 100 times more sensitive than a neutral relay, of the pony type for example.

A. 1. The two accompanying diagrams, Figs. 1 and 2, shows two interesting types of polarized relays used extensively for telegraph purposes. The polarized relay at Fig. 1 has a soft iron armature, which is magnetized permanently by the tempered steel magnet, as shown. Resting on the front end of this steel magnet is a soft iron yoke supporting two magnet cores and pole-pieces made of the same material; the softer this iron is the better, so as to permit it to reverse its polarity with the slightest amount of lag. The armature is supported between brass screws or else brass tipt iron screws in an iron saddle, as shown in the sketch. Directions for adjusting such a relay are given in any telegraph hand-book, and no spring is necessary to return the armature to its open-circuit position.

In brief, the armature of the relay shown at Fig. 1 is adjusted just past the neutral point, so that the attraction between one of the pole-pieces and itself will keep it against the insulated back-stop screw. When a current of the proper polarity is then past thru the electromagnet coils, an opposite magnetic pole is set up in the pole-piece which is retaining the armature, thus nullifying the attraction, while the opposite pole-piece is magnetized oppositely to the other one and an attraction is set up, thus drawing the armature against the contact post and closing the local bell or alarm circuit. The armature action here is all based on the simple law of magnetism that like poles repel while unlike poles attract.

The polarized relay design shown at Fig. 2 is interesting, as it shows how a balanced soft iron armature is arranged so that it may be moved in either direction at will, according to the direction of the current past thru the electromagnet winding shown. The field of the permanent magnet tends normally to retain the armature in the balanced position here illustrated.

The great sensitiveness of polarized electromagnets as compared with those which are non-polarized is because of the greater change in flux density. All other conditions being equal,

the attraction is proportional to the flux in lines per sq. cm. squared or B^2. Hence, if under the influence of the permanent magnet alone $B = 1{,}000$, $B^2 = 1{,}000{,}000$. If now the electro-magnet alone produces a flux density $B = 5$, $B^2 = 25$. With the complete polarized electro-magnet, however, the total flux density after the current flowed would be $B = 1{,}005$ and $B^2 = 1{,}005^2 = 1{,}010{,}025$, an increase in attraction proportional to $1{,}010{,}025 - 1{,}000{,}000 = 10{,}025$. Hence in this case the polarized electro-magnet would have 401 times as great an attraction for a change of 5 lines per square centimeter as would be obtained with the electro-magnet alone; for the reason that B^2 for the electro-magnet, as compared to B^2 (total flux) from both permanent and electro-magnet, is in the ratio of 25 to 10,025. Dividing 10,025 by 25 gives the ratio factor of 401, as will be seen. The above results could, however, be obtained only under ideal conditions.

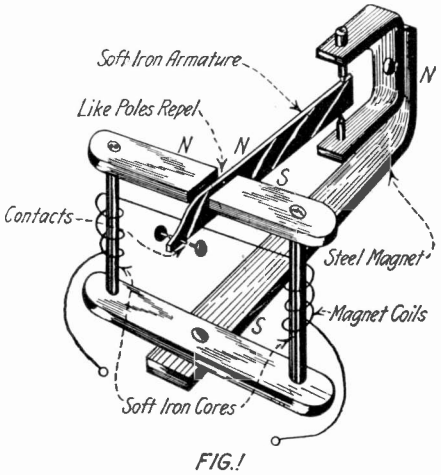


FIG.1

Ordinary Type of Polarized Relay.

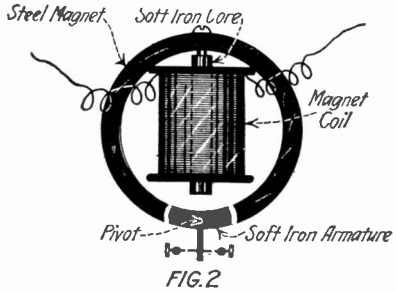


FIG.2

Balanced Polarized Relay Which Responds to Current in Either Direction.

How the Ouija Board Works

(1193) Mark C. Malamphy, Pittsburgh, Pa., asks:

Q. 1. Please give the scientific explanation for the operation of the ouija board.

A. 1. Regarding the scientific explanation for the operation of the ouija board, we would say that there is none. The writer has yet to see a ouija board which can be operated so as to spell coherent words and phrases when both individuals who are operating the board are properly blindfolded. If the board had a peculiar property of communicating with the occult, such simple blindfolding could not in any way influence its integrity or operation.

Q. 2. Do any of the methods of communication demonstrate its existence?

A. 2. We cannot definitely assert that any method of communication, whether thru the agency of a ouija board or any other means, bears upon the actual demonstration of the possibility of communicating with departed spirits or whether such manifestations are dependent directly upon the materializations of the subconscious mind.

Sneeze and Itch Powders

(1194) Norman MacDonald, Duluth, Minn., asks:

Q. 1. Please give the formula for sneeze powder.

A. 1. The following will make a very good "sneezing" powder:

Orris root	1 oz.
Bayherry bark	1 oz.
Soap bark	2 ozs.
Wild ginger	1 oz.

Q. 2. I also would like a very cheap "itch" powder.

A. 1. The following one is very good: Allow roses to come to seed after the flowers have withered. Dry these buds, remove the envelope coverings of the seeds and powder them.

Size of Wheel vs. Speed

(1195) F. D. Moriarty, Augusta, Kan., asks:

Q. 1. In two motor cars, motor car A has wheels the same size in front as at the rear; car B has wheels the same size as car A behind, but has smaller wheels in front; is there the slightest difference in the speed of the two cars?

A. 1. All other factors being the same, the difference in speed between the two cars would not even be measured simply because of the fact that, regardless of how accurately both cars were made, the motors in either car would not perform exactly the same, or if the same, would not perform identically in two successive trials. Theoretically, however, the car with the larger wheels in front will have less resistance upon the axles and will pass over obstacles better, and, therefore, might be able to go faster. Candidly speaking, we do not believe that this difference will ever be determined in gasoline vehicles.

Wash Drawings

(1196) Eric Monro, Boston, Mass., asks:

Q. 1. In your magazine you often use drawings—will you please tell me the usual size of these?

A. 1. Our wash drawings vary in size; some of these are 60 inches long and 50 inches high, and others are only 12 or 14 inches long and proportionately high. The size depends entirely on the amount of work which must be enclosed in the space allotted. Thus, if the artist must form many detailed sketches, it is much easier for him to work on a large drawing than on a smaller one. Inasmuch as the drawing is made to reduce to the proper size to scale, so that it will fit upon the page or a part of the page, there is no difficulty at all in handling different size drawings. You can, for instance, take any of the drawings in our magazine and increase them to any size desired. They will automatically come up proportionately.

Hardening Aluminum, Gas Engine Inquiry and Perpetual Motion

(1197) A. Shrama, Boston, Mass., asks:

Q. 1. How can I harden or temper aluminum?

A. 1. It is possible to harden aluminum and copper by only one method and that is to make an alloy or composition of it with some other metal. An alloy of 95 parts aluminum, 5 parts copper becomes so hard that it can be machined with difficulty only.

Q. 2. Do you think it possible to make a gasoline engine to give 10,000 revolutions per minute.

A. 2. We doubt very much whether it will ever be possible to produce a small gasoline engine capable of giving 10,000 revolutions per minute, unless the inventor designs a practical gasoline turbine. A turbine on the principle of the Tesla turbine might be constructed to give just such an effect.

Q. 3. How would you advise me to go to work in constructing a perpetual motion machine?

A. 3. It is our opinion that a perpetual motion machine will never be possible, and, therefore, we can give you no suggestion as to how it should be made.

Incandescent Gas Mantle Construction

(1198) W. J. Ratchford, Halifax, N. S., Canada, asks:

Q. 1. How are incandescent gas mantles made?

A. 1. Mantles are made after processes differing but slightly from the original method employed by Welsbach, which depends upon the impregnation of vegetable fiber wicks with certain mineral oxides in solution, drying out and arranging on the holder. One solution is as follows:

Lanthanum oxide	3 parts
Yttrium oxide	2 parts
Burnt magnesia	5 parts
Acetic acid	5 parts
Distilled water	10 parts

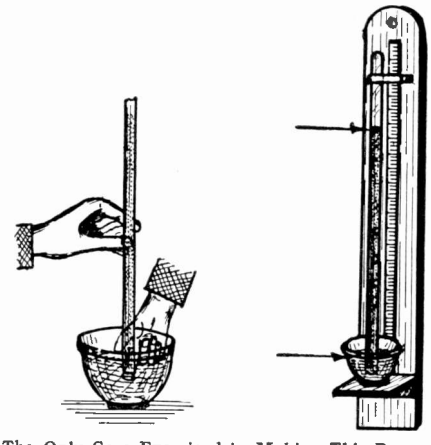
The oxides, which are procurable at any large wholesale drug supply house, are mixed in the water, the acid is added, and to the mixture 15 more parts of distilled water are added. The whole is then filtered. The vegetable fiber in a knitted or woven form is then impregnated with the solution and dried.

The acetic acid may be replaced by nitric acid. The latter seems to have some advantages over the former.

Mercurial Barometer

(1199) Harland S. Mardon, Bangor, Me., asks:

Q. 1. What is necessary in constructing a mercurial barometer?



The Only Care Exercised in Making This Barometer is to Prevent the Leakage of Air in Inverting the Tube.

A. 1. There are but a few materials necessary for making a mercury barometer. A glass tube about 5 m.m. upward in diameter is first required. It should be at least 36 inches long, a meter stick and a bowl of mercury are all the other additons.

Q. 2. How can I construct a barometer?

A. 2. A glass tube, about 36 inches long, sealed at one end, is completely filled with mercury so that there are no air bubbles in the tube. It is quite difficult to get rid of the bubbles. A finger is placed over the open end of the mercury tube which is then turned upside down in a bowl of mercury. Due to the weight of the mercury in the tube, a vacuum will be formed in its upper end, this space will be about 6 inches long. Measurements are taken from the top of the mercury in the bowl to the height of the mercury in the tube.

Q. 3. What is the price of mercury?

A. 3. Inasmuch as the market price of mercury varies so greatly, we regret that we cannot inform you of its present price.

Cancer Cure and Hughes Balance

(1200) Mr. Joseph S. Wiedman, asks:

Q. 1. Do you know whether cancer can be cured by tea or innoculation,

A. 1. We know of no method of curing cancer by tea or innoculation, and we also know definitely that such methods are absolutely impossible. Up to the present time cancer has been treated successfully in only a few ways: First, by complete excision; secondly, by radium; thirdly, by X-ray. To a slight extent it has improved under ultra-violet ray, electricity or sun ray treatments.

Q. 2. How can I construct an ore locater or Hughes balance?

A. 2. A Hughes balance may be easily constructed by following directions given in the June, 1920, December, 1920, and the August, 1921, issues of this magazine.

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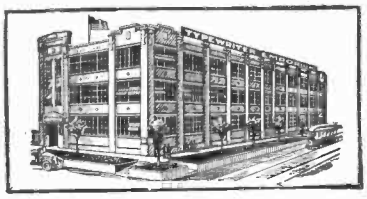

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Einstein On The Screen

By EDWIN HAYNES

(*Continued from page* 1117)

effected in a simple manner. A hollow brass tube was bent into the form of an interrogation point. The large part of the form, when inserted in the balloon, preserved the full diameter of the sphere at its vertical axis; the stem, extended from the opening into the balloon, served as a point of attachment for connecting it with a reservoir containing compressed air under control. After the balloon was inflated a map of the western hemisphere was painted on one side, as the sphere is made to represent the earth, and a position given it about six inches in front of a black velvet background. When taking pictures, the decorated glass plates were made to move in the same directions, as in the photographing of the flying brick, in order to give apparent motion to the sphere. As the balloon was deflated automatically at a rate determined by experiment it was not necessary to take stop pictures as in the other instance. The gradual collapse of the balloon into a decreasing double convex towards its vertical axial line, and its apparent movement through celestial regions, gives the impression that it is contracting during its flight through interstellar spaces. When the sphere reached its maximum of deflation it was again inflated, the map of the western hemisphere painted on the opposite side and a sequence of pictures taken as it seemingly continued its flight in the same direction with a gradually increasing convexity until it again becomes a complete sphere.

In one sequence of scenes an old man, seated on a curbstone, who is endeavoring to get understanding of the Einstein theory from a book on the subject, and who has been indulging too freely in home brew, is depicted as becoming subject to the illusion of houses telescoping into themselves. This illusion which is uncanny in its effect, is produced by partly covering the lens of the camera and making use of the device known in motion picture photography as double exposure.

The magic of the camera is best exemplified in the illusion produced of an automobile being contracted in its longitudinal dimensions. It is pictured as standing in the street unoccupied. All at once it begins to shorten at each end toward its median line, and after reaching its maximum contraction, continues subject to the hypothetical force, termed time-speed, until the car is completely reversed. The unusual occurrence produces great excitement. To chance observers it is a mysterious and awesome phenomenon. A policeman arriving on the scene is aroused from an habitual condition of torpidity into great activity. The owner of the car assures the others that what has happened is only every day "Einstein stuff."

REGARDING MUSICAL EXPLOSIVES IN FEBRUARY NUMBER

We publisht an article by Arthur Kaye which credited Major Harold C. Woodward, late of the U. S. Army, with the idea of detonating explosives by sounding a musical note in the vicinity.

We are informed by one of our readers, Mr. R. G. Bickford, of Newport News, Va., that he has first hand knowledge that this idea was first tried in 1916 by Lieutenant Decker, U. S. A., who was then stationed at Fortress Monroe. Lieutenant Decker is a native of Texas and had carried out a large number of experiments, says Mr. Bickford, in connection with the destruction of vessels by both wireless and music.

Go as High as You Like

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

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The airplane industry is going forward by leaps and bounds. Transportation—passenger carrying and mail carrying lines are being opened up everywhere. This means men—men—men! Trained men only are wanted—men who know what's what. Get ready now to make big money. The industry is calling for real red-blooded fellows—heed the call—*now* is the time to get started—while the industry is still in its infancy.

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Fortunes from Little Things

By CHARLES FREDERICK CARTER

(*Continued from page* 1125)

drew it thru a folded strip of paper bearing the igniting compound. After cooling your burned fingers sufficiently by stuffing them in your mouth, you went without a smoke or borrowed a match.

According to the traditions of the industry the book match was first used in something like its present form in Europe. Whether the idea was imported or not, the Diamond Match Company definitely set to work about 1897 to develop a machine, which would produce book matches on a commercial scale. Michael Paridon, of Akron, O., who is now a pensioner of the Diamond Match Company, is credited with being "the greatest personal power and inventive genius of the book match." Unemotional patent office reports name C. H. Palmer and J. W. Denmead, of Akron, as the inventors of the book match machine which seems to have been the first commercially practicable one. Patents granted in the United States and Great Britain were assigned when issued in 1899 to the Diamond Match Company.

This machine upon being fed cardboard, match composition and wire, would cut off pieces of cardboard, cut each end into combs of ten teeth each, fold the strip in the middle so as to bring the ends of the teeth together, dip them in the match composition, wire the doubled strip in a cover and affix the striking composition to one side of the cover and eject the finished product. Two years later the same pair who invented a number of important machines connected with the match industry, all of which were assigned to the match trust, produced a printing press which made it possible to print on each individual match as well as on the cover.

For some reason, probably because he wanted to sell and it wanted to buy, the Match Trust bought out the match manufacturing business of H. C. Traute. A part of the bargain was that the Trust should provide a job for Traute. That gentleman did chores for a while. Then, one day, the vice president in charge of sales, opened a drawer in his desk, picked out a book of matches, then an orphan product neglected by everybody, tossed it to Traute, and told him to see what he could do with it.

What Traute saw was an advertising novelty with possibilities which so astonished the vice president that he has not recovered yet. Orders came in so fast that S. O. S. calls had to be sent out for more machines to make the books. Then a new factory had to be built in which to make book matches. Traute increased his sales force, and then he was set up in housekeeping in an establishment all his own. So far his matches are for advertising purposes only.

Today three factories are going full tilt on book matches, and Traute is openly threatening to push the standard match end of the business into second place. He pretends to be joking, but the way timber is disappearing, the time is not so distant when a substitute for the standard match will have to be found.

According to the best available information the total output of book matches must be about 665,000,000 books annually. Patents have expired, so anybody who wants to do so and has the money and can find the customers can make book matches. Numerous small factories are springing up, some with a very limited output. A newly patented package sold as a "book match" for advertising purposes is not a book match at all, but merely a container for 20 ordinary safety matches.

