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MODERN ELECTRICS and MECHANICS

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MODERN ELECTRICS AND MECHANICS

ORLAND J. RIDENOUR, President. W. G. RIDENOUR, Secretary. AUSTIN C. LESCARBOURA, Editor.

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BUBIER'S POPULAR ELECTRICIAN, *Established* 1890 — BUILDING CRAFT, *Established* 1908
COLLINS WIRELESS BULLETIN, *Established* 1908 — AMATEUR WORK, *Established* 1901
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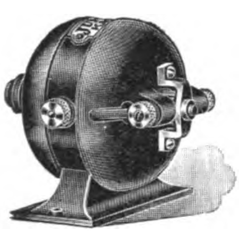

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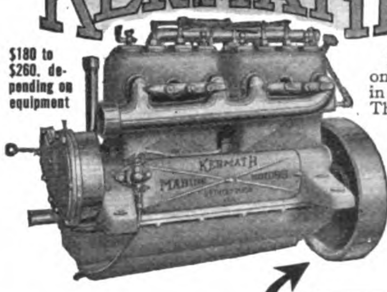

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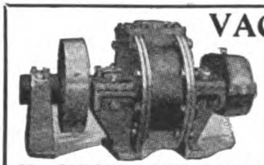

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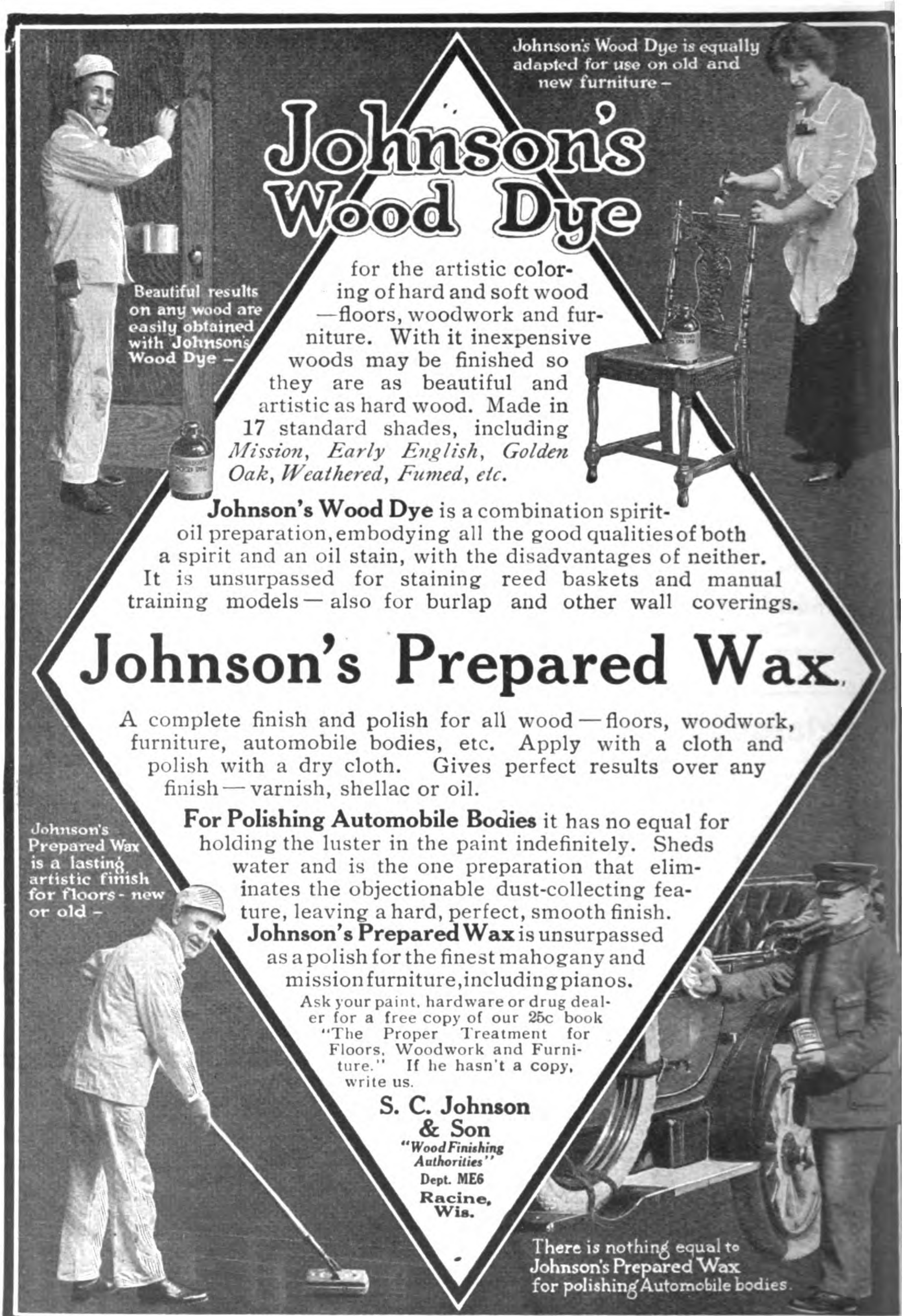
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Modern Electrics and Mechanics

VOL. XXVIII. June, 1914 No. 6

ANNOUNCEMENT

THIS issue marks the last number of MODERN ELECTRICS & MECHANICS *under that name.*

Beginning with the July number, it will be merged with POPULAR ELECTRICITY AND THE WORLD'S ADVANCE, *both of which will be published in the future as one magazine under the title of POPULAR ELECTRICITY AND MODERN MECHANICS.*

For some time it has been evident to the publishers of both magazines that the fields covered by each were essentially the same, although the editorial policies differed slightly in some respects. After due consideration, it was shown conclusively that the merging of the two papers would effect economic advantages, making possible the publication of a magazine absolutely unparalleled in its wealth of material in this particular field.

The new magazine will be published by the Modern Publishing Co., 32 Union Square, New York City, and its editorial policy will be quite unique in the field of popular scientific literature. The aim will be two-fold, namely, to afford both entertainment and practical instruction in the world of science, electricity, wireless and mechanics.

The present policy of POPULAR ELECTRICITY AND THE WORLD'S ADVANCE *in presenting bright and newsy stories of the latest achievements of science will be fully carried out and enlarged upon, and each number will be replete with profusely illustrated articles covering all that is new and interesting in the World's Advance.*

The plan for the departments of practical instruction has been evolved only after a most careful study of the requirements of the host of readers to whom this section of the magazine is most interesting. It is believed that there is a growing demand for authoritative information covering modern practice in the design, construction and use of electrical, mechanical, wireless and scientific apparatus of both unusual and special types. The available textbooks and reference works have not always given this information in a form conveniently available to the practical worker who wishes explicit but concise instructions, free from burdensome theory and confusing terms. It will essentially be the scope of this magazine to supply this information, for, when all is said and done, the most complete reference book is but a resumé of all that has been published in the periodicals during a certain period of time, supplemented by the personal knowledge and opinions of the authors.

In presenting the first issue of POPULAR ELECTRICITY AND MODERN MECHANICS, the publishers feel that they are taking the initial step toward the realization of an ambition to supply a journal of practical and useful information, the object of which shall be to tell the readers "how to make and how to do." Every effort will be exerted to supply data based upon the practical experience of the author in the actual construction and use of apparatus and devices described. Further than this, the efforts will be extended to the acquisition of material hitherto unpublished in any form. The result, it is hoped, will be a veritable gold mine of suggestions and aids to the man with a hobby, the practical electrical and mechanical worker, the experimenter, the high school or college student, the manual training or physics instructor, the lecturer, and the man or boy who wishes to absorb all available knowledge pertaining to electricity, mechanics, wireless telegraphy and the allied arts.