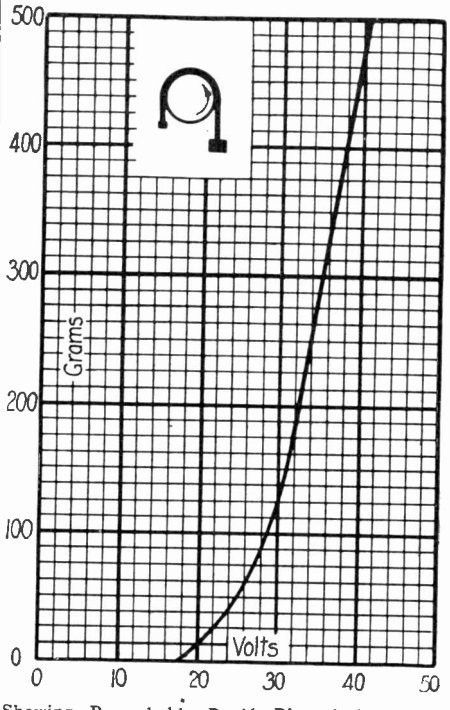
Stones That Talk

By DR. ALFRED GRADENWITZ

(*Continued from page* 1122)

slab. One especially striking experiment showed less than 1/10 watt to be expended for retaining a weight of 5 kgs., or 11 lbs. This is one three-hundredth part of the electrical energy used by a standard 25 candle-power incandescent lamp.

Radio Telephony From and to Railway Trains—Messrs. Huth have, on an experimental line in the neighborhood of Berlin, developed this system to such a point that any subscriber to the Greater Berlin telephone system will readily put himself into connection with travellers in the train, and



Showing Remarkably Rapid Rise of Attractive Force With Voltage Applied in the Case of a Stone Cylinder

vice versa. Electrical waves of moderate length, though small energy, are generated at one of the terminal stations of the railway line. These are transmitted to conductors serving for ordinary telegraphy and telephony along the railway track. The train carries on the roof of one or more cars a very low antenna in the form of a few wires insulated from and stretched out in the immediate vicinity of the car roof. The antenna is connected to a small radio telephone sender (-receiver) of a few watts energy, *the same antenna being used simultaneously for talking and listening*. The traveller, of course, uses an ordinary telephone, such as he is wonted to use at home. The electric waves coming from

the railway terminus and passing along the line are transmitted to the antenna of the train, in order thus to reach the receiving apparatus on the latter. The electric waves starting from the antenna of the train, on the other hand, after receiving the imprint of the talker's speech, are in a similar way transmitted by radio to the railway terminus, in order there to be transformed into normal telephone currents and thus to enter the local telephone system. Inasmuch as the electric currents reaching the train or starting therefrom are rather weak, a most sensitive relay is required to actuate the call bell or call lamp at both ends.

High Frequency Telephony and Telegraphy on High Tension Conductors—The same system of directed radio ("wired wireless") has lately come into extensive use in connection with power plants, allowing, as it does at any time, a communication to be most rapidly established, e. g., between the generating station and its substations in case of disturbance, without any special telephone line, the electric waves being made to travel along the high tension conductors. Messrs. Huth have installed such apparatus, using their new highly sensitive relays in a number of great power plants in Germany and Switzerland. The same possibility of "wired wireless" is found in the case of existing telegraph or telephone lines.

Normal Radio Telegraphy and Telephony—There are many possibilities in store for the new relay even in connection with normal radio telegraphy and telephony, e. g., for calling up ships in the same manner as in the case of wired telephony, so that, at least on small steamers, there is no need for the services of a permanent telegraphist to take care of the ship station. Ships in case of danger can be warned automatically.

High Speed Telegraph Recorders—Apart from the relay using stone slabs and metal plates, Messrs. Huth have developed apparatus comprising cylindrical stones or metal conductors. In such cases it is generally the stone (agate) which has the form of a cylinder. The first apparatus of this kind is a High Speed Telegraph Apparatus able to record and re-transmit Morse signals at enormous speeds, though the telegraph currents may be extremely small (1/100,000 amp.), so that the resistance of the line is of no importance and extremely thin wires (with a corresponding saving of material) can be adopted. Moreover, the speed of working can be raised to figures so far inaccessible (2000 letters per minute), without any prejudice to the distinctness of type, no matter whether wired or wireless operation is used.

Another interesting application is the construction of *loud-speaking telephones*, where the stone cylinder system actuates a membrane in accordance with fluctuations of the current supplied. Dr. Rottgardt in this connection treated us to some remarkable musical performances, viz., an orchestra playing on the roof (and symbolized by a single violinist or flutist) or a gramophone installed in some distant part of the building. It is expected to arrange a music transmission service enabling any telephone subscriber at given hours to treat his guests either to classical or to dancing music. Wireless transmission of talk and music has recently been effected with a 1 K.W. transmitter designed by Messrs. Huth between the premises of the firm and places in Sweden, in the Isle of Borkum, in Rotterdam and elsewhere, to a distance of 6-800 kms (×.62 mi. = 496.00 miles max.). Inasmuch as the acoustic intensity in this connection was considerable, the upper limit had not yet been reached.

There are many other devices based on the use of the new relay which have already been developed beyond the experimental stage, e. g., talking films, electrically operated typewriters, etc.

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

(*Continued from page* 1130)

If these bubbles are collected and tested they will be found to be hydrogen. Now this is due to the fact that copper sulfate, being the salt of a strong acid and a weak base, reacts with water to form a small quantity of sulfuric acid. And this acid acts upon the zinc to form hydrogen.

Place a strip of blue litmus paper in copper sulfate solution and it will turn red, showing the presence of an acid.

Action of Sodium Carbonate: In a solution of sodium carbonate place a piece of red litmus paper and a strong basic reaction will be obtained. In fact you would suspect, if you did not know it, that you were dealing with a pure base.

Sodium carbonate, being the salt of a strong base and a weak acid, reacts with water to form a small quantity of sodium hydroxide and therefore gives a basic reaction.

Action of Sodium Chloride: Upon testing a solution of sodium chloride with both kinds of litmus paper you will find that it is perfectly neutral. This is because sodium chloride is the salt both of a strong base and a strong acid.

If you wish to do a small piece of research work, you may test in this way all of the salts in your laboratory and discover which undergo this hydrolysis action and which do not. You will be surprised to find the large number of them that are either acid or basic.

Soap, which is the salt of a strong base and a weak acid, always undergoes hydrolysis and gives a basic reaction. Its cleansing action is partially due to this fact.

Preparation of Pure Sodium Chloride: Although sodium chloride is prepared chemically by one or more of the methods already described, the chemically pure salt is usually obtained in the following way:

Pulverize some rock salt and make a saturated solution of about 300 or 400 cc. Since sodium chloride is not much more soluble at high temperature than it is at low temperature, this must be done by shaking or stirring the pulverized salt with the water.

Then set up apparatus as shown in Figure 2. The generator is for hydrochloric acid. Place in the flask some ordinary table salt and cover it with a 2 to 1 solution of sulfuric acid. Heat the flask and pass the hydrochloric acid gas into the solution of rock salt. Almost immediately a white chemically pure precipitate of sodium chloride is thrown down. When the action seems to have ceased allow the salt to settle and then, pouring off the bulk of the clear liquid, filter the remainder. Wash the residue on the filter paper with distilled water containing a little hydrochloric acid, using repeated small portions. Then allow the chemically pure product to dry.

Preparation of Sodium Bicarbonate: This substance is of great commercial importance and the Solvay method of preparing it is as follows:

Set up apparatus as shown in Figure 3. In the generator place marble chips and in the small cylinder a saturated solution of sodium chloride in the strongest ammonia water, i. e., dissolve the salt in ammonia water.

Then pour dilute hydrochloric acid on the marble and pass the resulting carbon dioxide gas into the sodium chloride-ammonia solution for a considerable period. After a time a white precipitate of sodium bicarbonate will be thrown down. Ammonium bicarbonate at first forms and this reacts with the sodium chloride to form sodium bicarbonate.

Automatic Train Control

By C. S. CORRIGAN, C. E.

(*Continued from page* 1112)

genious inventions. To inventors I would say, "Let them be simple." In their 1908 report the committee told of having examined 371 devices, of which only 12 showed merit, then went on to say: "The ingenuity of train-control inventors has usually resulted in apparatus much more complicated than can be superimposed on existing block signal systems."

There are three general classes of control devices. 1st, those operated by mechanically or electrically controlled trips, overhead, or at the ground as shown in our picture. 2d, those operated electrically by induction magnets or electric contact, and 3d, those operated by wireless.

The principal objection made to the first class is that the tripping mechanism is liable to freeze up and be blocked by snow and ice in winter; this is very much overstressed, as there are few days in the north and none at all in the south when this would occur. Most inventors fix up control devices that do not work or give any indication except when tested; these are in a class with life preservers and fire extinguishers and liable to be out of order when most needed. They are wrong in principle, for it is of vital importance that any signal apparatus out of order shall tell on itself by giving the danger signal. Any train control device should always prevent a train from moving at high speed after passing a caution signal, as well as stopping it at a danger signal. The ideal system would record the position of all signals whether at clear, caution or danger. It can be seen that reliability is of prime importance, a stop device must not say "wolf" when there is no "wolf," as enginemen would find some way to disregard it and it would soon lead to disaster.

Continuous track circuit is free from patent, so can be used everywhere; it works continuously and is valuable in telling of broken rails and other dangers, but is rather expensive for railroads having only two or four trains a day, so a cheap and simple device to be attached to interlocking and train order signals should be invented, for a large proportion of the collisions we wish to prevent occur on these light traffic roads.

Considering the rapid development in wireless, and of the means it presents of operating and steering torpedoes, aircraft and boats, I believe a cheap and reliable system of wireless train control can be devised. It should consist of automatic sending sets to be attached to all signals and switch indicators, and to front and rear-end train signals, and be capable of recording the position of said signals on the signal indicator of any engine that came within a prescribed distance. The indicator on the engine would have to be proof against interference from ordinary wireless sets, it should show the position of all signals being approached, and have automatic means for setting the brakes when passing a danger signal, or approaching too close to the front or rear signals of another train, unless that train was on the siding and its signals set at clear. In place of solenoids or relays depending on clean contact points, the break operating mechanism might include a gas chamber with a spark plug that would operate by wireless to explode the gas and set the brakes.

Ordinary message sending and receiving sets on locomotive and caboose, and in stations and interlocking plants would add to the safety and facilitate giving train orders, the extra men provided by the full crew laws could act as radio operators and so make themselves useful as well as ornamental.

In 1901 a series of bad crossing collisions made the Texas Legislature pass a law that all grade crossings in Texas be protected by interlocking within one year. The Southern Pacific Co., wishing to comply with the order, put me in charge of all signal work on the various lines controlled by them, so all our crossings were finished on time. As president of the Texas Signal Club, I did a great deal to influence other roads to obey the order, but a number of the roads objected and fought the order on the ground of insufficient time, altho only four derails and four signals, such as we installed in a month, were required; some pretended they were going to change to non-grade crossings, others objected on account of cost of operation, so there were repeated delays and extensions of time, while the loss in human life and in property cost the railroads 100 times what it would have cost to have obeyed the original order, and then left their contemplated changes and improvements to be made later.

So it will be with the automatic train control order. Any postponement or delay in deciding on the proper system, or in finding a cheaper or better system is going to cost the railroads 100 times more in accidents, than any loss they will be likely to suffer in changing the system later.

Three years before President Spencer of the Southern R.R. was killed in a rear-end collision, I had urged him to install automatic block signals, but he contended that the telegraph block was best, and said he would personally pay the difference in cost on account of accidents. He did pay a part of it, but seven others were killed at the same time; now the whole road is protected by automatic block signals.

If it was provided by law that the cost of all accidents shall be paid out of profits, instead of being added to the cost of operation, every railroad in the country would have automatic block signals, automatic train control, and many other safety devices in less than a year.

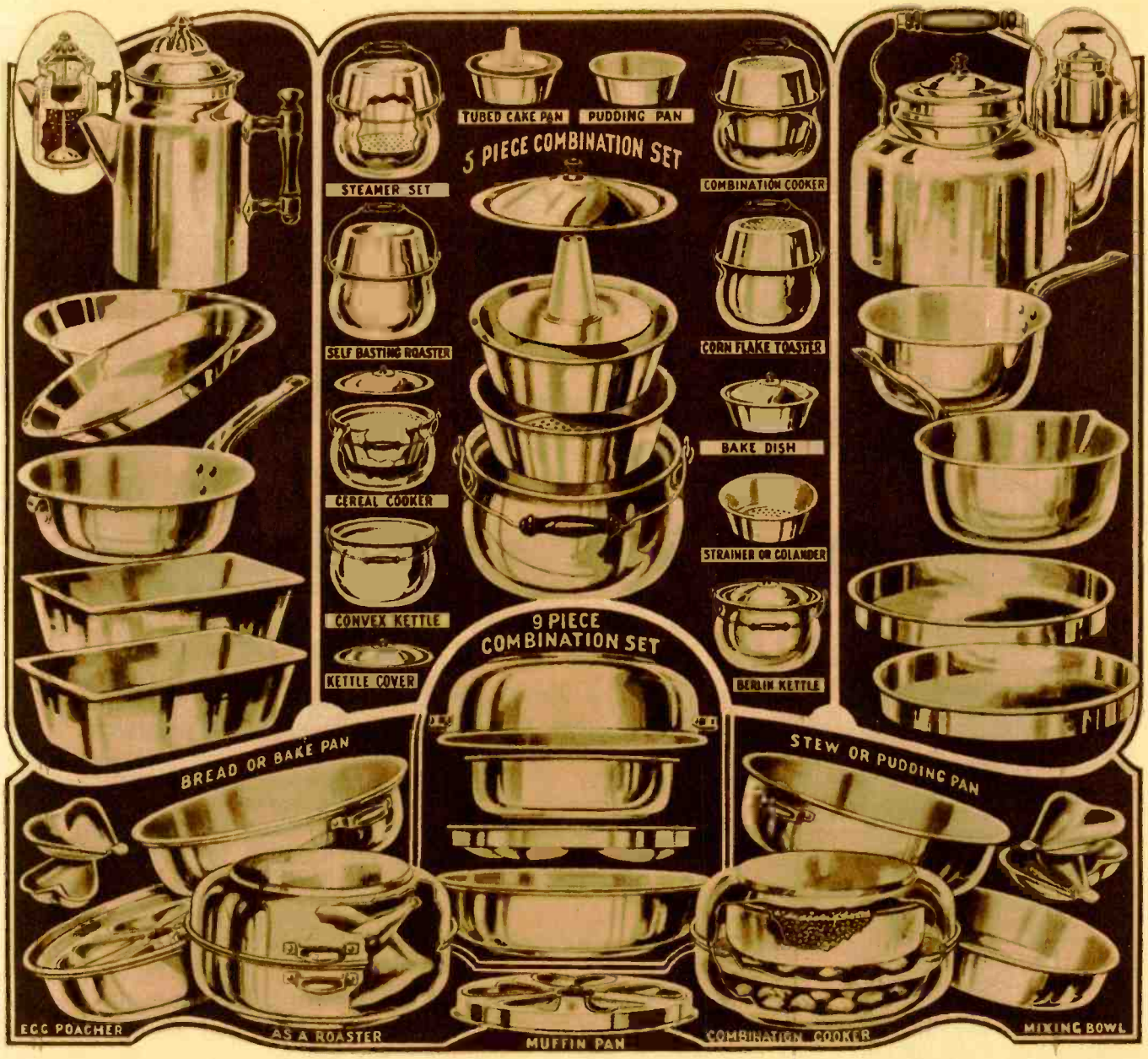
In the meantime let the thousands on thousands who have been injured and the relatives of the thousands who have been killed, impress on the Interstate Commerce Commission, that if they allow this order to be disobeyed or postponed, they, as well as the railroads, will be held responsible for the murders by negligence that are sure to follow.

Pilotless Plane Crosses English Channel

(*Continued from page* 1109)

shows the control cables of stranded steel as arranged in standard aircraft, and the control column and wheel in front of the pilot's seat is also the one standardized and generally employed. The pilot pulls or pushes on the wheel column to raise and lower the horizontal rudders; swings the vertical rudder to right or left or vice versa, by means of the steel cables connected to the pivoted foot lever; while the ailerons or pivoted wing members at the rear wing tips are raised and lowered by turning the wheel mounted at the top of the pivoted steering column, the aileron cable being fastened to a drum mounted on the same shaft as the control wheel.

Any form of automatic product for airplanes or dirigible airships are invariably arranged, or should be, so that if they get out of order at any instant the pilot can, by simply pulling a lever or pressing a button, instantly cause the automatic steering device to cease acting and return the control actions to his full personal charge by means of the steering wheel and joy stick.



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Madam: *The biggest bargain in years!* A complete set of genuine "Lifetime Ware" Aluminum, each utensil stamped with the manufacturer's brand; heavy gauge, extra hard, pressed sheet, *seamless* aluminum—and at a price *less* than is asked by others today for thin ordinary aluminum ware! We, ourselves, had to charge $23.90 for a set like this only a few months ago; but now on a special factory offer we have **smashed the price to $13.90** (on easy monthly payments), *lower than pre-war prices* on aluminum ware of this grade. This is an exclusive offer to Straus & Schram customers by special arrangement with the factory. We had the cash; they needed business to keep their employees working—that's how we can make you this amazing price-smashing offer.

LIFETIME WARE DIAMOND BRAND SANITARY BRIGHT DURABLE PURE ALUMINUM

Notice: Some sets offered for sale are made of cheap, soft aluminum which bends easily, dents with every fall or knock and is not durable. The set offered here is made of genuine pure sheet aluminum, heavy gauge and extra hard. Guaranteed "Lifetime Ware."

Everything in the Kitchen of Pure Aluminum—28 Pieces Combination tea kettle and double boiler (3 pieces) 5-quart size, 8 1-4 inch inside, with a double boiler 2-quart capacity; one Colonial design coffee percolator (2 pieces) 8-cup size with welded spout, dome cover, fully polished; one roaster consisting of 9 pieces, measures 10 1-2 inches wide and 6 inches high. These 9 pieces have dozens of different uses, some shown in illustration, including bread or bake pan (7 pint capacity); stew or pudding pan (7 pint capacity); pudding pan or mixing bowl (4 pint capacity); egg poacher (5 eggs at a time); muffin pan; biscuit baker with 6 custard cups or jelly moulds; deep locking self-basting roaster, double boiler cereal cooker or triple steamer. The outfit also includes 2 bread pans, 1 lip stew pan (1 quart capacity), 1 lip stew pan (1 1-2 quart capacity). Two 9-inch pie plates; two 9 1-2 inch extra deep cake pans; one colander with 9 inch top, 5 1-8 inch bottom and 2 1-4 inch depth (can also be used as a steamer). 5-piece combination set, having 12 different uses as shown in illustration, consists of 6 quart convex kettle with cover, 2 quart cake and pudding pan with cake tube; strainer or colander. Shipping weight about 15 lbs. **All pieces (except the pie plates and bread pans) are highly polished, made of genuine pure sheet aluminum, extra hard, absolutely guaranteed the famous "LifetimeWare."**

Order by No. A6729A. Send $1.00 with order, $1.50 monthly: Price, 28 pieces, $13.90.

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Only $1.00 down brings the set to your home for thirty days' trial. See how it cooks and bakes better than any other kitchen ware, heats quickly, will not crack, chip or peel, polish can't wear off. If not perfectly satisfied, return the set at our expense within 30 days and we will refund your $1 plus any express charges you pay. If satisfied, start making small payments of $1.50 a month until you have paid $13.90 in all. We trust honest people anywhere in the U.S. No discount for cash; nothing extra for credit. No C. O. D.

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Enclosed find $1.00. Ship special advertised 28-piece Aluminum Kitchen Set. I am to have 30 days' trial. If I keep the set I will pay you $1.50 monthly. If not satisfied, I am to return the set within 30 days and you are to refund my money and any freight or express charges I paid.

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If you ONLY want catalog, put X below:

☐ Furniture, Stoves, Jewelry ☐ Men's, Women's, Children's Clothing

A 200-Year Calendar

(*Continued from page 1137*)

vember is reached; move on that line to the right until we find Thursday, and then up that column, and we find that the last Thursday in the month is on the 26th.

Next we may wish to determine the names of the days of the week on which the first day of each month will fall in the year 1925. Locating 1925, we again travel downward in that column to the table of months; then turn to the right and in the corresponding columns in the very first row we find the week days desired. In February, March and November, the first falls on Sunday; in June on Monday; in September and December on Tuesday; in April and July on Wednesday; in January and October on Thursday; in May on Friday, and in August on Saturday. This chart may similarly be used to locate past events.

As a novel addition, the use of a watch as a calendar will be found quite satisfactory. On your watch dial write or print the factors shown immediately under the numerals. The twelve hours on the face of the watch represent the twelve months of the year. One is January, two February, three March, and so on until as we come to December, which is twelve o'clock and also the twelfth month. You now have the calendar completed.

Here are a few examples of its use. Suppose you wish to find the day of the week on which a certain date occurs. We take the date and add to it its factor dependent of course upon the month, divide by seven, and we get the day of the week by the remainder. One as a remainder, represents Sunday, two Monday, three is Tuesday, and if the remainder is zero or seven, the day of the week is Saturday. Should the sum of the factor and the date be less than seven, it is regarded as the remainder.

Example; Upon what day of the week does February 22, 1922, fall? To the date 22 we add the factor of February, which, according to our watch, is 3. This sum is 25. Dividing by 7 we have 4 as the remainder, and 4 being the fourth day of the week counting Sunday as the first, we find that the date falls on Wednesday. Similarly, we can locate, let us say, October 3, 1922. The date is 3, to which we add the factor of the month of October, found alongside of the figure 10 on the watch, which is zero in this case. The total is, of course, 3. Inasmuch as the sum is less than 7 we regard it as the remainder. Hence October 3 falls on Tuesday.

To find the date of a given day in the week, we reverse the order by first subtracting the factor from the number of the day of the week. The remainder shows the date of that day in the first week of the month. Here again if the number of the day of the week is smaller than the factor, we add seven before subtracting. For instance, what date is Friday in the month of June, 1922. Friday is the sixth day in the week; from this we subtract the factor 4, the remainder is 2. That is the date of the first Friday in June, and hence the others are the 9th, 16th, 23d and 30th.

Let us take another example: What are the dates of the Mondays in July? Monday being the second day of the week, and the factor of July being 6, which is larger than the numeral assigned to Monday, we add seven first before subtracting the factor. We then have 2 plus 7, equal to 9; we now subtract the factor 6. Six from 9 is equal to 3. Hence the first Monday in July falls on the 3d, and others are the 10th, 17th, 24th and 31st respectively.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page* 1127)

with the star, but for some reason does not share in the spectral shift of the other elements, possibly owing to the fact that it is at a level in the star's atmosphere that is not affected by the cause that produces a shift in the lines of other elements. If the first theory is the correct one the presence of vast non-luminous clouds of matter in the universe must be far more general than we have formerly had reason to believe. The chances of collision of star with nebula would be greatly increased and such collisions are believed by some to be the cause of the temporary outbursts of new stars or novæ. There is no doubt that such stars are surrounded by a nebulous envelope soon after their outbursts, though of course, the nebula observed may be the product of the catastrophe rather than its cause.

It appears more probable that dark nebulæ are composed of dust particles finely divided rather than of clouds of gas, that is that they are meteoric in their composition. There is abundant evidence of the existence of finely divided meteoric matter within the solar system. The earth is encountering millions of meteoric dust particles daily and it is known that clouds of such particles in the solar system produce the effect of the zodiacal light. Possibly these meteoric particles are of the nature of cosmical dust drifting through space and swept up by our solar system in its journey through the universe. In some parts of space these particles may be gathered into cloud-like masses sufficiently dense to obstruct the passage of light. There may be included in these clouds, also, some meteoric masses of exceptional size, similar to the meteorites that penetrate the earth's atmosphere occasionally, weighing many hundred pounds, or even tons, and in addition a few masses of the size of asteroids or small planets. The encounter of a star, with one of the larger members of such a meteoric cloud, might result in the outburst of a nova, as has been suggested by some astronomers.

Though the nature and origin of these dark markings in the sky are still in doubt there can be no question that they have an actual objective existence and are not merely vacant spaces or holes in the denser portions of the Milky Way through which we may look into more distant regions, as was formerly believed. Dark stars may exist in great numbers in space and remain undetected because of their small size or feeble attraction for neighboring stars, but no dark object of the size of the coal sack in Centaurus or the dark lanes in the Trifid nebula or the sharply defined dark objects in Orion could escape our eyes when thrown in relief against their luminous surroundings. A study of the structure and distribution of these objects may have a direct bearing upon the subject of the form and structure of the universe and possibly of the evolution of the stars as well. Possibly these dark markings are the stuff from which future worlds are to be formed or they may be the remnants of past worlds.

NEW FISH CLEANER

James J. Barry, of Boston, is marketing a unique invention, a machine that strips the skin from fish and removes all the bones.

The Barry contraption is about the size of a washing machine. It handles 25,000 pounds of fish a day.

Twenty-two workers are out of jobs wherever a Barry machine is installed. They are released for other productive work. Each machine like this saves labor and in the long run raises the standard of living, providing an ever-increasing variety of commodities for general use.

List of Radiophone Broadcasting Stations

(*Continued from page* 1148)

Sacramento, Calif., J. C. Hobrecht. Call letters, KVQ. 360 meters.

San Francisco, Calif. Leo J. Mayberg Co. Call letters, KDN. 365 meters.

Sunday, 10 to 11 A. M., Fairmont Hotel station.

Monday, 7 to 9 P. M., Presidio station.

Monday, 7:30 to 8:30 P. M., Los Altos station.

Monday, 8:30 to 9 P. M., Fairmont Hotel station.

Tuesday, 7:30 to 8:15 P. M., Hotel Oakland station.

Tuesday, 8.15 to 9 P. M., Radio Shop station, Sunnyvale.

Wednesday, 7:30 to 8:15 P. M., Harrold Laboratories, San Jose.

Thursday, 7:30 to 8:30 P. M., Fairmont Hotel station.

Thursday, 8:30 to 9 P. M., Los Altos station.

Friday, 7:30 to 8:15 P. M. Radio Shop station, Sunnyvale.

Friday, 8:15 to 9 P. M., Hotel Oakland station.

Saturday, 8:15 to 9 P. M., Fairmont Hotel station.

Every afternoon except Sunday, 3:30 to 4:30 P. M., Rockridge station of Atlantic-Pacific Radio Supplies Company. 360 meters. Call letters KZY. Concert.

Every night except Sunday, 6:45 to 7 P. M. Same station. General news, sports, foreign news.

Sunday, 11 A. M. to 12:15 P. M., sermon and sacred music. Same station*

3 to 4 P. M., same station. Concert.

4 to 5 P. M., same station. Concert*

*This station will carry the Sunday morning schedule of Trinity Center and the Sunday afternoon schedule of Colin B. Kennedy until these two stations are ready to carry their schedules shown for that day.

Wednesday, 7:30 to 8:15 P. M. Same station. Concert.

Saturday, 8:15 to 9 P. M. Same station. Concert.

Also the following, daily except Sunday:

7:10 to 7:20 P. M., Hotel Oakland station. General news.

7:20 to 7:30 P. M., Fairmont Hotel station. Market, bond and weather reports.

4:30 to 5:30, Fairmont Hotel station.

Until the California Theatre can make the necessary changes to operate on 360 meters, the Presidio will broadcast concerts on their schedule, Wednesday evenings, 8:15 to 9, and the Fairmont Hotel will run the full hour and a half from 7:30 to 9 P. M., on Saturdays.

The Fairmont Hotel, Los Altos, Hotel Oakland, and the Presidio are heard consistently up to 1,500 miles. Reports have been received from Alaska, British Columbia, Washington, Oregon, Nevada, Utah, Arizona, Montana, North Dakota, and practically all of the Northwestern states. Stations within a radius of two and three hundred miles are consistently receiving concerts from the above mentioned stations loudly enough to be heard all over the house.

San Francisco, Calif. Edwin J. Lorden. Call letters, KGB. 360 meters.

San Francisco, Calif. Station? Call letters, KUO. Wave length, 360 meters.

San Francisco, Calif. Radio Telephone shop. Call letters, KYY. 360 meters.

San Jose, Calif, Chas. D. Herrold. Call letters. KQW. 360 meters.

Schenectady, N. Y. Union College. Call letters, 2-XQ. Broadcasts program of interest to public. Music, church services.

Schenectady, N. Y. Station of the General Electric Co. Call letters, WGY. 360 meters. Heard 1,450 miles away at Santa Clara, Cuba. Impromptu program.

Seattle, Wash., Post-Intelligencer. Call letters? Wave length? Broadcasts programs of interest to public, including U. S. Public Health Service Lectures.

Seattle, Wash., Northern Radio Electric Co., call letters, KFC.

Springfield, Mass., Westinghouse station. Call letters, WBZ. 360 meters. Program varied See Newark WJZ program.

Stockton, Calif., C. O. Gould. Call letters, KJQ. 360 meters.

Stockton, Calif. Portable Wireless Tel. Co. Call letters, KWG. 360 meters.

Sunnyvale, Calif. The Radio Shop. Call letters, KJJ. 366 meters.

Toledo, Ohio, Marshall Gerken Co. Call letters, WHU. 360 meters.

Toledo, Ohio. Call letters, WHU. Station? Wave length?

Washington, D. C. Church of the Covenant. Call letters, WDH. Wave length, 360 meters.

Washington, D. C. Radio Construction Co. Call letters, WDW. 360 meters.

Washington, D. C. Station of the White & Boyer Co. Concerts with short lectures on radio and information of interest to amateurs. Planning to broadcast. Keith's vaudeville.

We will be glad to have any of our readers point out any discrepancies and errors in this list, which we know is far from complete. We will thank those of our readers who make additions giving us the wave length of the transmitting station, call letters, location of the concern and their distance from it. Address communications to Call Letter Editor.

A Simple Radiophone Receiver

By JAMES LEO McLAUGHLIN

(*Continued from page* 1141)

number each fastener from right to left, 1 to 9. Alongside of hole No. 1 push two fasteners with a paper clip underneath—mark GND (ground). One half inch down from GND, punch a small hole; this is the starting point of the coil.

Take the wire and push the end thru the hole. Wrap the end around one of the fasteners GND (on the inside of the container). Be sure that where the wire touches the fastener, the enamel has been scraped off or else a poor connection will result.

Next pull the wire tight and commence winding the coil. The total number of turns is seventy, and a tap is taken off at each of the following turns: The 15th, 20th, 25th, 30th, 35th, 40th, 45th, 55th and the 70th.

Fig. 1 shows how to tap the coil. The important things to look out for are that the coil is wound as tight as possible, and that the enamel is scraped off the wire, where it makes connection with the fasteners. The 15th turn is contact No. 1, the 20th No. 2, etc.

The next job is the switch that moves over the contacts. Fig. 2 shows how this is made. Take one of the large fasteners, push the ends thru the side of the cover, close to the lid. Bend one end down flush with the side and push the other end thru the top and bend over.

Put the cover back on the container and bend the end of the fastener so that it rides over the contacts easily, when the cover is turned, but be sure that it touches each of them. Break off the surplus end.

The other large fastener is pushed thru the lid opposite the switch and is bent, as shown in Fig. 2, so that it can hold the small crystal. A short piece of bare wire (about No. 24 will do), acts as the cat-whisker, a pin is fastened to one end and the other end is wrapped around the end of the switch—the part that is bent over (see Fig. 2).

Fig. 3 shows the diagram of connections and needs little comment.

The telephone receiver is a single Murdock without head band, and can be purchased for about $2.00. Of course any other kind may be substituted.

For the antenna one-half pound of No. 18 bare copper wire will do. This will give about 100 feet of wire. Two porcelain cleats will also be required and should not cost over 5 cents. The wire can be had for about 30 cents.

String the wire the greatest length possible, and attach outer end to a tree or other elevation, at least thirty feet high (see Fig. 4). The other end of the wire enters the house and is attached to the switch button marked ANT and a short piece of rubber tubing should be slipped over the wire where it passes through the wall of the building.

A good ground can be had by connecting a wire to the nearest gas or water pipe. Scrape the pipe for a length of about two inches, so that it shines, then wrap several turns of wire around it and twist tightly.

To operate the set, bend the cat-whisker wire so that the pin rests on the crystal. Move the pin over the surface until a signal is heard; at the same time move the switch over the contacts, and leave it on the one that brings in the station the loudest. With this set in New York City using only a single No. 24 wire, 25 feet long strung up in a room, WDY'S and WJZ'S concerts came in fine, and on several occasions, the phone could be held about six inches from the ear and still the music and voice could be distinguished.

The Radiophone Now a Household Necessity

By MRS. CHRISTINE FREDERICK

(*Continued from page* 1143)

agricultural activities, their industries, etc., should appear to view; let samples of Chinese music or songs, or a spoken fragment of Chinese language, then be heard. And the next day have the teachers "tie up" these visual and auditory images with a written test! Do you believe the children would then find geography "dull" or "uninteresting"? And could not many other studies be treated the same way? Particularly history.

I could write further at considerable length of the benefits of the radiophone to the woman and housekeeper. So often she is *lonely*, especially if she is a farmwoman or living in any remote district, where she feels cut off from city contact and amusement. For her I see a solution of the problem in the installation of such a set, because she will then be more in touch with outside interests than if she lived in the city itself. She will not need to take a half day's journey, spend considerable carfare, or take the time or effort usually required to attend a single concert or other form of amusement. Further, knowing women, as I do, I understand how they simply *want something* or want to go somewhere, after they have finished a tiring day's washing or been confined to the house all day, or have had their nerves scrambled by taking care of petulant children. In short, there are thousands of women practically shut-in because of their house duties, care of young children, etc., who never *have the time* to go a distance to secure change and a bit of recreation.