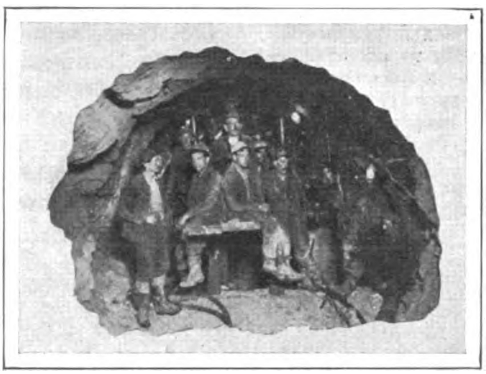
In order that the ambition of the publishers may be fully realized, the hearty co-operation of the readers is necessary. The magazine is published for you; without your support it could not exist. Therefore, your suggestions are more than welcome. On the appearance of the first and succeeding numbers of POPULAR ELECTRICITY AND MODERN MECHANICS, will you not voice an opinion which may aid us in realizing our highest ambition,—to give you a magazine you will refer to as your ideal?

THE STRENGTH OF THE HILLS

High in the Sierra Nevadas, the Harnessed Mountain Streams Furnish Power and Light to Far-Away Los Angeles

By Charles Elmer Jenney

BACK into unmeasured time a little stream of the mountains, rather presumptuously named Big Creek in these latter days, had played and frolicked over boulder and cliff, through valley and gorge, high up in the Sierra Nevadas. The other day it became grown up and went to work, and is now turning the wheels of business activity in Los Angeles, two hundred and seventy-five miles away. Its former playground, known to the favored few who have camped out in the high Sierras in past summers as the Big Creek Basin, a beautiful little rock-walled valley back in the wilds of Fresno County mountains, is now a basin indeed, or rather a large lake several miles long, made so by two immense dams of re-enforced concrete. And the many small waterfalls, cascades and swift rushes of the creek down through and out of it are now combined in one swift leap of over two thousand feet, and its excess force running in lightning current over aluminum wires to a great city in a far distant part of California.



A VIEW IN THE TWELVE-FOOT TUNNEL, SHOWING THE LABORERS OR "TUNNEL STIFFS" AS THEY ARE KNOWN

The whole Sierra Nevada range of California, the backbone of the State, is a vast source of latent power, and this one project is but a mere unit of which hundreds more are available when capital and labor are able to unite in civilizing the rude force of nature. Light and power for the whole Pacific Coast of the United States lie sleeping beneath the blanket of snow that enfolds the Sierra summits. There is no need to encroach on the few well-known pleasure resorts like the Hetch-Hetchy, when a hundred drinking cups big enough for a western metropolis are dripping along the range.

A little over a year ago the Pacific Light & Power Corporation decided to develop one of the most favorable of these mountain storage situations at Big Creek, about seventy miles east of Fresno, in the Sierras. It is located in almost the exact centre of the State of California in its north and south direction. The natural conditions made it one of the most feasible, and by damming Big Creek, a branch of the upper San Joaquin River, at a narrow pass and by erecting another lesser dam at the only other low point in the outline, a large lake could be formed of the Big Creek Basin, and peculiarly well situated for controlling the thus pent-up force.

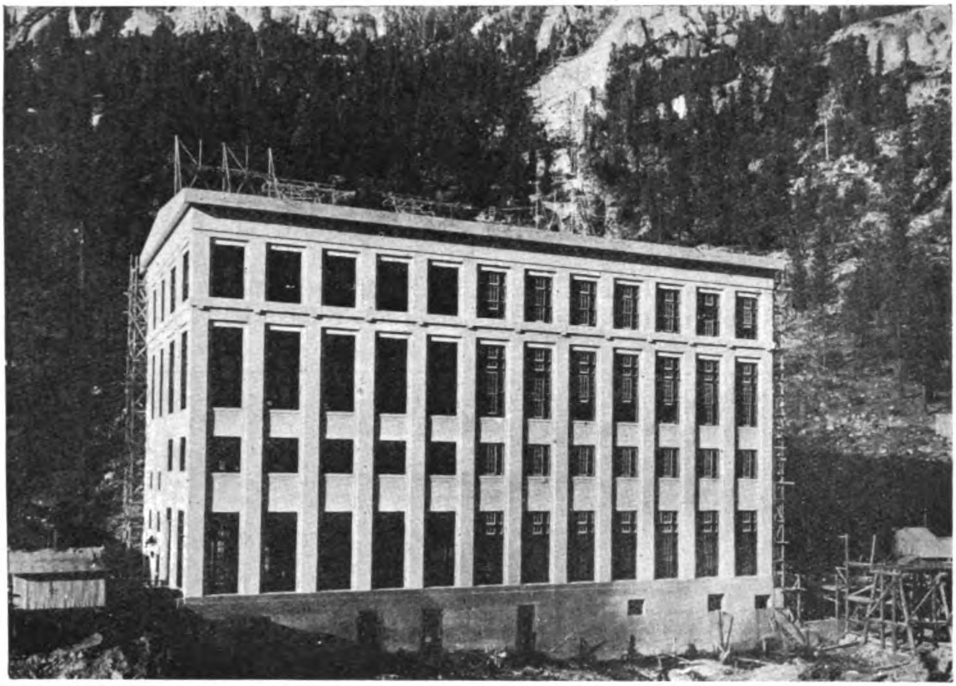
The Stone & Webster Construction Company, of Boston, undertook the project and successfully carried it through to completion. The country was a wild one, accessible only to pack-trains with difficulty, and for the conveying of the vast quantity of material and machinery necessary one of the first steps was the construction of a mountain railroad fifty-six miles long, one of the most crooked in the world and with many excessively steep grades. This cost in the neighborhood of five million dollars. In addition to the clearing of forests from the basin and the right of way in a diagonal line across the mountain to the plains, incidentally about one hundred

THE INCLINED RAILWAY AT POWER HOUSE NO. 2. THIS RAILWAY RISES FROM 3,800 TO 4,800 FEET AND HAS A TOTAL LENGTH OF 6,000 FEET. A GROUP OF SHACKS USED BY THE WORKMEN MAY BE SEEN AT THE RIGHT

A VIEW OF DAM NO. 2, LOOKING NORTH, BEFORE THE BASIN WAS CLEARED

and twenty-five miles of wagon road was constructed, which means a great deal with one familiar with the ruggedness of this range. Right through the mountain they drilled a new channel for the impetuous waters—a tunnel twelve feet in diameter and six miles long; through granite of such compression that the electric drills fast dulled. The power of neighboring mountain streams was called into use in the form of electricity to carry on the work. Three thousand six hundred men were employed at one time on the work and the names of sixty thousand men altogether are shown on the payrolls. In spite of the inability to carry on the work during part of the winter months, the undertaking was completed in a little over a year's time, and the power turned on just before midnight of November 7th. Within an hour the full output of one of the two power-houses, 80,000 horse-power, was passing over the line that runs nearly one-third the length of the State.

This transmission line has its own remarkable features. Starting from two twelve-story re-enforced concrete power houses, each of which cost in excess of half a million dollars, and wherein are installed the most complicated and latest electrical appli-



ances, the current passes over aluminum wires one inch in diameter, from one steel tower to another, down the mountain side, across the foothills and two hundred miles across the great interior plains of California, to the city of Los Angeles. The securing of the right of way for the placing of these towers and maintenance of the line was no mean task. Eight million pounds of aluminum is stretched in the two long cobwebs, spread, as it were, in a night. This means that the equivalent of the entire output of aluminum of the United States for a year was consumed in this one job. The combined capacity of the two power houses, which are four miles apart, is 150,000 h.p. It brings back the fancies of the Arabian Nights to us adults again, to realize that the power to move mountains is traversing the little shining wire; that the turning of one wheel by the water up in the mountain will turn a thousand car wheels in a great city a day's journey away. This is believed to be the longest power transmission in the world.

It cost twelve million dollars to complete the work, yet so overshadowed is it by the great canal project that comparatively few people have ever heard of it. Within the bounds of the moun-

POWER HOUSE NO. I AT BIG CREEK. THIS BUILDING IS OVER TEN STORIES HIGH AND CONSTRUCTED OF CONCRETE. THE WINDOWS ARE NUMEROUS AND SO ARRANGED AS TO PERMIT THE MAXIMUM OF LIGHT TO ENTER THE BUILDING

A DISTANT VIEW OF POWER HOUSE NO. I AND KERSCHOFF DOME

tain region of this one county of California there is sufficient latent power undeveloped but fully capable of being developed, to supply San Francisco and the other Bay cities with all their light and power.

Men in these days are realizing the eternal truth embodied in the ancient psalm, "I will lift up mine eyes unto the hills, whence cometh my help."

Back and forth across the mind flash the two pictures so different, and yet each so vivid—the beautiful mountain valley with its blue lake, with the Keiser Summit outlining its horizon, and the magnificent pines darkening the slopes, off in any direction from any of the surrounding heights are seen trackless snow-vistas equal to the best Switzerland can afford; and the other, the beautiful city of the Angels set amidst the green of its orange groves. And a touch hath made them kin.

A TYPICAL SCENE DURING THE CONSTRUCTION OF THE POWER PLANTS. PACK MULES WERE PRACTICALLY THE ONLY MEANS OF TRANSPORTATION IN THE BEGINNING BECAUSE OF THE ROUGH CHARACTER OF THE COUNTRY

A GIGANTIC SILENCER

The principle of the Maxim silencer has been suggested to solve the problem of eliminating the disagreeable rumble of huge generators.

Because of the great speed at which the generators of the 201st Street Station of the United Electric Light & Power Company, of New York, are run, the sound is carried out through the ventilating doors, disturbing the sleep of nearby residents.

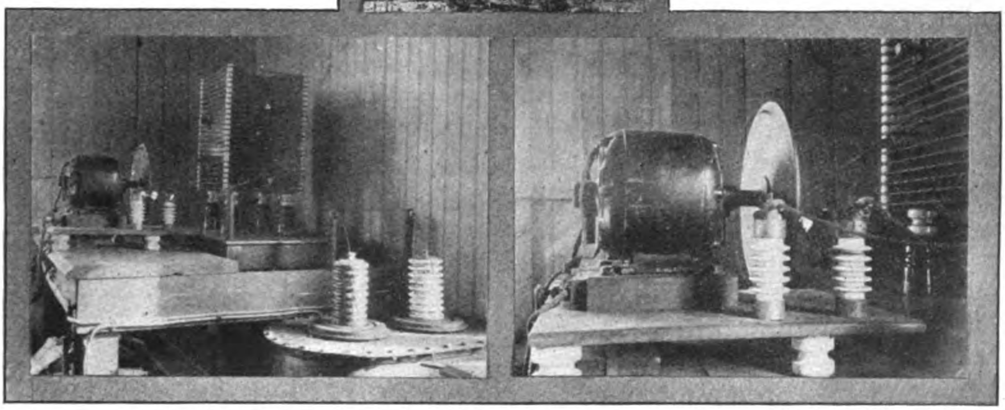
Professor Sabine, of Harvard College, and his associate, Professor Swan, have worked out an elaborate system which they think will do away with the sleep-disturbing roar in the future. They believe that the rush of air up from the basement carrying off the sound of the generators through the open doors is the vital part of the problem. Due to the great speed at which the turbine-driven generators are run it is necessary to keep a draught circulating through the generator room. Otherwise the air would become unbearably warm and the machines would be overheated to a dangerous degree.

A system has been devised whereby the air from the basement will be conducted into a small well, which will lead to the first floor. This well is to be equipped with partitions arranged close together after the fashion of the series of compartments in the Maxim silencer. The partitions are made of thin boards which provide a substantial foundation for layer after layer of felt made of cattle hair. The felt is three inches thick. The idea is that when the air rushes through the well to the first floor the sound will be killed, as in the Maxim silencer, and the rumble of the generators reduced to a minimum.—*Frank H. Jones.*

THE MARCONI STATION AT SAN PEDRO, CALIFORNIA

By Stanley E. Hyde

THE latest commercial station belonging to the Marconi Company on the Pacific Coast and in the United States, is situated at the little port of Los Angeles harbor, or as the natives would term it, East San Pedro. It is situated near the water front and from the outside the station appears as in one of the accompanying views, which shows the two-room house, the aerial and the masts. The tallest mast is 200 feet high while the shorter one is but 50 feet.



VIEWS OF THE NEW MARCONI STATION AT SAN PEDRO, CALIFORNIA
At the Top, the Exterior of the Station, Showing the Building and the Two Masts. At the Left, the Complete Transmitting Set, Showing the Rotary Spark Gap, Helix, Condenser, and Transformer in the Immediate Foreground. At the Right, a Closer View of the Rotary Gap in operation.

The transmitting set of this station comprises a five kilowatt commercial transformer, which may be seen at the right of the illustration depicting the complete transmitting apparatus, a leyden jar condenser, oscillation transformer and rotary spark discharger. The discharger is operated by a small induction motor, a closer view of which is shown in another illustration. A spark can be seen jumping from the fixed electrodes.

As for the receiving apparatus, this comprises a valve tuner and telephone receivers. Aside from these, there are placed on the desk of the operator a sounder connected to the Western Union system and a telephone. A switchboard, on which are mounted numerous switches, rheostats, and a volt and ammeter, is within convenient reach of the operator.

This station (KPJ) works with ships along the southern California coast and also with the station at Avalon, Catalina Island. Three operators are kept busy handling the traffic and work their watches at eight hour shifts.

In northern Arizona, Utah, Nevada, southern Idaho, and western Wyoming, the fires in national forests set by campers have decreased in four years from nearly a third to approximately one-fifth. Lightning fires have increased from less than one-fourth to nearly one-half. The relatively larger proportion from lightning, however, is due partly to decrease in other causes.

DO RADIO GHOSTS EXIST?

The Experiences of Wireless Operators with Freak Atmospheric Conditions Give Rise to This Momentous Question

By Alfred C. Pickells
U. S. Radio Inspector

IF the signals energizing one's radio receiving apparatus should come in loud and strong, should suddenly decrease in volume or die out altogether, and then should as suddenly resume their former strength, continuing as if there had been no interruption at the transmitting station, the supposition would be that something was wrong with the detector or that the power at the transmitting station was varying. Either might be the case. But what is the operator to suppose when the same effect is frequently encountered at approximately the same location? Neither detectors nor transmitting apparatus wait for location to exhibit their freaks.

¶ There are certain sections on the North Atlantic coast which seem to be "blind" under certain conditions. It has been frequently noted by operators on coastwise ships that on approaching Charleston the signals from that station will suddenly diminish in strength or die out altogether, remain so for a period covering the length of time necessary to travel several miles, and then resume their normal strength.

For instance, there are certain sections on the North Atlantic coast which seem to be "blind" under certain conditions. It has been frequently noted by operators on coastwise ships that on approaching Charleston the signals from that station will suddenly diminish in strength or die out altogether, remain so for a period covering the length of time necessary to travel several miles, and then resume their normal strength. There are other instances at various localities in which operators, who have been receiving messages, have noted the same effect covering shorter periods of time; in other words, in which the intensity of the signals was alternately strong and weak.

In the aerial transmission of sound, investigation and experiment have established the fact that certain localities and certain atmospheric conditions absorb or reflect sound waves. At sea they call them "Ghosts" because they interfere with the blasts from the fog horns. Unfortunately, little or no data has been collected bearing on this condition in radio telegraphy, but the experiences of operators give rise to the question: Are there radio ghosts? In other words, are electric waves refracted?

Such a condition is a serious matter in the aerial transmission of sound when it is applied to seafaring work. It means that lives are at stake; that property to the amount of millions of dollars may be lost in a few short hours.