National Radio Broadcast by Bell System

(*Continued from page* 1144)

important centers thruout the United States by the American Telephone and Telegraph Company. As these additional stations are erected, they can be connected by the toll and long distance wires of the Bell system, so that from any central point the same news, music or other program can be sent out simultaneously thru all these stations by wire and wireless with the greatest possible economy and without interference.

Only on special national holidays or other occasions will all the broadcasting stations of the A. T. & T. system be tied together on the common telephone circuit, so as to have their vacuum tube transmitting sets operated by the original voice current from a central point, such as Brooklyn, or Washington, D. C., or some other city. Ordinarily, all broadcasting stations, say, at Philadelphia, Washington, Pittsburgh, Cincinnati, New Orleans and elsewhere will put out each its own concert and program of music, advertising, and other attractions. When these stations are fully developed according to the present ideas of the company's engineers, as explained in an interview with our radio editor, several different classes of entertainment will be broadcasted simultaneously on different wave lengths. So in the near future we will probably find ourselves calibrating our tuning condenser and variometer dials for different kinds of music and entertainment, such as dance music; church music; popular songs; advertisements; opera; popular plays, and so forth, instead of the now familiar circle graduation marks in degrees.

Radio Loud-Talkers

(*Continued from page* 1146)

so as to distribute the sound equally in all directions.

Phonographs Make Good Loud-Talkers

Many people are using their phonograph amplifying chambers as horns for radiophone loud-talkers with very good results. There are two general methods of doing this, as shown in the diagram at Fig. 4. The radio receivers, or at least one of them, are placed at the end of the tone-arm to take the place of the regular reproducer, or if this is not possible, owing to difficulty in removing the reproducer, the tone-arm may be unscrewed from the shelf, and the radio receiver placed facing downward over the opening into the amplifying chamber. It is preferable to place the receiver at the end of the tone-arm in the position previously occupied by the reproducer, as the metal tone-arm in most cases has a well defined taper to it, and the sound has a chance to swell out slowly, as the size of the tube gradually increases.

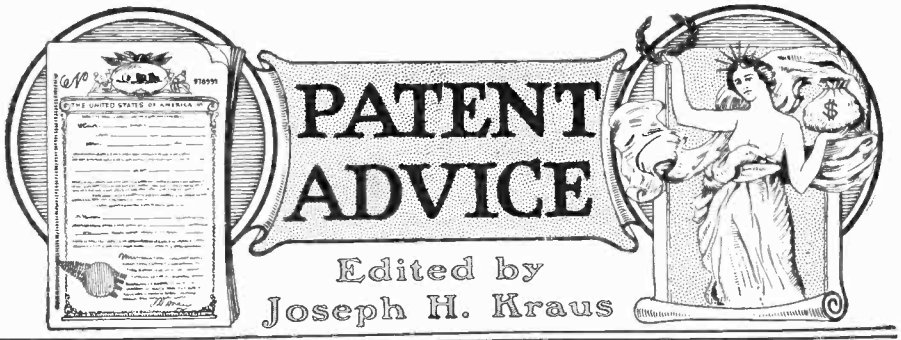
There is on the market at the present time a clever loud-talking horn fitted with two projecting openings at the base, having rubber gaskets against which the two receivers of a head set can fit tightly. This horn has been tried out and works very well indeed, especially if a sensitive pair of phones are used in conjunction with it, such as the Baldwin amplifying type or Brown phones. Calling on the phonograph once more, we see at Fig. 5, how a friend of the writer's successfully built his own duplex horn for use with a radio head set, the chamber at the base of the horn being formed of a wax phonograph record of the cylinder type, some of these generally being available from the attic storeroom. Of course this chamber, which joins the amplifying horn with the two receivers, may be formed of a piece of pipe, the heavier the better. A piece of water pipe, for example, would serve the purpose very well, and after cutting off a piece of the right length, only a single hole has to be drilled in the centre of one side, and the large horn fitted tightly into it by soldering or otherwise. If the phonograph record is used, the length will usually be found right for the average run of head phone sets and a felt or rubber gasket may be used between the receiver and the end of the record shell at either end. The joint between the horn and the record should be made thoroly air-tight by melting sealing or other wax around it.

Relaying Radio Music

It is frequently desirable to relay a part or all of the radiophone music or concert to another floor or room. The diagram at Fig. 6 shows how a loud-talking telephone circuit can be rigged up in conjunction with the radio receiver, a microphone being placed tightly against the radio receiver or one of a pair, which microphone is connected with four to six dry cells and a four to five ohm loud-speaking telephone receiver fitted with a horn. Ordinary bell wire may be used for the circuit between the microphone and the telephone receiver, but No. 14 wire is better if the run is of any considerable length.

There is at present on the market an ingenious loud-talker which is composed simply of a copper plated steel cone about ten inches in diameter and ten inches deep. Supported on a metal strip across the mouth of the cone is a receiver cap facing the exact centre of the cone, which is adapted to fit a Baldwin or other radio

(*Continued on page* 1177)



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Deaf Phone

(567) A. F. Katke, St. Paul, Minnesota, asks us if we do not think it a good idea to develop a telephone receiver small enough to be introduced into the ear for deaf or partially deaf people.

A. You have evidently never heard of the thermophone. This solves the problem which you have advanced. The instrument is already on the market; name and address will be forwarded upon receipt of stamped and addrest envelope. It is small enough to fit inside the ear.

Auto Lock

(568) B. J. Kline, New Haven, Connecticut, submits a sketch of an automobile lock which will permit the machine to travel one to two hundred feet before locking. He asks our advice on this and on financial matters.

A. The idea of an auto-theft prevention device which you have advanced is quite novel, and we would advise you to have a search made in the Patent Office files with a view to subsequent patent developments. You will find it rather difficult to place this device upon the market, however, and we would most assuredly advise that you attempt to get the necessary financial assistance before further developments are considered.

Pet-Cock Key

(569) John Kangas, Ely, Minnesota, submits a sketch of a wire key for turning off pet-cocks located in inaccessible places in automobiles.

A. Such a device as you suggest for turning pet-cocks on and off can be made in so many different forms that we believe the idea is too flexible and too imitative for a patent.

Nevertheless, if you feel certain that you can establish a good market for the tool, and if you will not miss the money such a patent would cost, a patent would protect you in the best manner.

Variable Speed Transmission

(570) Frank Kreimer, Marshall, Illinois, asks: "Do you think there is a market for a variable speed transmission device which I have designed?"

A. There are so many variable speed transmission devices on the market at the present time that we doubt whether the transmission device you have designed could ever find a ready sale, but in view of the fact that details regarding the construction of such a variable speed transmission has been omitted from your communication to us we are unable to give you definite counsel.

Telephone Message Recorder

(571) William H. Knapp, Battle Creek, Michigan, enters a drawing of a phonographic recording device to be used in conjunction with a telephone so that should anyone call while the parties are out the message is recorded on the phonograph. At the end of the dictation the machine stops.

A. We do not see anything vastly different in your idea from other ideas along the same lines. Up to the present time no very efficient device has been invented which would automatically release a phonograph record the instant a person starts talking.

When it comes to making attachments to the telephonic service, we believe that you will meet with great difficulties, as the telephone companies do not allow any attachments to their phones unless these considerably increase the efficiency of the phone service. It is obvious that your scheme will not do so. Therefore, you will immediately meet the opposition heretofore suggested. Your idea has not been developed fully enough by you to warrant further proceedings.

Gasoline Turbine

(572) W. J. Bingham St. Paul, Minn., claims he has designed a new exploding gas turbine. He requests a patent advice and asks whether we know of any individual who might be interested in financing the device (patent and model).

A. There have been a great many patents on turbines issued recently particularly of the combustion types. These turbines, with perhaps the exception of the Tesla gasoline turbine, have been far from efficient and, we doubt very much if you have built or designed your turbine so as to bring up the efficiency to the point even equaling the regular exploding style of gas engine, now using the reciprocating piston arrangement. We regret to state that we know of no individual or concern who would be willing to finance your idea, and frankly, we would hesitate at advising a patent upon any form of gasoline turbine in that, in our opinion, few, if any will ever see the light of a successful market.

Spring Binding Post

(573) John S. Ball, Chicago, Ill., enters a description of a spring binding post, and requests patent advice on the same.

A. Regarding the push button binding post, we would advise that this idea is very old indeed. The push button binding post has been on the market for some 15 years or more. This binding post is much inferior to other styles now found upon the market, particularly for radio work where all connections must be extremely tight.

Automatic Tank Switch

(574) H. L. B., Middlesboro, Kentucky, submits a sketch of an automatic compressed air tank switch. He requests our patent advice.

A. Your device is quite ingenious, and although we frankly cannot advise a patent upon the system, it would perhaps be worth your while to have a search made, patenting the system later if you have clear claims.

There are a great many automatic switches which function in a similar manner, although perhaps not constructed as illustrated by you.

Tooth Brush and Paste Container

(575) Juan A. Acevedo, Palo Alto, Calif., submits an idea of a tooth brush in the handle of which is a paste tube, and sends two patents which have already been granted to others which resemble his suggestion closely. He writes, "In view of the patents already granted, do you think I can secure a broad patent on my system?"

A. We have carefully checked over the two patents you have forwarded us, and altho we believe it possible that you could obtain a patent upon your device, we doubt very much whether this will be basic enough to warrant manufacture of the tooth brush.

The claims of the McCain patent, No. 967,413, are very broad indeed, and claim No. 1 practically covers the idea advanced by you, with the exception of the fact that he uses a roller to compress the paste tube. A ball could of course be termed a roller, by stretching the word. We do not see that your idea is a very radical improvement over the other ideas, and the resemblance is so great that we would hesitate at advising a patent.

Idea for a Badge

(576) Brian Bray, Pukekohe, New Zealand, suggests that some concern manufacture badges in the form of the Statue of Liberty, which should have a great sale in patriotic America. He asks whether he can secure a patent on the idea.

A. This idea is not by any means new. As a matter of fact, badges very cheap and made out of lead, exactly as described by you, were offered as prizes in candy prize boxes, which may be secured from a local candy store at one cent, the candy included. These badges are very common here in America, and we frankly do not believe that you could possibly patent the idea, as the Statue of Liberty adorns our homes today in hundreds of different forms; ink wells, fountain pens, ash receptacles, and mimic flashlight statues with a switch in the base and flashlight bulb in the hand. These in still larger forms adorn milady's boudoir, and in fact thousands of other places.

Automobile Friction Drive

(577) Arnold Blankenburg, Rockville, Conn., submits a cone friction transmission system varying speed by changing one lever.

A. Although your gearless transmission is practical, there is a much better transmission found in the Kelsey car. This car is built in Newark, N. J. In your particular contrivance, there is very little possibility of neutral and reverse actions. In the Kelsey car, neutral and reverse are obtained by very simple action. See description of this car in the next issue.

Chimney Flue Turbine

(578) David Arkin, Brooklyn, N. Y., submits two ideas. The first is a turbine set into the flue of a chimney used to drive a generator; the second is a fluted phonograph record which is to be revolved and tunes played by shifting the position of a reed touching the record.

A. Your first idea is absolutely worthless, and any attempt to produce a turbine operated by heated air from a furnace, automatically cuts down the draft and causes the fire to lack in vigor, preventing at the same time absolute consumption of fuel.

The second would undoubtedly sell very well as a novelty, but marking a disk diametrically will not serve the purpose, in that each different note has a distinct number of vibrations per second, which vibrations are not multiples of each other. By changing the position of the hands, music could undoubtedly be played even on your contrivance which would be passably fair. We would advise that the device be made of rather heavy metal with a reed in the end of a wooden horn to serve the purpose of the vibrating member. The idea is quite favorable, and we suggest that you have a search made.

Railroad Crossing Gate

(579) George Auringer, New Rockford, N. D., submits a sketch of a pivoted railroad crossing gate and requests our opinion.

A. We do not advise a patent upon your railroad crossing gate because it is far from efficient; besides, it obstructs the road considerably. There are many more favorable devices upon the market.

Many have been patented, which railroad companies would not consider. What is desired in railroad crossing gates is one which is impenetrable, which will absolutely stop automobilists and pedestrians from passing the gate when the same is set against them, and yet will permit any vehicle upon the tracks to travel easily to the opposite side. This gate must not be expensive, preferably operated automatically, and must not in any way obstruct or interfere with public highways.

Storm Window Fastener

(580) Martin Anderson, Stockholm, Maine, enters a drawing of an elaborate hook fastener for storm windows, claiming that the windows may be opened at any time or removed at will.

A. If you had built the storm window fasteners according to the specifications you have forwarded us, you would have found that they did not function, as described. And when you start to change these window fasteners sufficiently, they will conform with ordinary hooks.

We do not see any advantage which this window fastener may have over the hook and eye. In addition, you would have to make some provision for fastening the top of the storm windows so as to permit of their opening. This would have to be a hinge or a hinge-like construction.

Radio Loud-Talkers

(*Continued from page* 1174)

receiver. Mr. Howard Brown, the artist, who paints the handsome covers for SCIENCE AND INVENTION, is a "radio-bug," and he has constructed a very satisfying loud-speaker on this principle, using instead of the metal cone a wooden chopping bowl which can be purchased at any kitchen utensils store.

Mr. Brown thoroly sandpapered the inside of the wooden bowl, which measured about twelve inches in diameter and five inches in depth, until it was as smooth as he could get it, and it then received several coats of varnish. Each coat of varnish was rubbed down with pumice stone and oil, so as to be thoroly smooth before the next coat was applied. Each coat of varnish or shellac should be thoroly dry before applying the next one, the final coat should be as hard and dry as possible, even if it has to be baked in an oven, in order to reflect the sound waves efficiently. A thin piece of wood or a metal strip was then mounted across the bowl exactly on the centre line, and two holes were drilled thru it about four inches apart off centres. These holes, about one inch in diameter, have two horns about three inches long fitted into them, the horns being of metal or fibre, and slightly expanding at their outer ends. Each receiver of a head set was then secured over the respective holes and Mr. Brown states that with four audions and using an indoor aerial, comprising simply a few wires stretched across the room from the picture molding on one side of the room to that on the other side, he fills his studio with music, loud, clear and thoroly satisfying to everyone who has heard it.

A wooden chopping bowl is very excellent material to make this reflector from, as will be evident from the foregoing theory of acoustic horns as discussed by Prof. Miller and Mr. Blackwell, the cost being so small that every radio-bug can procure one, but in a rank emergency and where it simply is not available for one reason or another, a tin, or better still, an agateware or enamel wash basin will fill the bill in pretty good fashion. It is a simple matter also to try out a porcelain wash bowl, and this is of a pretty good size and of a different curvature also. They are certainly solid and firm, and if there is a harder and smoother reflecting surface than glazed porcelain, we would like to hear of it. If you try this porcelain wash bowl stunt out and it works as well as we think it will, just drop us a line and tell us about it, but "make it snappy," as they used to say in France, for we have been receiving about 400 radio letters a day recently.

LITTLE PLANET DISCOVERED

Dr. Hartmann, Director of the La Plata Observatory, Buenos Aires, S. A., says that the orbit of the little planet he discovered on Nov. 4, in the constellation of Cetus lies between the orbits of the planets Jupiter and Mars. The orbit is elliptical and is covered in five years and seven months. It has the considerable eccentricity of 0.272.

The little world may be observed from the end of this year until the Fall of 1923 in a very northern position, most favorable for observation from the northern hemisphere.

The diameter of the globe is estimated at barely twenty-five kilometers (about fifteen and a half miles), as its brilliancy taken at the last observation appeared to be of the fifteenth magnitude.

The Gravity King

By CLELLAND J. BALL

(*Continued from page* 1115)

High in the air he could see huge fleets of airboats—HIS company's airboats—mammoth beyond Wright's wildest dreams—speeding meteor-like in all directions. He saw distance annihilated—the world's barriers broken down! He saw railroads and steamship lines falling into disuse. His puffy hand clenched itself, as tho in its merciless grip, he was already crushing his business rivals who still manufactured the old style planes. He sensed the power that would be his—ELIAS CRAIG'S—could his company but corner this gigantic enterprise. But hold—what would the inventor demand as his share? Or, perhaps, his invention after all would prove a fizzle.

"Slowly, slowly, old boy," Craig said to himself, "you build air castles like a school child—but real or false, we must investigate this thing. If it should prove true and some other company should get control, we'd be forced to close our doors!"