The volume of sound emitted from the axis of the bell of the average first-class trumpet or siren has been calculated to be from ten to fifteen times greater than that of the largest locomotive or ship's whistle. Should this enormous blast spread laterally, as it was supposed when aerial signals were first constructed, the sound waves from the siren would travel horizontally to a distance of eighteen miles, from the trumpet, eleven miles, and from the 12-inch whistle, ten miles.

This would mean that the navigator would first hear the signal about eighteen miles off shore and by its guidance steer directly for his objective point—a fact which might make it appear that such a system would give thorough protection to the navigator in foggy weather. But it often occurs that he will hear the signal at its outer range, then pass through irregular intervals of silence that sometimes stretch out to four or five miles in extent. Sometimes he will hear a double report from two widely different points ahead. One is the original, one its echo; but the two are exact in tone. The question therefore arises: Which is the original? Which course shall he follow? There are other times, for instance, when, having heard the signal distinctly on his starboard bow, he passes through an area of silence and hears it again—as distinct as before—on his port bow. Then the question: Is this an echo, or has a cross-current swerved him from his course?

In the evening of February 21, 1901, the Pacific Mail steamship *Rio de Janeiro* approached the entrance to the Golden Gate in a dense fog. Under the circumstances the ship was a possible victim of two dangers—that of being run down if at anchor, or that of stranding if under way.

The Pacific Mail Steamship Company considered the act of anchoring the lesser of the two risks and their regulations so ordered. The ship, therefore, anchored. But the seafaring man knows that just as much danger, if not more, threatens the ship in a fog and out of command. Hence, at 5:30 a. m. the following day, when the mist showed the first signs of breaking, the commander, Captain William Ward, gave the order to proceed.

A few miles farther in the fog settled again. They were already in the channel; the opportunity to anchor had passed. The pilot was a man of long experience. He steered by the fog signals of Point Bonita and Lime Point on the north and of Fort Point on the south, selecting by this help a course which undoubtedly would give the dangerous rocks off Fort Point a wide berth.

A half hour passed thus, then the warning notes suddenly faded into a deep, uncanny silence. The pilot tried his whistle, hoping to get an echo from the high bluffs of Point Diablo. He listened often, and having listened in vain, shook his head at the gravity of the situation. He knew that there existed a certain condition that the mariner has termed the "Ghost."

Forty minutes later and barely a half mile farther in, the *Rio de Janeiro* rested at the bottom of the ocean. Captain Ward had met his death and 130 persons out of the 210 on board had been drowned. And all this occurred well within the range of audibility of four fog signals which, proofs afterward declared, had been kept in continuous operation.

It was nearly twenty-two years before the loss of the *Rio de Janeiro* that the wrecking of the steamer *Rhode Island* caused the revelation of these startling facts, and upon these facts the owners based the reasonableness of their orders. But, as in the case of the *Rio de Janeiro,* the *Rhode Island* also demonstrated that it was sometimes necessary to disregard these orders.

In a similar way it was caught in the channel of the West Passage leading into Narragansett Bay after having been guided by the fog signal at Beaver Tail Point. An hour later,

¶ The volume of sound emitted from the axis of the bell of the average first-class trumpet or siren has been calculated to be from ten to fifteen times greater than that of the largest locomotive or ship's whistle. Should this enormous blast spread laterally, as it was supposed when aerial signals were first constructed, the sound waves from the siren would travel horizontally to a distance of eighteen miles, from the trumpet, eleven miles, and from the 12-inch whistle, ten miles.

while groping blindly in the thick mist in the center of an area of silence, the vessel crashed on the rocks of Bonnet Point. When the fog lifted in the morning, November 7, 1880, it was found that the vessel was within one and one-half miles of a fog signal whose range of audibility was about ten miles.

Naturally the officers and passengers swore that the fog signal was not sounding at the time. Quite as naturally, also, persons residing for many miles on either side along the coast testified that it was sounding uninterruptedly, because they had heard it.

It was this wreck which prompted the Lighthouse Service to engage in an investigation of the acoustic conditions surrounding this fog signal. In his report Lieutenant Commander Chadwick, U. S. N., said:

¶ Refraction is considered the cause for areas of silence. Whenever the lower current of air opposes the direction of the sound and there exists a favoring current in the upper air, it is claimed that the front of a wave of sound is tilted upward. Sound waves, too, are said to have a tendency to spread laterally. Moreover, cold, denser air is found to reflect them. Hence one of the explanations that has been tendered is that the combined effects of reflection and the lateral spreading of the waves themselves causes them to descend to earth again at some point farther on.

"In the summer of 1881, in a heavy fog, while running from Narragansett Pier to Newport, I came near wrecking the steamer *Cactus* by steaming as near to Beavertail as possible, that I might find out for myself if the fog signal, which I could not hear, was really sounding. It was not until we were abreast of the signal that we heard it at all, and then it burst suddenly on us as if it had just been started. We carried the sound on another course clear to Newport, and lying there the next day, Sunday, in a fog, we heard it all day. In 1885, when I spent a day cruising round Beavertail, I heard it at points where I did not hear it in 1881; and I did not hear it in 1885 at points where I did hear it distinctly in 1881."

Lieutenant Commander Chadwick's results and the report which, in the meantime, came from Portland, Me., that the Cape Elizabeth fog signal, nine miles away to the southwest, could be plainly heard in the city of Portland in spite of northeast gales which blew directly against the sound, and that it could not be heard in the intervening distance, aroused the scientists in both the United States and British lighthouse services to advance theories. They were infant theories and therefore aroused controversies; but out of the controversies came an accepted explanation.

Refraction was considered the offending cause. Whenever the lower current of air opposes the direction of the sound and there exists a favoring current in the upper air, it was claimed that the front of a wave of sound is tilted upward. Sound waves, too, were said to have a tendency to spread laterally. Moreover, cold, denser air was found to reflect them. Hence the accepted explanation was that the combined effects of reflection and the lateral spreading of the waves themselves caused them to descend to the earth again at some point farther on.

But there was still another explanation to be made; another question to be answered. Why should the same condition exist when the wind did not blow? A few months after the *Rhode Island* stranded, the yacht *Galatea* ran ashore in a dead calm and fog on Little Gull Island, in Long Island Sound, within a half-mile of the fog signal. The navigator did not hear the signal at all, though proof was given that it was heard in varying directions and distances as great as sixteen miles.

The suggestion was made that local conditions might be responsible. But this was refuted; and an extract from the journal of Professor Milton W. Humphrey, of the University of Virginia, showed that such phenomena existed over land as well as over water.

"June 17, 1864.—Breckenridge, with 11,000 men, was joined by Early with 4,000 at Lynchburg, Va. We were intrenched around the southern limits of the city. Hunter, with about 20,000 men, was driving in our cavalry from the direction of Bedford City, nearly south. The weather was very hot and there had been no rain for a long time. About 6 p. m. I observed shells exploding in the air in our front, but I could hear neither the guns nor the shells, though the distance was barely two miles. I called the attention of others to the phenomenon, and their observations were in accord with mine. About sunset, when the shells were still exploding, the reports not only suddenly became audible, but seemed unusually loud. Then we also heard the guns."

Professor John Tyndall, the scientific adviser of the Elder Brethren of Trinity House, or the British Lighthouse Service, explained such phenomena to be due to the existence of an acoustic cloud in the atmosphere, a cloud which obstructs the waves of sound in the atmosphere in the same manner that heavy clouds break the sun's rays. He claimed that such a cloud consisted of air of different density and humidity than the surrounding atmosphere; that it also existed in clear as well as foggy weather.

Though Professor Tyndall and other scientists explained the cause, when it came to suggesting a remedy, their brains went the fog signals one better—they worked, but they suffered aberrations of products and, therefore, issued no advice. They knew of no law which would foretell the appearance of these acoustic clouds, the length of their visitations, nor the place which they might select for their operations.

There is much in these facts suggesting that certain conditions may exist in radio transmission. The theories which have been advanced concerning the transmission of electric waves are somewhat similar to those describing the propagation of sound waves and light waves.

In radio transmission we have what are termed "freaks," the phenomenon that permits of the reception of signals at record-breaking distances. It is known also that the atmosphere can be, and frequently is, so irregularly ionized by local static electrical conditions as to completely destroy the signals sent out by even the more powerful shore stations.

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In practical radio telegraph work this is partially overcome by the use of gaps of high spark frequency. Down in the Gulf of Mexico there are numerous high-pitched spark stations but they, also, have noted the same trouble; they have noted that "ghosts" do appear.

Radio transmission has been within our grasp from a practical standpoint for a little over eleven years, and during those years the energies of patentees have been directed toward the development of various parts of the apparatus. Some scientific data has been collected in distance tests and energy tests, but the facts concerning the transmission of electric waves through space under various conditions have not been much sought after.

It is a problem that may, in the course of time, be tackled by a corps of capable investigators who may bring out revelations that may put the Ghost, if it really does exist, to flight. They may show that the waves which transmit radio intelligence are in a class which will prove more likely of control than those which are given off by the fog signals.

THE ENERGY OF THE FUTURE

The Ultimate Exhaustion of Our Coal Supply Gives Rise to Several Unique Motive Power Producers

By Stephen House

Illustrations from drawings made by the author.

IT is a question of no small interest as to what will occur when the present sources of energy are exhausted. We do not at the present day anticipate fuel exhaustion, though future generations must face the problem of finding a substitute for the coal which is so plentiful to-day. Many factors are at work to prolong the supply of coal. Oil, natural gas and peat all lend themselves as motive powers in modern engines. It is estimated that the sources of these, however, will be forgotten before the coal supply gives out. Timber is a poor substitute. We are in the progressive age distinguished by the dominating factors coal and steel. This must give place to a period of conservation, when man's whole energies and powers of mind must be concentrated on the task of utilizing supplies of energy in the most economic manner and to prolong new sources. Among the factors which tend to prolong the coal supply are the increased

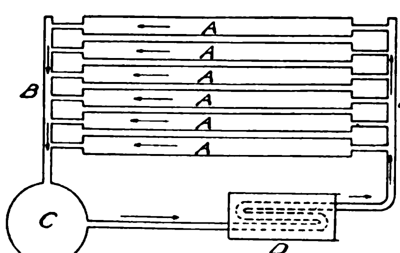


Fig 1

economy and higher efficiency of the engines of to-day and of the future, as well as the utilization of the tremendous powers possessed by running water, where the energy is transformed into the transportable electric form. It has been estimated that this latter source will prove unequal to the demands of industries at their present rate of increase in more than about four hundred years.

Fig 2

This reduces man's resources to the natural ones, viz.: 1—Solar energy; 2—internal heat of the earth; 3—wind power; 4—the tides; 5—the ether, and 6—transmutation. The following of these may be set aside as unfeasible: The internal heat of the earth, the ether, and transmutation. The first is rendered impracticable owing to the enormous depths to which shafts would have to be driven in the earth in order to reach a temperature zone of any use. The energy contained in the ether as calculated is immeasurable and were it possible to yoke it in man's service it would prove a source of infinite supply. One may doubt, however, whether the genius of man will ever be able to harness it. The enormous quantities of energy liberated during the disintegration of the radio-active substances would be a tremendous help, but little real assistance is to be expected from this quarter unless man's ingenuity devises a means of accelerating the process. Though these sources appear at present to be utterly outside the sphere of practical utilization, they supply a field as yet unploughed for the brain of genius.

There are left to us then, solar energy, wind energy and the energy of the tides. It is a debatable point whether any great use will ever be made of the winds, for it is discovered that a wind travelling at a rate more than 20-25 miles per hour causes more damage to the machinery of the windmill than is equalled by the profit gained. Advance along this path appears to lie in improved and strengthened machinery. Both the energy of the sun and the energy of the tides lend themselves to very practical application and each is worthy of closer examination.

The sun is continually radiating into space enormous quantities of energy in the form of light and heat waves and these waves when focussed to a point are sufficient to cause fire. This is well known. The first system erected for the purpose of using the sun's heat in this way, employed a huge parabolic lens to concentrate a wide beam of rays upon a small stationary boiler. One of the chief disadvantages to this plan was the prohibitive first cost which the results obtained by no means repaid. Hence the simpler and handier method of heating water in shallow pans replaced the lens.

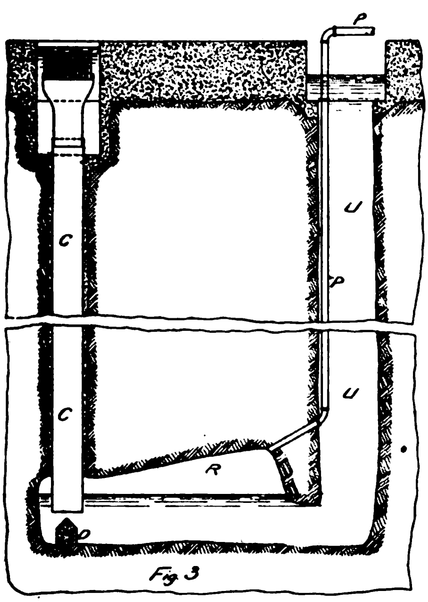


Fig. 3

A series of shallow pans is connected with a reservoir which in turn is connected with an internal combustion engine. Fig. 1 shows a simplified plan of this. The pans, A, are of metal with an outside covering of felt or other non-conductive material such as sawdust, and have a double glass cover, Fig. 2. Between the two glass covers is an air space of about 1/8 inch. At one end these pans are connected with a channel B (fig. 1) which discharges into the

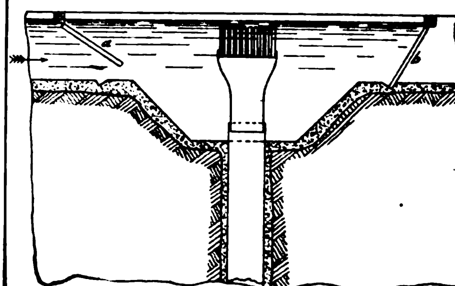
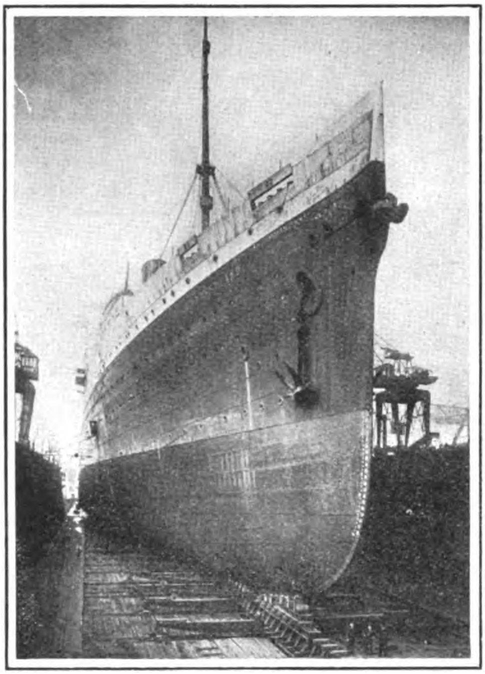