Now closing the doors of his large concern was the last thing Craig intended doing. In the first place the business was too profitable, and in the second place, his iron nature would not permit defeat, defeat to which he had so often forced smaller concerns by certain methods commonly known as "strong arm." For Craig's operations, altho they kept the letter of the law at least, were absolutely merciless in driving possible rivals to the wall.

Craig's interest in such methods was eminently personal for he and his company's three other directors controlled all the stock. Starting with a few thousand dollars capital, he and his three partners had built up the present immense business. This was accomplished by means of an invention—an automatic airplane stabilizer—to which the company owned the sole patent rights. Just where they had obtained the invention was never disclosed altho the public commonly supposed that Craig was the originator, a supposition, by the way, that Craig never denied. Now as he read the inventor's letter over he again smiled. Well, if they could get hold of an invention like that, the public would have something to talk about.

Turning to the phone, Craig called up each of his three associates in turn, and requested them to attend a meeting at his office that evening on very important business.

When the hour arrived, the president turned to the other directors and read the inventor's letter which, as can be imagined, caused quite a sensation. While some doubted if the inventor had really accomplished what he claimed, they all agreed that the matter was of too much possible importance to neglect. Therefore, the following evening the president's limousine containing the four men drove out to 77 Oakhurst Avenue, the inventor's residence. The place was located near the outskirts of the city, and proved to be a modest dwelling of two and a half stories, located among some gloomy pines.

Upon ringing the bell the door was opened by an elderly man apparently sixty-five or seventy years of age. He wore a flowing white beard and on his head was a close fitting skull cap. His piercing gray eyes surveyed the party, finally resting upon Craig.

"Mr. Craig and associates, I presume? Step right in, gentlemen, I've been expecting you," he said. "My name's Norton." Craig started—where had he heard that peculiar ringing voice before? But the memory eluded him and the inventor was speaking again.

"You are all familiar with my letter, of course, and are anxious to see my—pardon

the natural pride—epoch-making invention. I have the model in my workshop upstairs. If you will kindly follow me," he said courteously, "I shall be pleased to give you a demonstration and explain such things as are necessary to the proper understanding of the value of my invention." Turning abruptly, he led the way up several flights of stairs to the upper half story, and paused before a door. Unlocking this he switched on a shaded light in the center of the low-ceilinged room, and entered, eagerly followed by his guests.

The single light that Norton had switched on was so shaded that it cast most of its illumination on a massive table beneath, leaving the rest of the room in comparative obscurity. Craig half unconsciously glanced around and was surprised at the extreme lowness of the ceiling, but quickly remembering that this was the upper half story of the house, and that therefore the ceiling must necessarily be low, he turned his eyes to the table.

Resting on the table was a metallic cigar shaped object, looking for all the world like a submarine without a conning tower. It was about eight feet long and wide in proportion.

"The model, gentlemen," said Norton, passing his hand caressingly over the shining metal. "This is an exact representation of the way I shall build my passenger airboat with the exception that on this model, the forward-driving apparatus is left out. However, with this boat I can show you the main principle—the annulling of gravity's effect. Please be seated."

The little party, afire with expectation, seated themselves about the table and watched the inventor intently.

"You will notice," Norton continued, "the utter absence of cumbersome planes, also how the shape of the airboat is made to offer the least possible resistance to the air when traveling at high speeds." Here he paused and sliding back a cover in the top of the model, he reached inside and slightly moved a small lever across a dial. Withdrawing his hand, he watched the boat. For an instant it rested quietly, then amid a gasp of astonishment from the little circle of watchers, it arose as lightly and noiselessly as a balloon, and mounted steadily to a height of about three feet above the table and then remained there absolutely motionless. After the expressions of amazement had subsided a little, the inventor reached up and again touched the little lever. The boat settled gracefully back to the table.

"Now will two of you gentlemen kindly sit astride the machine?" Norton asked. His request was quickly complied with and he again slid back the metal door, this time shoving the lever far over on the dial. As easily and as silently as before the cigar-shaped object arose until the directors' heads touched the ceiling. Norton then mounted a chair and reversing the lever gradually, the machine descended and came to rest on the table. The two men dismounted from their metal Pegasus, and Craig said, "Looks good, but now let's have a little explanation of just how your machine overcomes gravity. You know sometimes things are not what they seem," this half sneeringly.

Norton's eyes flashed for an instant, but he said in a controlled voice, "You will find no trickery connected with my invention, in fact," significantly, "I am sure before the evening is over, you will be more than convinced of its genuineness!" He paused. Again Craig had a fleeting impression that he had somewhere heard this man speak before. But rack his brain as he would he couldn't remember the incident.

"You will pardon me," Norton resumed, "if I digress a little, before I explain the really simple process by which I turn earth's attraction, as it were, against itself, thus leading to my most marvelous results.

It is necessary for your proper understanding of the subject," he said with what Craig thought concealed sarcasm, "to recount a little personal history which happened twenty-five weary years ago," he paused bitterly.

"At that time I was a young man of thirty-five years, working as a mechanic in a factory which manufactured airplane propellers. I was happy and contented in my work. I had a loving wife and little baby boy to keep me cheered up and altogether the world looked rosy. Fortune seemed to favor me, when one day I got an idea for a much needed invention on an airplane which I was sure would be a winner. Wishing to be sure of the value of my idea I consulted with four of my associate mechanics who, I had every reason to believe, were honest faithful friends." Here Norton looked keenly at his auditors who squirmed uneasily beneath his glance. He continued, "They readily saw the importance of my idea and urged me strongly to go ahead with my plans. Little did I suspect that very evening they met and planned not only to rob me of my invention, but to put me forever out of the way as well." At the telling of this remembrance, Norton's eyes grew sombre and threatening. A cold sensation started at the base of Craig's spine and moved upward. That voice was knocking, knocking at his brain. Wilfully buried memories began to awake—he gazed half fearfully at his colleagues and he saw that they too were looking questioningly at him. Could this man be——? but no, that was too absurd, a mere coincidence. Listen, he was speaking again.

"It was the old, old story of the lamb and the wolves. My so-called friends invited me to a little party with the boys, drugged me, and stole my plans, which I carried in my inside pocket. But mark you, not content with robbing me, they must needs put me out of the way where my future outcries against them could not be heard. So they took me down to the factory, drugged as I was, clubbed the watchman into insensibility from behind, and left me before the company's safe with a kit of burglar's tools. I presume they then notified the police, for there they came and found me struggling to get up. They arrested me and with all that circumstantial evidence against me, I was sent to prison for ten years."

The effect of Norton's story upon his auditors was startling. The blood had slowly drained from the faces of all of them and they had risen to their feet with straining eyes. That voice was now only too familiar—"you are—you are—!" they murmured.

"Jim Rodman, the man you heartlessly betrayed"—his voice rose—"the man you sent to prison for ten long weary years—leaving his wife and baby to die of privation and shame, while you, you damnable slinking hypocrites, taking the fruits of my labors, made yourselves rich and powerful! Look at me, an old man at sixty, broken with suffering and prison indignities!" His voice broke with passion, but he resumed quickly, "Now, however, I've got you where I want you, damn you!"

"Don't be too sure," said Craig, whose hardened nature had recovered from its temporary fear. He drew an automatic from his coat pocket. "Stand aside," he said, sneeringly, "I haven't time to listen to your yelps further!" He strode to the door and jerked it open, then stood petrified with amazement. Gone was the narrow hallway—gone were the stairs—the room in which he stood, hung five thousand feet in midair, far above the quiet moonlit streets of the city. Craig's eyes bulged with fear and unbelief. He rubbed them violently, thinking himself the victim of a troubled dream, but no, it was reality

(*Continued on page* 1182)

Making a Radio Loud Speaker of Your Phonograph

Fifty miles away is the broadcasting station. "Paul Whiteman of the Palais Royal will now play the 'Sheik,'" says the announcer. And the strains of the "Sheik" ripple out through the ether. Couples dance to the music in scores of radio homes.

The music comes from the phonograph, used solely as a loud-speaker.

Anyone can couple the receiving set to a Victrola, Columbia or any other machine and project broadcasted music right into the room.

Here are the essentials:

1. Type AD. Standard Antenna equipment comprising an unobstructive aerial erected out of doors or stretched across the room. Price, $7.50.

2. Combined tuner, detector and amplifier circuit, Type RC. Price, $132.50.

3. Attachment to the sound chamber of any talking machine, which magnifies the sound and enables the phonograph to project it into the room so that all can hear it. Type 307262. Price, $15.00.

4. Storage battery for lighting filaments of Radiotrons. Type 3-LX-9-1. Price, $23.00.

5. "B" battery for energizing the plates of Radiotrons. Type 2156. $3.00.

See the R. C. Line at Your Nearest Dealer

Radio Corporation of America

WORLD WIDE WIRELESS

Sales Department, Suite 1805
233 Broadway, New York City

The Gravity King

(*Continued from page* 1180)

—the room like Mahomet's Coffin hung suspended between Heaven and Earth.

Ashen-faced, Craig turned and dropped into a chair, all the bluster taken out of him. "What infernal magic is this?" he whined. "Put me on earth again, Rodman, and I'll do anything, give you anything!"

Norton, or Rodman rather, as we will now call him, surveyed Craig contemptuously, "Whine you cur, whine—just as I thot—like all traitors you are a coward at heart! Do you think that anything you could do now would erase those ten years of Hell from my memory! Can you offer me anything that would resurrect my darling wife and babe from the darkness of eternal sleep! No! No! You've had your fling—now you must pay—pay——" his voice shrilled and Craig shrank back as from a madman.

"Oh, don't be afraid, I'm not going to kill you outright, you're going to be my guests for some time yet." Then with mock politeness, "Pardon me, gentlemen, for not relieving your curiosity as to your present aerial location sooner. I am certain you'ld like to know. You see this room you are in is really only the center section of my airboat, the 'Gravity King.'" The men started. "Yes," resumed Rodman, "I merely disguised it from the too curious gaze of passers-by. It was very simple. I tore the roof off the long narrow room at the back of my house leaving the floor and walls intact. Within these protecting walls, my faithful assistant and myself gradually assembled the different sections of the 'Gravity King.' Consequently, instead of entering my workshop this evening, as you supposed, you entered my airboat. As you perceive this room is enclosed at each end by metal walls, beyond these partitions is housed the machinery for raising and lowering the 'Gravity King,' and also for propulsion. While you were so interestedly watching the small model, my assistant was guiding our airship 'high into the sky.'" He hesitated, then called, "Oh, Harry!"

A door in the forward compartment opened and a young man stepped into the chamber and looked coldly at Craig and his party. Craig noticed that it was the young man who had brought him the inventor's letter, and he swore silently.

"Is everything working all right, Harry?" Rodman asked.

"Splendidly," said the other, "your instructions are being carried out," this with a significant look at the inventor.

"Good," said Rodman, and his assistant disappeared.

"These instructions, by the way," continued the inventor grimly, "may prove of interest to you, as they are concerning your future home." He watched their faces. "Would you care to know where that is? Well, listen."

"Far to the south of Tierra del Fuego, well within the antarctic circle, is a small island. It is well stocked with game and seafowl, but it is absolutely uninhabited, and is not even charted. As a peaceful place to rest from civilization's strife, and to recuperate shattered nerves, it is unexcelled. This island, gentlemen," in a mocking tone, "you will grow to love as the years roll by, for it is your future home." Then sternly, "you have proven yourselves unfit for civilization, so civilization casts you out to the beasts where you belong."

"You devil," Craig shouted—"our business—our homes—we'll pay anything, but don't bury us alive on one of those God-forsaken antarctic islands!"

(*Continued on page* 1184)

"RASCO HAS IT!"

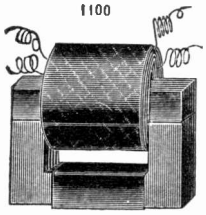
THE Radio Specialty Co.—"Rasco" for short—is probably the most unique supply house in the United States, if not in the world to-day. This company makes a specialty of small orders, no order being too small to get immediate and prompt attention for the simple reason that most of our orders are small.

The reputation of this house was built upon service. Ask any of your acquaintances what they think of Rasco goods, Rasco service, Rasco promptness!. Thousands of unsolicited testimonials on file to prove that we serve the public best!

Be sure to get our great catalogue, containing several hundred different parts, which is illustrated below.

ORDER DIRECT FROM THIS PAGE. ALL GOODS SENT PREPAID IN 24 HOURS

1100



"RASCO" AUDIO FREQUENCY TRANSFORMER

We have compared many of the present transformers on the market but have finally decided upon a type that is the most efficient one we have seen so far. The best amplifying transformer is that in which the impedance of its primary is equal to or exceeds the impedance of the plate-to-filament circuit of the tube in which it is connected.

We guarantee this transformer to equal any one on the market.

No. 1100 "Rasco" Audio Frequency Transformer **(not assembled) each prepaid**.....**$2.65**

ANTENNA CONNECTOR

This antenna connector is made entirely of aluminum, is light and will not rust. The only connector of its kind. The 4 antenna wires go to the upper holes; the lower hole takes the lead-in. Don't solder your aerial, don't have loose connections. Dimensions 2" high, 1¾" wide, ⅝" thick.

No. 999. Connector, each..**$0.35**

999

PANEL KNOBS

6241

838

No. 6241 is well made and has a good corrugation. Its dia. is 1", height is ½", hole 5/32". The shank is ¼" high.

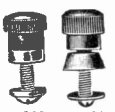
No. 6241, Knob, each.....**$0.08**

MARCONI KNOB

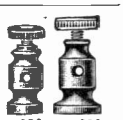
Has a central hole of 5/32" and seat to hold the screw, dia. is 1¼", height ¾".

No. 838, Marconi Knob, each.....**$0.15**

RASCO POSTS



202 201



030 029

These are our very own patterns, from our own designs and look mighty handsome on any instrument. The top knobs are of composition, the bottom parts brass nickel plated polish.

No. 202 is nickel plated at bottom part.

"Rasco" Binding Post, 8/32 thread, each, **$0.10**; doz., **$1.00.**

No. 202, Post, each, ...**$0.08**

Nos. 650 and 651 made entirely in composition with a hexagonal brass nut in center.

No. 650 has 8/32 machine screw.

No. 651 has bottom wood screw.

No. 650, Post, each.....**$0.08**

No. 651, Post, each.....**$0.08**

Dozen, each style.....**$0.90**

650 651

BRASS NICKEL POSTS

No. 029, Binding Post, each.....**$0.05**

No. 030, Binding Post, each.....**$0.04**

75 1 2 3 4 5 6 7 77 76

RASCO SWITCH POINTS

Nickel plated and polished. The following have been found the most popular.

No. 1 ⅛"x¼", 6/32 thread, ea., **$0.03**; doz., **35c**

No. 2, 3/16" high, ¼" dia., 6/32 thread, ea., **$0.03**; doz., **35c.**

No. 3, 3/16" x 3/16", 4-36 thread, ea., **$0.03**; doz., **35c.**

No. 4, ¼" dia.; ⅛" thick; stem 6/32, ea., **$0.03½**; doz., **40c.**

No. 5, ¼" dia., 3/16" thick; stem 4-36, ea., **$0.03½**; doz., **40c**

No. 6, 3/16" dia.; 3/16" thick; stem 4-36, ea., **$0.03½**; doz., **40c.**

No. 7, 3/16" dia.; ⅛" thick; stem 4-36, ea., **$0.03½**; doz., **40c.**

No. 75, Switch Stop, ⅞" long, 4-36 thread, complete with nut, ea., **$0.05**; doz., **50c.**

No. 76, New style Switch Point, to be pressed into bakelite panels with forced fit. Wire is soldered to pin end. Head ¼"; dia., 1/16" thick, ea., **$0.03½**; doz., **40c.**

No. 77. same as above, but head is ¼" dia. x 3/16" thick, ea., **$0.03½**, doz., **40c.**

1898

THE RASCO BABY DETECTOR

In presenting this little Detector, we feel sure that it fills a place never taken before by any small detector. It does a variety of things and does them all well and better than many $5.00 detectors. The base is solid, black composition. Mounted on same is a nickel holder and binding post which holds a flutted hard rubber knob with its sliding rod member.

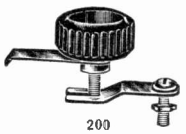
The outstanding part of the Detector, is the patented nickel detector cup and binding post. The knurled cap unscrews and you place the Galena Crystal in the cup, then replace the knurled cap and the galena crystal is held secure. The circular hole in the cap exposes enough of the crystal for ordinary purposes.

No.1898,.Rasco Baby Galena Detector. Price, prepaid **$0.50**

No. 1899, Rasco Baby Detector with Galena and Radiocite Crystals. Price, prepaid.....**$0.75**

PANEL SWITCH LEVER

New style switch lever with lock fork. It is impossible for this lever not to make positive contact at all times. The blade radius is 1¼". Blade is nickel plated and polished. Fork is phosphor bronze. The lock fork holds the screw (in which it rotates), securely. A loose contact is impossible.