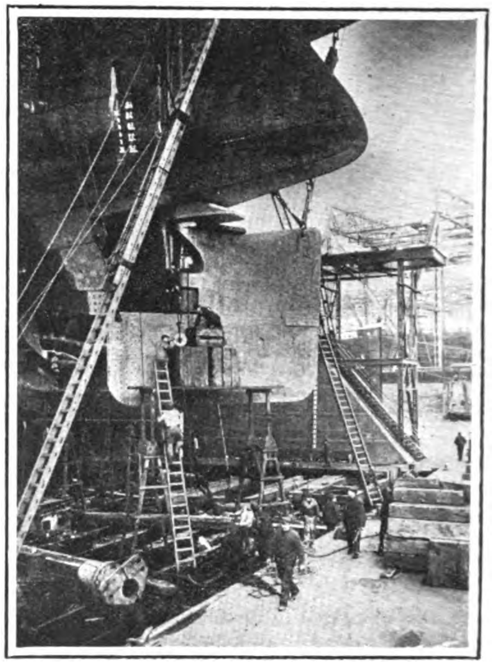
Fig. 4

reservoir C, and at the other end with the channel E, which leads from the internal combustion engine. A stream of water enters each pan from the channel E and flows very slowly through to channel B. During its passage it is heated to about 160° F. by the heat of the sun absorbed through the glass. The water thus warmed flows into the reservoir and thence to the internal combustion engine, where it gasifies such fuel as ether, liquid carbon dioxide, or sulphur dioxide, which gas expanding in the piston cylinder sets the engine in motion. In this way a continuous supply of energy is obtained so long as the sun is shining. During cloudy days the system is obviously at a standstill. In countries where the greater number of the days are sunny, as in California, Africa, and Australia, such a scheme ought to lend itself to more than theoretical consideration. It has during late years been used very successfully in both California and Egypt and must play a prominent part in the industrial life of the future. So far only small horsepower engines have been employed, though there has been discovered no reason why a higher power and higher degree of efficiency per square yard of land occupied should not be possible. In this system full use is made of the sun's rays. The loss incident upon the slope of the rays during the morning and afternoon is obviated by the use of special rotat-

(Continued on page 806)



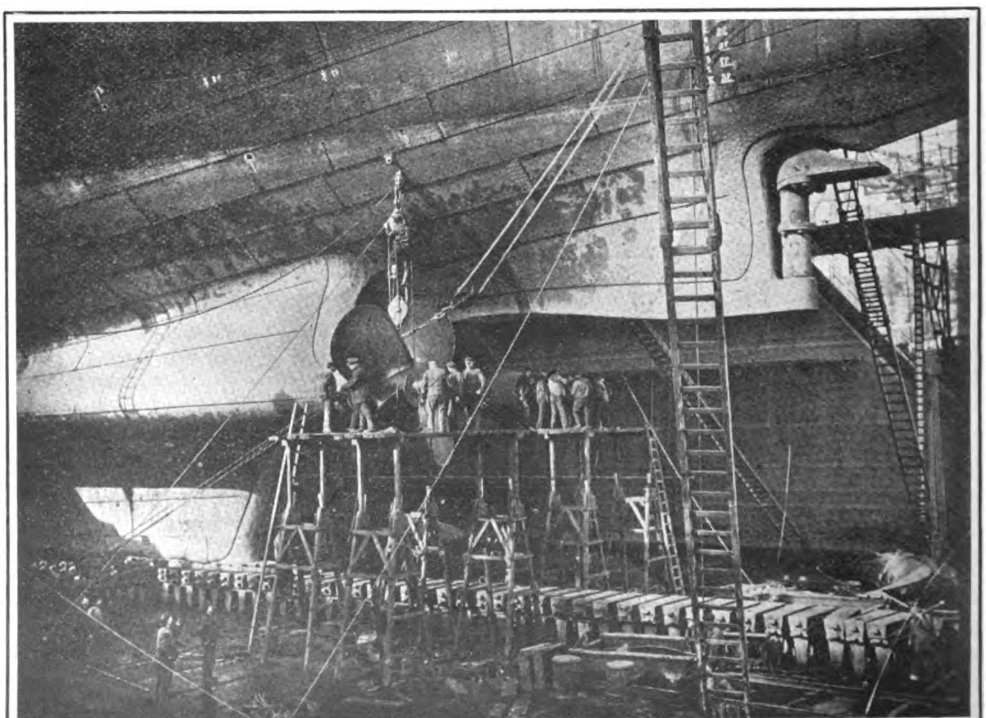
STEAMSHIP "VATERLAND" IN DRYDOCK
Showing the Graceful Lines of this Huge Ship which Closely Resemble those of a Fast Yacht.



LARGEST RUDDER IN THE WORLD
Workmen Placing the Rudder of the "Vaterland", Showing its Huge Proportions and Balanced Design.

THE STEAMSHIP "VATERLAND"

THE PROPELLERS OF THE "VATERLAND" AND A PORTION OF ITS HUGE KEEL
Four Propellers Revolving at a Speed of 150 Revolutions per Minute Drive this Latest Goliath at 23 Knots an Hour. Each Propeller is 19 Feet 7 inches in Diameter and Weighs Nearly 15 Tons.



THE STEAMSHIP "VATERLAND"

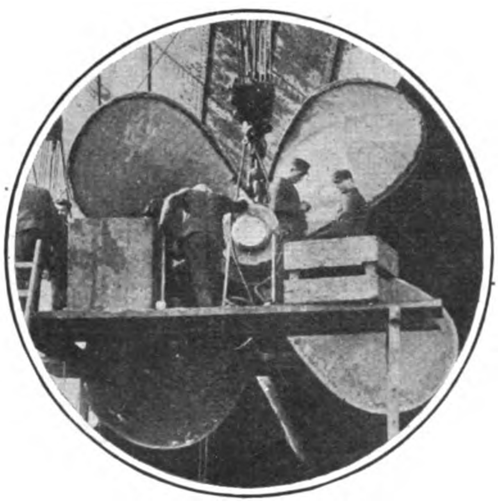
This Latest Ocean Greyhound, the Largest Ship Afloat, will Soon Make Her Maiden Trip

IN the accompanying collection of views is shown the *Vaterland*—the world's largest steamer at the present time. This huge vessel measures 950 feet in length. The top of the foremast rises 300 feet above the keel, which is equivalent to the height of the average skyscraper in New York City.

Although of huge proportions, the lines of the *Vaterland* are so graceful that one is apt to fail in realizing her immense size. In fact, the lines of her long narrow prow rather suggest those of a fast yacht than those of a monster ocean liner.

In the building of the *Vaterland* it was necessary to group two of the largest drydocks ever constructed to accommodate the great ship. In one of the accompanying views may be seen the prow as well as one of the huge anchors, said to be the largest in the world, weighing 11.8 tons. The starboard anchor weighs 10.5 tons. The liner has a tonnage of 58,000.

The propellers of the *Vaterland* set a new standard for size in such construction. The great blades suggest a windmill, strikingly dwarfing the workmen standing about them. Each of the four powerful propellers has a diameter of nineteen feet seven inches and weighs nearly fifteen tons. When the quadruple propellers revolve at a speed of 150 revolutions a minute, the great liner is driven forward at a speed of over 23 knots an hour. The propellers are made of the finest quality manganese bronze to withstand the strain which is put upon them, and before being installed they were subjected to the most exhaustive tests.



ONE OF THE PROPELLERS OF THE STEAMSHIP "VATERLAND"

The adjustment of the rudder of a great ocean liner is one of the marvels of mechanics. The rudder of the *Vaterland* is shown in one of the accompanying views while being placed in position. This rudder is made of forged steel and weighs 50.5 tons. It is of the balanced type and a considerable part of its surface extends forward of the rudder post on which it turns. This offers a greater steering surface than the conventional forms and renders it much more sensitive to the steering wheel. Incidentally the rudder shaft measures nearly three feet in diameter. The rudder is upward of a fifth of a mile from the navigating bridge, yet so perfect is the machinery controlling the mammoth rudder that at a touch it swings smoothly from side to side. It is said that the great ship answers her helm as quickly as a tugboat.

The *Vaterland* is a sister ship of the *Imperator*, although exceeding her in every dimension. This new monster liner of the Hamburg-American Line will make its maiden voyage sailing from Hamburg May 14th and reaching New York May 21st.

New Jersey is said to have the greatest proportion of railroad mileage of any State in the country, or one mile of railroad to every three square miles of territory. This makes an unusual risk of forest fires set by railroads.

AN ELECTRICALLY FIRED CANNON

With a Fair Amount of Mechanical Skill the Cannon Described May be Constructed at Moderate Cost

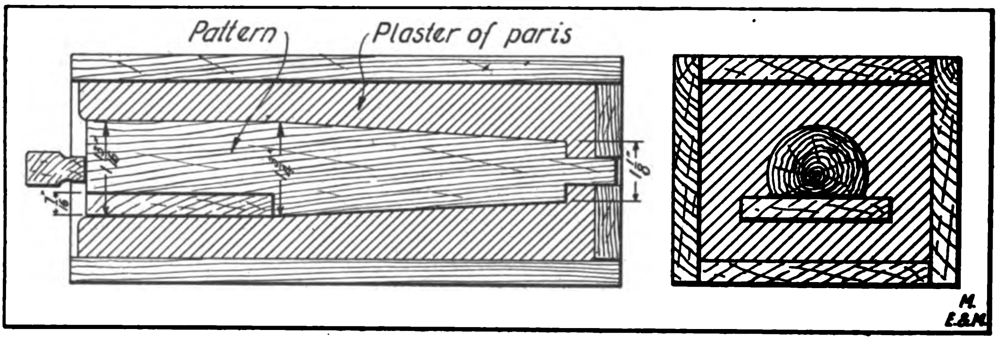
By Stanley McClatchie

Illustrations from drawings made by the author.

THE apparatus herein described will be found not only interesting from the standpoint of the scientific experimenter, but also a source of perennial Fourth of July entertainment. The writer has built several of these cannons, and can testify from intimate experience to their satisfactory operation. They will blast through pine boards and similar materials in a very formidable manner, and will produce an explosion which can be heard for nearly two miles. Notwithstanding the violent nature of the discharge, its effects will extend for only ten or fifteen feet beyond the muzzle, owing to the fact that the ramming material consists of nothing more than old paper. This apparatus is therefore much less dangerous to handle than large firecrackers, as well as being far less expensive to operate.

The construction of the outfit is comparatively simple, but involves a fair amount of skill in mechanical arts. The cannon itself consists of a section of ¼-inch pipe around which is cast a heavy layer of zinc or babbit metal. This casting is mounted upon a small box constructed of heavy hardwood. Inside this box is placed a dry cell. The firing mechanism consists of a device for holding short lengths of fine wire over the fuse hole, together with a spring so arranged that when pulled back by means of a string, a circuit through the dry cell and fine wire will be closed.

The form of the pattern required for making the casting, is indicated in figs. 1 and 2. In fig. 1 is shown a longitudinal cross section of the pattern embedded in the mould. It will be noted that this pattern is made one inch longer at one end than is the finished cannon. This is done for the reason that in cooling the metal will sink down in the center, necessitating the removal of about an inch of the casting at the pouring end.



FIGS. 1 AND 2.—SIDE AND END VIEWS OF THE PATTERN FOR MAKING THE MOULD

In one side of the pattern a separate piece is inserted. As may be seen in fig. 2, this piece is flat and projects beyond the sides of the barrel, forming the two lugs by which the cannon is attached to its base. Great care should be exercised to see that this piece tapers properly with respect to the barrel of the pattern. As indicated in fig. 1, this taper is to amount to 1/32-inch either side of a central line drawn through the piece parallel to the axis of the barrel. The upper portion of the barrel has a similar draught. At the lower end of the pattern a short stem will be noted. This stem is to be made the exact diameter of the pipe which forms the center of the cannon. After the pattern is withdrawn, this pipe (which is to be cut an

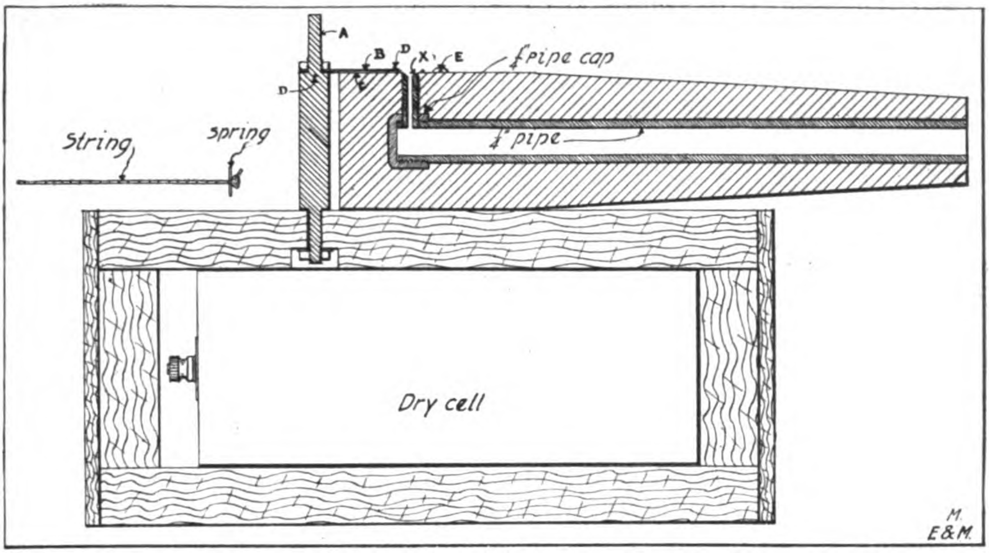


FIG. 3.—SIDE VIEW OF THE FINISHED CANNON, SHOWING THE METHOD OF MOUNTING AND THE BATTERY BOX

inch longer than required) is inserted in the resulting hole for support.

Now to prepare the mould. Nail together a light box of about the dimensions indicated in fig. 1, taking care that the joints are made reasonably tight. Dip the pattern in melted paraffine several times, coating it to a depth of about 1/32 of an inch. Insert the lower stem in the hole in the bottom of the moulding box. Prepare a thick liquid solution of plaster of paris, and pour it in. When the plaster is set, place the mould in an oven until it is thoroughly warmed. The paraffine will thus be melted from around the pattern, making possible its ready removal.

An alternative method of making this mould is to use founders' sand instead of plaster of paris. This latter process may, perhaps, prove less difficult where the proper material is obtainable. The sand used must be obtained from some brass or iron foundry, as no ordinary earth will serve the purpose properly. This sand is to be moistened to an easily workable consistency and gently packed around the pattern as it stands in place in the moulding flask. Success demands a good deal of care in getting the sand moistened to just the right point, and in packing it in with just the right amount of pressure. Too much ramming will make it impossible to withdraw the pattern clean and free, and too little will leave a bad mould. Before the pattern is removed from the sand, a number of small vent holes should be made down through the mould by inserting a piece

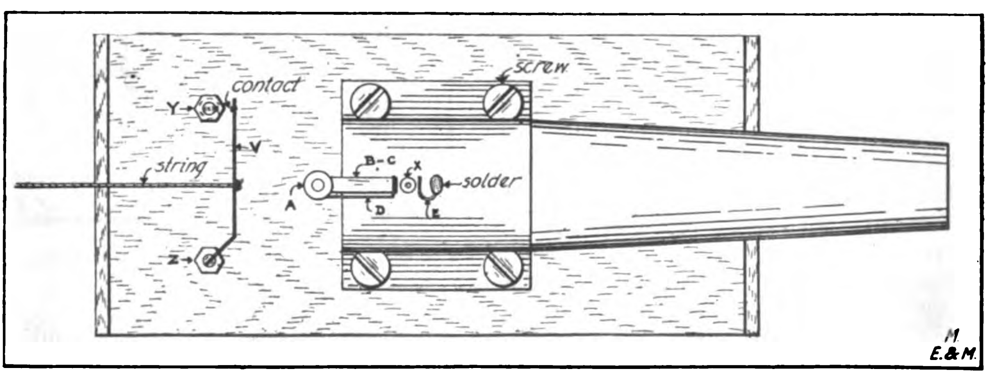


FIG. 4.—TOP VIEW OF THE FINISHED CANNON, SHOWING THE ARRANGEMENT OF THE DIFFERENT PARTS FOR IGNITING THE CHARGE

of straight wire or a hatpin. This is done to permit the escape of steam from the moist sand after the metal is run in. No matter what material is employed in