200

No. 200, Switch Lever, complete as illustrated..**$0.30**

LITZ WIRE

323

This wire is recognized as the only thing for winding coils for Radio instruments. Particularly recommended with our **No. 343** Variocoupler Rotor, for vario-couplers, banked windings, etc.

No. 323, Litz Wire, 20 No. 38 strands, enameled double silk wire, per foot, **$0.02**; per 100 feet, **$1.15**

No. 890, Litz Wire, 10 strands No. 38 wire, per foot, **$0.01**; per 100 feet, **$0.75.**

No. 891, Litz Wire, 16 cables of three strands No. 38 wire, per foot, **$0.03**; per 100 feet, **$2.25.**

NOTE: This page contains only a few of our 300 specialties.

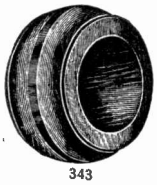
PANEL KNOB

This is a very distinctive knob and can be used on dials, panels, switches, condensers, etc. It is exceptional and well made. Dia. 1 1/16"; height 11/16"; comes with 8/32" bushing.

No. 815, Knob, each.....**$0.18**

815

VARIOCOUPLER ROTOR



343

This rotor is used by all up-to-date amateurs. Is accurately turned of hard wood and is used as a secondary coil. It takes any finish, either shellac or stain and can be drilled readily for any size hole. Large hole 2" dia. Width of spool is 2". Total dia. 3⅜".

No. 343 Variocoupler Rotor, each **$0.75**

827

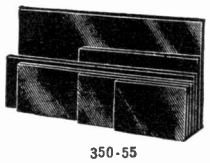
"RASCO" NAME PLATES

839

Our name plates are of brass with a black background. Letters are polished nickel. Order by name and number.

	Each		Each
807 "Phones"	$0.05	810 "Ground	$0.05
809 "Aerial"	$0.05	812 "Primary"	$0.05
811 "Secondary"	$0.05	814 "Detector"	$0.05
813 "Audion"	$0.05	866 "On"	$0.05
865 "Off"	$0.05	840 "Increase Current" (Left)	$0.10
839 "Increase Current (Right)	$0.10	834 "Series"	$0.05
813 "Vacuum Tube"	$0.05	830 "Receive"	$0.05
831 "Transmit	$0.05	820 "2nd Step"	$0.05
821 "3rd Step"	$0.0	827 "Tickler"	$0.05
819 "1st Step"	$0.05	825 "Plate Variometer"	$0.05
826 "Grid Variometer"	0.05	835 "B Battery"	$0.05
823 "Secondary"	$0.05	817 "Output"	$0.05
836 "A Battery"	$0.05	824 "Primary Condenser"	$0.05
818 "Input"	$0.05	828 "Parallel"	$0.05
829 "Telephone"	$0.05	837 "+ —"	$0.05
833 "Detector Tube"	$0.0	841 "(Blank)" (takes pen or pencil writing)	$0.05
822 "Coupling"	$0.0		
808 "Load'g Coil	$0.0		

Price of all of our name plates in dozen lots, **50c**, with the exception of the two "Increase Current"



350-55

BAKELITE PANELS

We list below six panels, the sizes of which have been selected after carefully checking up many dimensions of the most popular radio apparatus on the market.

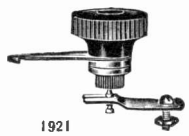
Note particularly that our prices are anywhere from 25 to 50% lower than those quoted by most other concerns. The reason is that we buy these panels in very large quantities, **and we do not cut sheets to order.** Remember always that when sheets are cut to order they cost you at least 50% more than our prices, because **you must pay for the cutting and the necessary waste.**

Note also that we ship these panels prepaid. This alone amounts to a considerable saving.

No. 350	6"	x 12"	x 3/16"	thick,	each	**$1.90**
No. 351	6"	x 18"	x 3/16"	"	"	2.85
No. 352	9"	x 12"	x 3/16"	"	"	3.00
No. 353	12"	x 18"	x 3/16"	"	"	5.65
No. 354	6½"	x 19½"	x 3/16"	"	"	3.50
No. 355	6"	x 7½"	x 3/16"	"	"	1.20

"RASCO" LUBRICATED PANEL SWITCH

A radio switch that has two nuts at the end is a monstrosity, for the reason that it will never stay put. Our patent spring fork holds the switch handle always under uniform tension, at the same time it insures the best contact possible. **New wiping contact,** which covers every point of the switch point. Another new improvement is the lock fork, which can assume three different positions to accommodate the switch to various thicknesses of panels.



1921

No. 1921 "Rasco" Switch, as illustrated, each **$0.50.**

KNOBS

199

4451

These knobs are favorites with all experimenters The size of both is: dia. 1⅛", height ⅝". No. 4451 comes with 8/32 and 10/32 bushing.

No. 4451, Knob, each...**$0.06**

No. 199 (screw length ⅝") Knob, each **$0.10**

NAVY KEY KNOB

This navy key knob is now used on all standard wireless keys. It gives the right swinging mation and rests the fingers. It is a favorite with all advanced amateurs. Once used always used. The screw is 8/32 and will fit all keys.

748

No. 748, Key Knob, each.....**$0.28**

8032

THREADED BRASS ROD

We carry two styles, 6/32 and 8/32 thread. **Only 6" lengths sold. No others.**

No. 8032, Threaded Brass Rod 8/32 thread, per 6" length **$0.08**

No. 6032, Threaded Brass Rod, 6/32 thread, per 6" length **$0.06**

THE "RASCO" CATALOG

CONTAINS 50 VACUUM TUBE HOOK-UPS

Complete hook-ups of all important vacuum tube circuits are given in clear diagrams with complete explanation. Just to name a few.—The V.T. as a detector and one-step amplifier; regenerative circuit; De Forest ultraudion; V.T. to receive undamped and spark signals; Armstrong circuits; one step radio frequency amplifier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; V.T. radio telephone; 4-stage radio frequency amplifiers; radio and audio frequency amplifier, inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; etc., etc. The catalog contains 200 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of

The catalog contains 200 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of

15c in stamps or coin.

Radio Specialty Co.

This business was originated with the sole purpose to cater to the amateur who has small orders. ALL OF OUR ORDERS ARE SMALL and that is why your small order will never be sidetracked by us. A trial order will make you a life customer. Order from the above illustrations. "We can only stick you once." Try us with a 50c order. ALL GOODS PREPAID.

DEALERS

Get Our Special Proposition

100 PARK PLACE, NEW YORK CITY

Factories
Brooklyn, N. Y.—Elkridge, Md.

The Gravity King

(*Continued from page* 1182)

"Too late," murmured Rodman, "did you think of that when you buried me alive between those cold bleak walls of San Quentin?" He gave a short sardonic laugh and turned on his heel.

At that, Craig's restraint blew up completely. He raised his revolver and aiming it at Rodman shrieked, "Turn around, damn you, and order that mechanician of yours to take us home or I'll blow your brains out!"

Rodman turned smilingly, "Shoot, you coward, if you have the nerve—but you haven't. You know only too well if you shoot me you'll never return to earth," and leaping suddenly forward he knocked up Craig's weapon. The pistol roared, but the bullet went over Rodman's head and pierced the forward compartment. At this, there came a sharp crack from the front end of the boat and the men were all hurled to the floor by a sudden upward lurch of the "Gravity King." A yell came from the mechanician, "That bullet has broken the control—we're shooting away from the earth and I can't stop it!"

The men staggered to their feet and gazed thru the glass. It was true! Insane terror filled their eyes, and reason tottered, but the "Gravity King," unheeding, hurtled upward like a metallic demon released from the pit, and was lost forever in the illimitable reaches of space.

HOW TO TELL TEXTILE GOODS

Yarn Characteristics: Woolen yarns are hairy, soft, resilient, irregular in surface and varying in lustre; worsted yarn is a defined thread, but slightly hairy, harder than woolen, but elastic and fairly lustrous all through; mohair yarn is almost as bright in lustre as silk, with a clean body, in which the component parts are visible, and rather hard to the touch; cotton yarn is smooth, firm, clean, almost devoid of elasticity and lustre, and hard to the touch, unless when very softly spun; linen yarn of high quality is straight and fine, of a gummy lustre, of medium hardness, but firm consistence and slightly elastic in feel; silk is lustrous, clean, clear, soft to the touch, and firm in body; spun silk has lustre and may be spun to any degree of softness or hardness, but it is always spongy, lacking the fine body of true silk; artificial silk yarns are hard, with a dullish lustre, smooth to the touch and elastic. Sometimes cotton cloths are finished to imitate linen and sold as linen. Detection of the fraud is very easy. Untwist the yarn of which the cloth is composed; if it is cotton the yarn will fall away into small fibres, averaging little more than an inch in length; if the cloth is linen, the fibres are very long, and lie almost flat together, with very little twist. Even unskilled hands can draw out fine fibres of three or more inches in length from a good linen, though the fibres average a much greater length.

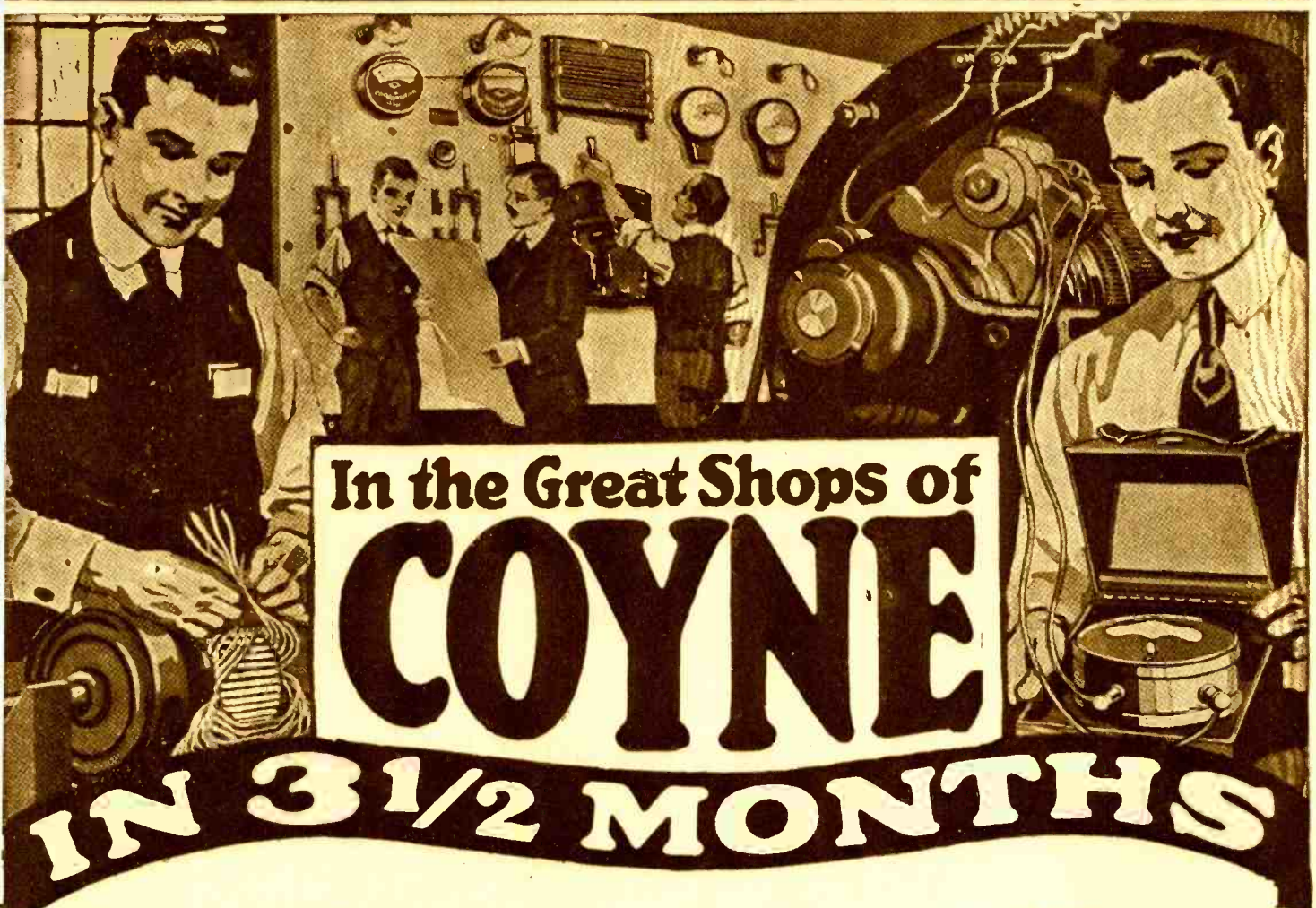
WM. R. REINICKE.

RADIO LINK FOR BRITISH

The English Wireless Telegraph Commission has recommended the erection of stations in England, Canada, Australia, South Africa, India, Egypt, East Africa, Singapore and Hong Kong.

The average cost of the stations is estimated at not more than £160,000, but the cost of those in England, Egypt, Singapore and Hong Kong would aggregate about £853,000. The commission recommends two wave lengths for each transmitting station, and that each centre be equipped for receiving from several stati ns in the chain simultaneously.

Learn Electricity



In the Great Shops of COYNE IN 3½ MONTHS

Earn $50 to $125 a Week

Your future lies in the Electrical Field. The opportunities are limitless. This industry is growing faster than any other, and attracting BILLIONS of capital. Get your share. The demand for trained men was never so urgent and the pay was never so large. Act—ACT NOW. Make a start in this wonderful calling.

Hundreds of our graduates are making big money as Power Plant Operators, Electrical Engineers, Telephone Men, Superintendents, Electro Auto Engineers, etc. Hundreds of others are in the electrical contracting business for themselves, and making from $3,000 to $20,000 a year. I want you to drop your present line and come to Coyne now and let us prepare you for the big opportunities. Spend the next three and a half months in Chicago, the great electrical center of the world. Students taken on frequent inspection trips to the world's greatest electrical plants.

Come With Us for 98 Days!

I offer you EXCLUSIVE advantages here. $100,000 worth of massive electrical apparatus is reserved for your special use. You learn quickly because you work—in a class of ONE—with a special instructor to help you—on our immense and modern equipment of dynamos, switchboards, generators, locomotives, etc. When you graduate you KNOW your business, for you have DONE everything in a practical way.

Earn While You Learn

Don't wait to save a lot of money. Our employment department helps place students in spare time jobs to earn their living expenses, or if they must earn all expenses it helps place them where they work days, generally at electrical work, and go to school evenings for a while, then later change to day school. Hundreds of our students have worked their way through, you can do the same. Make up your mind right now—send the coupon this very minute for our big free catalog and full information.

Business Management

A thorough training in business management is also given to you under the most competent instructors, without an extra cent of cost. You are now technically trained, and in addition gain a thorough knowledge of business which enables you to apply your technical knowledge to much greater advantage. Instead of $200 to $450, you can command $500 to $800 a month and more in a business of your own. Write for further particulars about this wonderful offer.

B. W. COOKE PRESIDENT

Auto Electricity Included

We are able for a limited period to make you an astonishing offer—a complete course in Automobile Electricity. We have greatly enlarged and newly equipped our Auto Electrical Department with thousands of dollars' worth of the latest apparatus, and can give the finest training in America on batteries, ignition, lighting and starting systems, as used on autos, trucks, tractors, etc. To those enrolling in our complete electrical course now we offer you this entire Automobile Electricity course. The cost of this training would cost you more than we charge for our entire course—Write for particulars.

GET OUR CATALOG—Contains hundreds of large size photographs of our shops and our wonderful equipment. This is a very large and expensive book, but it's yours FREE for the asking. Get it now and learn all about the great opportunity we offer you. Send the coupon or a postal—TODAY.

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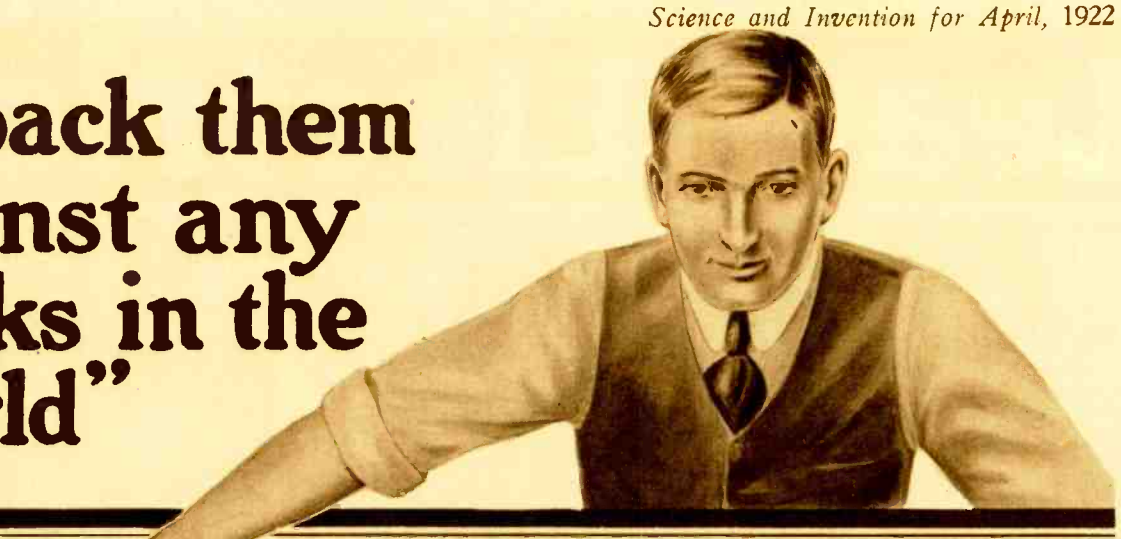

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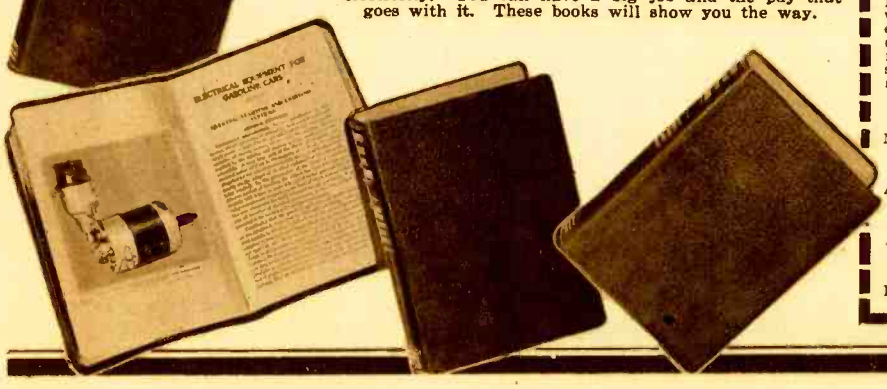

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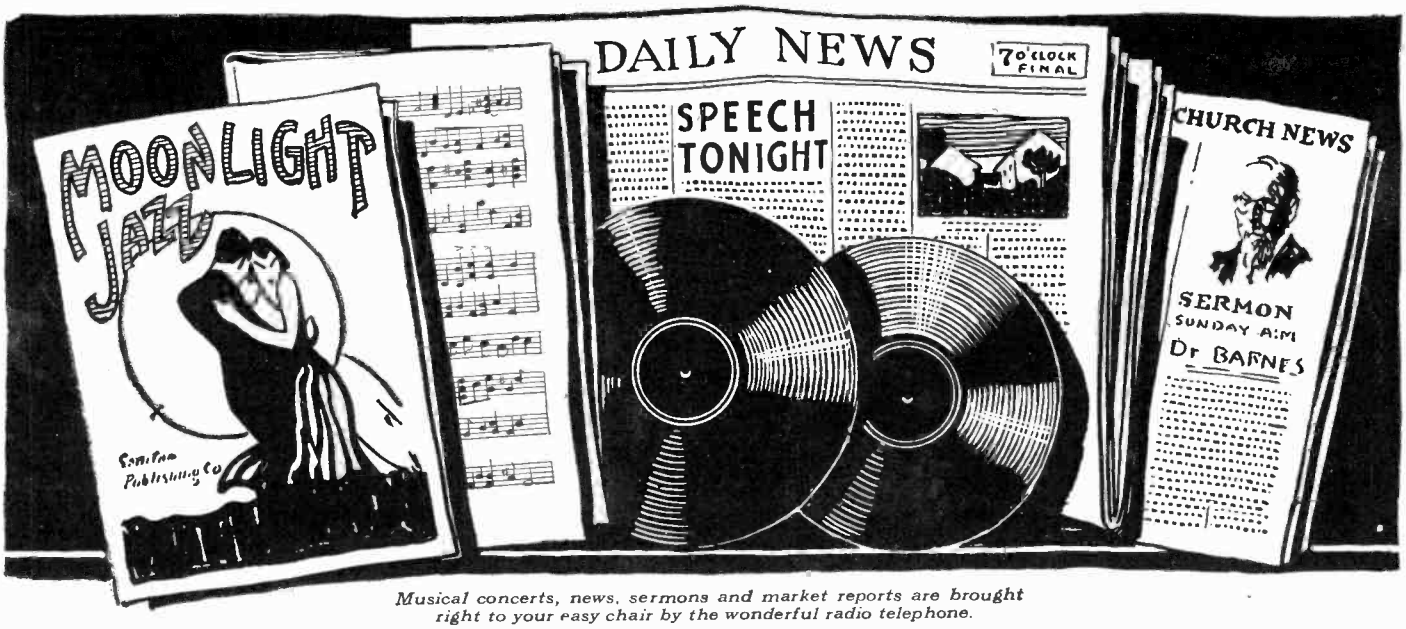

Musical concerts, news, sermons and market reports are brought right to your easy chair by the wonderful radio telephone.

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It seems too marvelous to be true—that you can sit in your favorite chair and hear market reports just as they are being given out hundreds of miles away—that you and your guests can dance to music that's being played in the far corner of another state—that you can listen in comfort to a sermon delivered in a distant city.

Yet thousands of people are doing it every day, thanks to the miracle of the radio telephone! Concerts, news, market reports and sermons are being sent on regular schedule from several principal cities, to be heard by all who wish to listen.

No one knows the limits of radio for instruction, for inspiration or for entertainment, but you can easily have in your own home the advantages that have so far been developed.

There are dozens of reliable sets made up and ready to use. There are scores of plans available for those who prefer to build their own sets either wholly or in part.

Make up your mind today that you will not miss any more of the good things that are going through the air. Your radio club, or that of your nearest city, will gladly tell you where to buy sets or material, what you need to begin with, and will help you in getting the best results from your apparatus.

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Radio for the Beginner

By ARMSTRONG PERRY

(*Continued from page* 1150)

repeat until you get your station. Once the station is heard, small movements of the slider or knobs will show how loud the signals can be made. It is better to make all adjustments slowly and listen closely, otherwise you may pass a faint signal without hearing it. When you hear a station, write down the positions of all knobs, handles and other adjustments so that you can set the tuner the same way again and get the same station. Also put down the time of day as by so doing you may discover a transmitting schedule that will be useful later.

In case repeated efforts fail to bring in the desired station, it is probably a case for trouble shooting, which will be described in another article. Not always, though. Once I was on the point of giving away a $250 outfit because I could not get NAA, the big Navy station at Arlington, near Washington, that is always in the air at 9.55 P. M., Eastern Standard time. The next day I learned that the station had been struck by lightning and was not transmitting.

There are fewer disappointments with vacuum tube outfits than with receivers using mineral detectors. That is because the vacuum tube outfits are so sensitive that they will bring in signals over distances of from one thousand to ten thousand miles. Nevertheless I use a mineral detector a good deal even though I have a very good vacuum tube outfit. In Washington recently I heard within a short time, using only a low-priced mineral detector set, the following: Daily digest of the world's news; an address by Senator Henry Cabot Lodge on the results of the Conference for the Limitation of Armament; a message from President Harding; a lecture by John Temple Graves on "Armageddon"; an address by Princess Cantacuzene, granddaughter of General Grant, on conditions in Russia; an address by Secretary Wallace of the Department of Agriculture; an address by Senator Pomerene; several important health lectures by Dr. C. C. Pierce of the United States Public Health Service; several interesting lectures on radio by Commander Taylor and other experts of the United States Naval Air Service; weather forecasts several times daily; concerts several times a week, and three church services each Sunday.

These all came through stations within a radius of ten miles. If I had been more than fifty miles away I would have needed a vacuum tube receiver. With the last named receivers all these speakers were heard over distances up to a thousand miles by amateurs. The operation of a vacuum tube receiver will be described in the next article.

STUDYING THE SPEED OF ALASKAN GLACIERS

The speed of Alaskan glaciers is being studied by Prof. William S. Cooper of the University of Minnesota. He is making a special examination of Muir Glacier at Glacier Bay. Muir Glacier has receded sixty miles in the last 127 years. When Vancouver visited the glacier in 1794 he found the ice extended to the mouth of Galcier Bay.

Prof. Cooper hopes to determine the time that has elapsed since many parts of the earth now free were covered with ice.

The Man in the Moon—A Super Cave Man

By C. S. CORRIGAN, C. E.

(*Continued from page* 1114)

Moon, the picture you see in the telescope is a thousand times more beautiful and enchanting than the man in the moon picture you imagined as a child.

So without using any imagination at all, by mathematical, geological and scientific comparison of what we see on the Moon's surface, with similar things on the Earth's surface and vice versa, I will attempt to show that there is now inside the Moon and some day will be inside the Earth, great caves and caverns such as shown in the accompanying picture, and as Nature on the Earth abhors a vacuum, so Nature on the Moon sucked all the water inside to form lakes in these caves and the air that once formed its atmosphere now occupies all the space in the caves not occupied by the lakes. Then as certain as day follows night, the people of the Moon went to live in the caves, as the people of the Earth will do, when Nature has prepared caves ten thousand times as large and beautiful as Mammoth Cave, and made our earth's surface almost uninhabitable.

To prove anything in Nature you must have studied Nature, and discerned some known facts with which to compare it; for instance we know the interior of the Earth was once much hotter than at present, and that its crust is gradually getting thicker. Second. We know that Mountain Ranges are the result of breaks in the Earth's crust, allowing igneous rocks and lavas to protrude. 3d. Volcanoes are the result of water penetrating to the hot interior and forming steam and lava, the steam pressure breaking the Earth's crust and forcing the lava to the surface. 4th. Plains are made by wind, rain, waves and ice, eroding the mountains and depositing them in the seas.

We know that the same laws of Nature are working to some extent on the Moon as those a twork on the Earth, but the smaller moon has lost its heat faster and undergone other changes more rapidly. Most scientific men agree that it is about seventy-two million years since water first formed on the Earth; I have assumed that as the Moon cooled faster, water formed eight million years earlier, making the Moon's age eighty million years. I have divided this into eight periods of ten million years each, and let the first four represent time on the Moon, during which, on account of its smaller size, it aged and developed life corresponding to the development of life on the Earth during the whole seventy-two million years.

If God ever created men on the Moon, He did it about forty million years ago, when there was plenty of water and air on its surface, when its days were about the same length as ours, and the nights about the same temperature as the days, and when all Nature was agreeable and pleasant to the lunar beings, assuming that they were endowed with minds and appetites similar to ours. They tilled the soil, lived in cities, mined gold, and iron, and coal, made use of steam and electricity, and built boats, railroads, airplanes and automobiles, nor do we have to depend on imagination to follow their career. We simply decipher the characters God wrote in Nature's language all over the Moon's surface.

Looking thru the telescope we notice that some of the Moon's mountains and most of its valcanoes show such high and sharp peaks, that there has been very little if any erosion, for there is no water on the Moon to cause erosion. But the great

plains, which the first astronomers supposed were seas, and named accordingly, prove that two-thirds or more of its surface was formerly covered with water in which thousands of eroded prehistoric mountains were deposited to produce those smooth floors. The mountains and volcanoes we now see on the Moon must have been formed about the time the water and air lost its eroding influence, and as water is necessary to produce volcanoes, we have proof that the forces that made the volcanoes robbed the Moon's surface of its water and air.

Looking thru the telescope again, we notice that some of the craters on the Moon are a thousand times the area of craters in volcanoes on the Earth, while on account of the Moon's smaller area we would expect them to be smaller. Some scientists imagine that on account of the Moon's gravity being only one-sixth of ours, its volcanoes threw lava so high that in falling it built up those circular rings of mountains. Such an explanation is most absurd; it supposes that great numbers of volcanoes each expelled lava with unvarying force in all directions from a central hole for thousands of years, yet no two were of the same size. If we take a good look at the land of a thousand smokes in Alaska, we see the replica of one of the smaller lunar craters when it was first formed, and the correct explanation is simply this.

There came a time when the Moon's crust had become so rigid and stiff over certain areas, that as the interior cooled and shrunk and drew away from it, it did not fall; an immense cavern and vacuum was formed, water was sucked in and coming in contact with the hot rocks produced steam and lava; the steam pressure lifted the crust that would not sink, making innumerable fissures thru which steam and lava escaped. The lava being kept hot over a large area does not build a cone-mountain, but flows practically level to the edge of the area, a lake of molten lava, with escaping steam, verily a Land of a Million Smokes, always overflowing and cooling around the edge and so building its walls higher. At last the water cools the cavern off so that steam is no longer produced; the thick crust sinks until the fissures are closed and it has regained its original shape; the lake of lava also sinking and shrinking as it cools, leaves a high circular ridge of mountains with a level interior floor. Ages afterward, when the process was repeated directly underneath on a smaller scale, the smaller craters we see inside the large ones were formed.

When these great Lands of a Million Smokes became dead volcanoes and the crust had settled back to its previous shape, great caverns, approximately equal in area and cubic contents to the lava that had been expelled to form the surrounding mountains, were left filled with water robbed from the surface seas; the process was repeated; caverns below caverns were formed, until all the water was drained from the Moon's surface. The interior continued to cool and shrink, forming new caves deeper in the crust, which robbed the caves first formed of all their supply of water, except such as remained in lakes. The heavy air of the Moon's atmosphere was then sucked into these caves until the air outside became as rare, as if the surface had become the top of a high mountain, which in fact it had become for sea-level had gone down many miles below the surface.

The things that puzzled Prof. Pickering such as the changes in the color of the crater of Eratosthenes, clouds sometimes obscuring small craters in the plain of Plato, the slight falls of snow in the lunar Alps, all add proof to the fact that the interior of the Moon is not yet cold, but in cooling shrinks away from the cooled crust, and sucks water into hot caverns,

The vapors rise to the colder caves where they fall as rain; and at times small portions escape thru old openings in the surface, and every such indication of life on the Moon adds proof that its water and air and people are all inside in great caves.

Now let us go back forty million years and follow the development and life of the Man in the Moon up to the present time. In spite of wars and pestilence it was only a few thousand years after they became civilized, until they had populated all its land surface. As they advanced in civilization, wars were abolished and such progress made in the science and art of prolonging life, that men often lived a thousand years. Laws prohibited the use of land for any purpose, except for the production of man's food; all animals were exterminated except fish and water animals, the breeding of which was internationally controlled and this constituted the Moon-man's only food except vegetables and fruit. The raising of children was also under international control, all raiment was made from the refuse parts of food, such as corn husks and the like.

As we are doing they came to the same conclusion which we have reached, that future generations would be better able to make use of the forces of Nature than themselves, so they used up all the wood and coal and oil on the Moon in less than a million years. As these sources of power began to diminish, they tapped great volcanoes like Tycho and Copernicus, and by guiding the overflowing lava in great rivers, led it great distances to points where its heat was used to produce power and light. Tycho must have flowed regularly for thousands of years to have left the long streaks that now look so much like strings of beads.

When there was no fuel with which to heat their cities during the long cold nights they prepared cave cities at depths which were temperate at all times. On account of their iron picks and drills weighing one-sixth of what ours do, excavating their underground cities was very slow and tedious work. To use powder was most dangerous, on account of the broken rocks flying so far. Their deep well drills were only half as heavy as ours would be if made of aluminum and made no impression at all on the harder rocks. We have found that stone-cutting saws cut stone fifty times as fast as drills; they found that they cut 300 times as fast as their drills, and they made long stone-cutting chain saws for excavating cities, and cutting tunnels to connect them. These saws were operated by electric power and used as we might use a knife to hollow out a great cheese. It was possible to cut out solid blocks, six times as large as our machines can handle. Tunnels connecting underground cities were sawed out at the rate of a mile a day. Deep wells for tapping the Moon's interior heat to produce power, were made by sawing out cores with sets of these long stone-cutting chain saws, and as their cables had the same tensile strength as ours, they were able to saw wells 60 miles deep to follow up the interior heat every thousand years or so, as it receded.

The time came when the first underground cities were left stranded in the cold arctic regions of the Moon's crust, and new cities had to be built deeper and nearer the underground tropics. During all this time the people had to be lifted in great elevators, to the surface each day, to raise crops and catch fish for food. The waters kept receding and it was discovered that they were being sucked into the bowels of the Moon. Where the waters thus departed and left the bed of the sea dry, it was soon desert country where nothing would grow. There were few rains and some years the drouths were so bad that thousands of people died of starvation, and the bringing of children into a

life of misery was prohibited. Great areas of farm lands would turn into lakes of lava over night, many of these lakes being 50 miles across; there was an old story that the Moon had once been destroyed by water, and would later be destroyed by fire; it seemed that in a few years man must perish from the face of the Moon.

Then came the discovery of a great natural cave deep in the Moon's crust, where the temperature was tropical, where streams flowed, forming lakes and where other streams were lost in deeper caves; its land was covered with all kinds of vegetation, trees and flowers, such as history showed had once grown on the Moon's surface, but their leaves and flowers were white instead of colored. It was only the work of a few weeks to saw enough deep wells and tap the interior heat to produce power. Innumerable artificial lights of actinic quality were placed on the ceiling of the cave, the trees and flowers took on most brilliant colors, crops grew and multiplied enormously, and the joys of living became more varied and enchanting than even fairy stories had foretold.

As in Man's first days on the Moon, daring navigators had sailed the lunar Seas in search of new lands, so now tunnels were sawed in all directions, many supercaves were discovered, artificially lighted and prepared for Man's habitation and the surface of the Moon, which had become a vast desert, was entirely abandoned by the Man in the Moon, more than ten million years ago.

CHIMNEY SWIFTS AND THEIR GLUE

A very good cement is made by the bird called the chimney swift, which is generally called the chimney swallow, altho it is not even remotely related to the swallows.

Old-fashioned swifts still nest in hollow trees or caves, but chimneys are so much more convenient, that up-to-date birds prefer them. Without stopping in their flight, the parent swifts snap off with their beaks or feet little twigs at the end of dead branches, and these they carry, one by one, into a chimney, glueing them against the side until they have finished an almost flat, shelflike lattice cradle. Where do they get their glue? Only during the nesting season do certain glands in their mouths secrete a brownish fluid that quickly gums and hardens when exposed to the air. After nursery duties have ended, the gland shrinks from disuse. When the basket has been stuck against a chimney-side, it looks as if it was covered with a thin coat of isinglass. On this lattice from four to six white eggs are laid. Midsummer fires sometimes melt the glue when "down tumble cradle and babies and all."

As this material is exposed to all kinds of weather conditions, and must have some strength to keep the parts together and hold the weight, an analysis of it might give a formula for an useful glue.

Contributed by WM. R. REINICKE.

FINSEN'S CAT AIDED MAN

To Newton's apple and Watt's tea kettle now is to be added Finsen's cat as a humble coadjutor in the work of benefiting mankind. It has just been revealed in connection with a Finsen celebration at Copenhagen that the discoverer of the famous curative ray got his first idea from watching his cat warm herself in the sun. He observed that as the shadow crept up the cat moved on, so as to always keep as much as possible in the direct sunlight.

Believing that the animal's instinct must have felt that the rays were beneficial, Dr. Finsen decided to study the question scientifically, and his discovery was the result.

Dr. Hackensaw's Secrets

No. 4—THE SUPER-NOSE.
By CLEMENT FEZANDIÉ
(*Continued from page* 1113)

however, I hit upon the real solution of the problem."

"And what was that?"

"Have you ever heard of the 'corpuscular' theory of light?"

"Yes, I know that Newton believed that light consists of minute particles of matter which are hurled off from the illuminating body and travel at the rate of 186,000 miles per second. But there are such valid objections to this theory that modern scientists have adopted the *ether* theory instead."

Doctor Hackensaw snorted again. "Yes," said he, "the corpuscular theory of light does present difficulties, but on the other hand the ether theory doesn't explain anything, for it is no explanation to found a theory on an impossible substance like *ether*, which is unlike anything known to man, and of whose existence there is not the slightest proof. It was invented solely for the purpose of supporting the vibration theory. The discovery of radium, however, will lead us back to the corpuscular theory. This theory is supported by biology, for our senses of sight, hearing, smell and taste are all evolved from our sense of touch. The lowest forms of animal life show these gradations, and to a thinking biologist it is inconceivable that the senses of sight and hearing should be caused by vibrations and the sense of smell be entirely different, and be caused by contact of minute particles of matter. All three senses are closely related and the *corpuscular* theory of light and sound is the only one that properly combines the three."

"Well, but what has all this got to do with your smelling machine?" asked Silas Rockett, who was beginning to fidget at the length of this lecture.

"Simply this, that since sound, light and odors are corpuscular emanations, anything that will intensify one of them, may, if the proper means be employed, be made to intensify the others also. Now you are aware that the audion will intensify sounds to a high degree. I have modified the audion so that it will likewise serve as a microscope and intensify vision. And, finally, I have succeeded in making an audion that will intensify smells. By the use of a bank of audions I can raise an imperceptible odor to a smell of one hundred skunk-power!"

"What!"

"Yes, and my whole instrument is so compact, it will fit in an ordinary suitcase." So saying the doctor took from a closet what appeared to be an ordinary cowhide bag.

"There," said he, "That is my super-nose. It really consists of three instruments combined into one. First of all it is a 'smellometer.' It measures the intensity of any smell in terms of *MICRO-SKUNKS*. I use for my unit of measure *the odor of one drop of pure skunk fluid at a distance of one kilometer*, in still air at 70° Fahrenheit. This unit I call *one skunk*. One million *micro-skunks* make *one skunk*."

"I see," said Silas Rockett.

"Secondly, my suitcase contains an *OLFACTOGRAPH*, that is to say an instrument for recording smells on a reel of celluloid for future reference, as a phonograph records sounds or a movie-camera records sights.

"Third, and most important of all, my instrument is a *MICRODORSCOPE* or smell intensifier. By its aid I can magnify any smell from two to several million times its original strength."

"I understand all that," said the puzzled reporter, "but what I don't see is what practical use there is for such an instrument."

Dr. Hackensaw smiled. "I have made many valuable inventions," said he, "but I consider this super-nose as the most valuable I have ever made—at least for a commercial point of view. There is not a single art or manufacture which could not use it to great advantage for detecting adulterations. No tedious chemical qualitative and quantitative analyses are required. One sniff with my super-nose at once tells one whether an article is adulterated, and the amount and kind of adulteration."

"But suppose the adulteration is odorless."

"There is no such thing as an odorless substance," retorted the doctor, "any more than there is any perfectly transparent substance. Such things do not exist."

"Well, what else can you do with the instrument?" asked the reporter.

"It is invaluable in the kitchen. My super-nose enables the cook to combine her ingredients in proper quantities, and to tell when her viands are properly cooked. She doesn't need to open the oven to tell if her roast or cakes are cooked—one sniff is enough. The chemist uses the instrument in like manner in making mixtures. Weights and measures cannot give him anything like the accuracy which he can obtain by smelling the mixture through my instrument. He is sure of securing uniform products. You cannot weigh or measure the particle that carries an odor, but your nose can readily detect it. But I won't weary you with the technical uses for the instrument. They are too numerous. From the chicken-raiser who tests his eggs by smell to the sea captain who can tell his latitude and longitude by the smell of the ocean, the uses are too varied to even touch on. Teas, coffees and other such things are no longer tested by taste, but by smell. Milk and meat are inspected by smell also. But I cannot pass over in silence the immense value of the instrument to the physician in diagnosing disease."

"Surely, doctor, you are joking?"

"Not in the least. Every disease has its own characteristic odor. Any experienced physician will tell you that in *FAVUS* there is a pronounced *mousey* smell; in rheumatism a certain acidity; in *PYEMIA*, the breath is nauseous; in scurvy there is an offensive and putrid smell; in scrofula, there is a scent as of sour beer; the odor of ammonia in simple fever, and of new bread in intermittent fever. In female hysteria there is often a scent as of violets and pineapple, and in peritonitis there is an easily recognizable scent of musk. These are all well known in the hospitals, but my super-nose enables me to detect any disease by a simple whiff at the patient. I merely walk thru a hospital and one sniff at a patient tells me what disease or complication of diseases he is suffering from. More than that, I can tell the condition of each organ, whether his heart is working properly, whether his lungs are injured, what stage of digestion the food has reached in his stomach, etc., etc."

"Why, doctor, it doesn't seem possible!"

"Yes, and not only can I diagnose these diseases, but you or any other man can do it. I have an olfactograph record-strip containing the odors of one thousand of the commonest diseases. All you need to do is to sniff at the patient and then sniff at these thousand odors in turn until you find the one that corresponds and then you can read off the name of the disease."

"That is a remarkable achievement, indeed."

"Yes, and its greatest value lies in the fact that parents can recognize disease in their children in the incipient stage when they are easy to cure."

"But don't you see, doctor, that you will drive physicians and hospital assistants out of business if you nip all diseases in the bud."

"That doesn't worry me any more than the fact that our undertakers are having a hard time of it, because every time a man is about to die, I put him to sleep for a term of years until doctors have learned some means of curing his ailment. My super-nose helps me in ascertaining when death is near and serves as a signal for putting the patient into his long sleep."

"Well, is there anything else your instrument will do?"

"Certainly, I've scarcely begun to enumerate its uses. Personally I find it of great advantage as an aid to memory. I have a very poor memory for faces and many of my friends feel badly because I do not remember them after an absence of months. But if I get one sniff at them through my smellometer, I will remember them, even if I knew them as children and meet them grown up and changed by a beard. For purposes of identification, the smell is much superior to the finger-print. If you keep a record on the olfactograph of the smell of a criminal, you can recognize him at once in any disguise, when you pass him. With a finger-print you might never suspect him and would have to secure another finger-print to confirm your suspicions. But he cannot disguise his odor. Then, too, my instrument helps me in reading a person's mind."

"No, it is not possible!" cried Silas Rockett, incredulously. "I bet you can't read my mind."

"Pshaw!" exclaimed the doctor. "You're thinking of that eighteen-year-old girl you were dancing with this lunch-time!"

Silas Rockett gazed at the doctor in fear and amazement. "How did you know that I danced with a young girl to-day. Were you in the lunch-room?"

"No, I haven't left my office here, but my super-nose tells me that you had an omelet and coffee for your breakfast this morning and a glass of *hooch* to wash it down—where in the world did you get the whiskey? You put on a clean shirt but otherwise made no change in your linen. You rode down to your office in the subway and sat between a fat woman on your left and a sailor on your right. You took lunch at *THÉ DANSANT*, and danced three dances there, one with a young girl about eighteen, another with a married woman of forty, and a third with a dashing young widow of thirty-five who danced with one arm around your neck and her cheek against yours. She——"

"Stop! Stop!" cried Silas, turning red as a beet. "I'll never dare to come down here again if your smellometer tells you every blame thing I've done during the day. You'll lose all your friends, doctor, before you're a year older if you let them know you possess such an instrument. But how in the world do you do it?"

"Simple enough!" replied the doctor. "Every person or thing that touches you leaves minute particles adhering to you. From the odor of these particles I can tell the age and sex of the person, or the kind of object, if a thing. It is lucky for my friends that I am not a gossip. When I make a call I can tell without any trouble what callers have been there before me. If strangers I can usually tell their occupation and nationality—oh, yes, different nationalities have their characteristic scent, just as unmistakable as its other physical characteristics. In a crowd I can always tell whether any of my friends are present or not. At Asbury Park one day, I lost my pocketbook, and found myself stranded without a cent. I went on the boardwalk, took one sniff at the crowd and discovered that no less than seven of my friends were present in that mass of humanity. I had no trouble in borrowing the money I needed. In all kinds of odd places I

come across tokens of my friends, and not only have I thus been enabled to meet many persons I should otherwise have missed, but have learned many of their doings, which they thought they had kept secret. My instrument, too, has often enabled me to help a mother find her lost child in a crowd. One sniff at the mother's dress, where the child touched it, gives me the scent, and a five minutes' chase usually leads me to the child itself."

"Why don't you apply for a job in Central Park?" asked Silas Rockett, jocosely. "You could get a steady job on Sundays, hunting for lost children."

"In addition," continued Dr. Hackensaw, "my smell-intensifier and *OLFACTOGRAPH* have opened up an entirely new form of art. Smells, as you may perhaps know, appeal more strongly to one's emotions than colors or even musical sounds. I have carefully studied the harmonies of odors, and have combined different scents—not only perfumes but odors of all kinds, so as to form pleasing combinations. I have thus opened up an entirely new æsthetic field with wonderful possibilities for the future, and a stronger appeal to humanity than either painting or music. I have composed some garlic symphonies that would bring tears to the eyes of any Italian!"

"I had no idea there were so many uses to which your instrument could be put," observed the reporter, laughing.

"I haven't begun to tell you of its uses yet," continued Dr. Hackensaw. "My super-nose, at the present moment, informs me that you are carrying a wad of bills in your right-hand hip-pocket. The information might be useful if I wished to borrow money. Last Sunday while walking thru the woods, in the country, I smelt honey, and was led to a tree in which a wild swarm of bees had made their hive. I secured twenty-five pounds of delicious honey. My super-nose was also useful last week. It enabled me to detect a forgery in a will case, because the ink used by the forger had a different *smell* from that of the rest of the document. The signature was perfect to the eye, but the nose detected the fraud. In autopsies a single sniff will often reveal to me facts overlooked by the coroner. If I were a revenue officer I should never travel without a super-nose. Many a time has my instrument revealed to me concealed *hooch* carefully hidden in the false bottom of a wagon or other hiding place. When I go into a store I can tell at one sniff just what wares the proprietor has for sale, and I often astonish him by letting him see I know just what stock he has on hand and on what shelf it is kept. But what is the use of continuing this enumeration. It would be endless. My instrument enables me to do almost anything—even, as I showed you a minute ago, to read a man's thoughts. It is no exaggeration to say that a man's thoughts are revealed by the emanations of his body. Every emotion he experiences quickens or retards the vital processes and the amount of perspiration that exudes from the pores is altered. In my instrument these changes are very perceptible, and I can recognize at once when a man is lying, when he is afraid, when angry, etc."

"Doctor!" interrupted Silas Rockett, "You're just the man I want. I'm commissioned to write up the burglary of the safe in the office of the firm of Wealthy & Rich. The police are nonplussed and haven't the slightest clue. Bring your instrument along, and show us its powers in the detective line."

"All right," said Dr. Hackensaw with a smile, "I'll go."

An hour later, the doctor was carefully examining the safe. By means of an extensible tube that could be pulled out from the front of the suitcase that contained his super-nose, the doctor explored every cranny of the safe. The doctor was

provided with a hollow walking stick which fitted into a socket in the top of the suitcase, and seemed to carry the scent to his nose. By this means he could follow a trail in the street without attracting undue attention.

After a thoro exploration of the safe the doctor followed a trail to the letter files, opened them and removed a certain letter and after sniffing it, put it into his pocket. Then he went back to the safe and followed a second trail which led him down to the cellar. Then he looked up with a puzzled look.

"Where is the night watchman?" he asked of the porter, who had accompanied him.

"I don't know, sir," replied the man. "He wasn't here this morning. Either he ran away or the burglars killed him and carried off his body."

"What is below this grating here?"

"That's the sub-basement, but it hasn't been used for years."

"Well, get some help and open it. You will find the watchman there tied hand and foot. The burglars lowered him there."

Sure enough the poor man was found unconscious and delirious and could give no explanation of what had happened to him.

"Come with me, Silas," said *Keene*, and hailing a taxi he was soon speeding uptown. Dismissing the driver he climbed the steps of a fashionable residence and rang the bell.

"Please ask Mrs. Harkness if she will see me for a few minutes," he said to the maid, and shortly afterward the lady entered the parlor.

"Madam," said the doctor. "will you kindly tell us why you and your two brothers last night broke into the safe of Messrs. Wealthy & Rich?"

The lady turned white to the lips and for a moment appeared about to faint. Then with an effort she recovered herself.

"What do you mean, sir?" she cried.

"There is no use denying the matter," said the doctor. "I have proof positive that you and your two brothers did the deed and that you removed some letters from the safe. I think you will find it to your advantage to tell *me* all about the matter, rather than the *police*."

The lady hesitated for a moment and then burst forth. "You are right, doctor," said she. "Wealthy & Rich are nothing but a firm of blackmailers. In some way they got hold of some letters of mine—written to a dear friend. There is nothing really bad in the letters, but my husband would be wildly jealous if he should ever see them. Now these blackmailers have been extorting money from me for months and making my life miserable, and so——"

"And so you got your brothers to help you get the letters back and I see the ashes in your grate here. But do you know, madam, who is at the bottom of the whole blackmailing scheme? It is your husband! It was he who found the letters and who conceived the fiendish scheme of punishing you for your innocent affair by delivering you into the hands of these blackmailers. If you don't believe me, read this letter of his, addressed to them, and which I secured from their letter file!"

"Yes, Silas," said Dr. Hackensaw, as the two left the house, "a dog is all very well in his way for following a scent, but a dog lacks intelligence and means of communicating with us. A dog lacks knowledge, too. A detective provided with my super-nose can accomplish things no dog could attempt. When I recognized Mrs. Harkness' scent on both packets of letters in the safe that touched the missing packet, I followed the scent to her letters in the letter file, and there I found the tell-tale letter from her husband. No dog could have done that!"

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