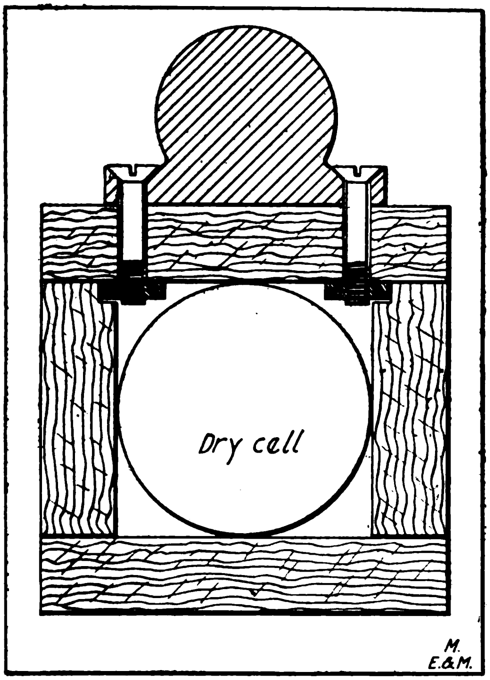


FIG. 5.—END VIEW OF THE CANNON MOUNTED ON THE BATTERY BOX

making the mould, several trials are likely to be necessary before success is attained. This experimenting will be comparatively simple where the sand is used. With plaster of paris it is necessary to take the moulding box completely apart each time a new trial is made. On the other hand, the use of plaster will produce a far cleaner mould, resulting in a casting which will not require finishing up to nearly the extent that sand makes necessary. A good, clear mould is the first and most important essential to a good casting, and a plaster mould is therefore preferable if successfully made.

The pipe for the barrel of the cannon should, if possible, be of brass, as this has a smoother bore than ordinary iron pipe. Gas pipe may, however, be employed if necessary. The pipe is cut to a length of 8¼ inches, and with a cap fitted to one end, is inserted in the hole at the bottom of the mould and very carefully centered. It should be fixed in place with a little plaster. The metal from which the casting is made may be either zinc or a good grade of babbit. This metal may be melted in an iron ladle over a very hot torch or gas burner. The flame of an ordinary gas or gasoline stove may be made to suffice by entirely surrounding the fire with bricks or clay after the manner of a brass founding furnace. A blacksmith's forge is likely to afford the simplest solution of the problem, however, if one is available. The hour or two required for the melting of the metal by the burner method may be reduced to a matter of a few minutes by the use of a forge. Considerable care should be exercised to see that the metal reaches just the right temperature before pouring. If too cold it will not run properly, and if too hot it granulates upon cooling. At the proper temperature, a pine stick inserted in the molten metal will instantly ignite. As the heating process goes on, keep testing with a bit of wood in this way. As soon as the flaming point is reached, run

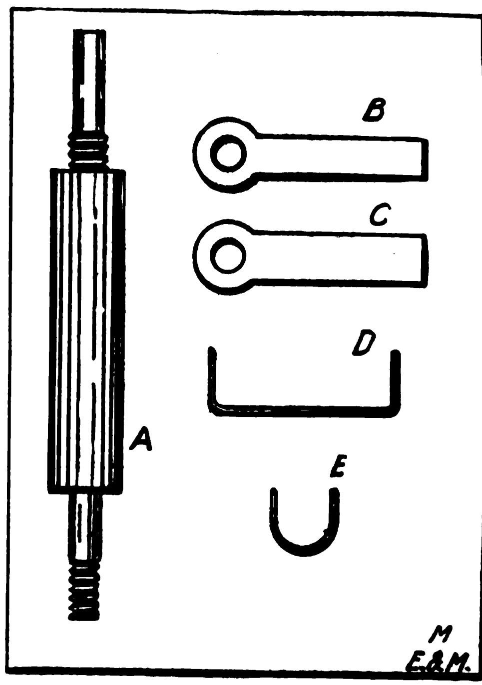


FIG. 6.—THE COMPONENT PARTS OF THE ELECTRIC FIRING DEVICE

the metal at once into the mould. A considerable period of time should be allowed for cooling, as parts will remain liquid long after the top has hardened.

The resulting casting should be reasonably clear and free from blow holes. If it is not, another attempt ought to be made, as an imperfect casting might render the cannon dangerous.

It may be suggested that it would be simpler to have the casting made at a brass foundry than to take the trouble of undertaking the work above described. This course is, however, rendered impractical by the long bore of the cannon. If this hole were drilled, it would be found to be much deeper than the length of any ordinary twist drill obtainable. In addition, the difficulties involved in cutting a hole of this size to any depth in brass, would be practically unsurmountable to anyone not possessed of a large drill press or lathe. Coring out the hole would be similarly impractical owing to the length of the core required, and the fact that it would be necessary, even were the hole successfully obtained in this way, to run through a reamer of very uncommon length. The method of casting a metal of low melting point around a pipe core as previously described, is in the end the simplest and most satisfactory method.

Having obtained a suitable casting, finish it up to the proper external dimensions, and drill a hole at the point indicated by X in figs. 3 and 4. Into this hole, tightly screw a brass bushing with an internal diameter of 1/16-inch. It is necessary that the fuse hole should be thus made, as the force of the exploding powder is sufficient to disintegrate the casting metal were it exposed at any point.

The box which forms the base of the cannon should be constructed of very heavy materials and firmly screwed together. A poorly made base will quickly go to pieces under the action of ramming and firing. The internal dimensions of this box should be just such as to admit an ordinary dry cell. The ends are finished off with thin squares of wood in order to lend a neater appearance to the work. The cannon is bolted to this box by heavy screws in the manner shown in fig. 5.

The construction of the firing mechanism may be gathered from figs. 3 and 4. The parts of the fuse wire holder are shown separately in fig. 6. This latter device consists of a brass post *A*, having bolted to its upper end the sheet brass part *B*, and mica insulation *C*. Soldered to the brass post, with one arm resting on the outer extremity of *B*, is the spring brass wire *D*. Another spring wire bent as indicated at *E*, is soldered to the cannon just in front of the fuse hole. The fuse wire is slipped between *B* and *D*, and then drawn on under *E*. The piece of mica *C* serves to insulate *B* from the cannon. Other materials than mica may, of course, be used for this insulation, but owing to the great heat developed at the ignition of the surrounding powder, any ordinary insulators would be gradually destroyed. The fuse wire employed should be of copper, and not larger than No. 40 gauge. The finer this wire is, the less energy it will consume in fusing and consequently, the longer the dry cell will last. No. 50 receiver wire should be employed if available. In operation a little coil of this

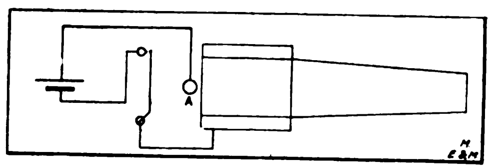


FIG. 7.—WIRING DIAGRAM FOR THE ELECTRICAL EQUIPMENT

wire is placed around the top of the brass post. When the cannon is ready for firing, one end is drawn out and slipped under the spring clips in such manner as to cross the fuse hole. Upon passing current from the dry cell through this wire, it will flash, igniting the surrounding powder and firing the cannon.

The trigger device is shown just behind the cannon in fig. 3. It consists of a flat spring *V*, attached at one end to a brass post and having a contact fitted to the other. A second contact point is fitted to the post *Y*. Upon pulling the string, which is tied to the middle of the spring, connection is made between the two contacts. The posts *Y* and *Z* may conveniently be made of brass screws, clamped to the base with nuts, and allowed to project a distance sufficient to permit the attachment of the spring and contact. The spring is soldered into a slot cut in *Z*, and the contact point is riveted into a hole drilled in *Y*. The wiring for the firing arrange-

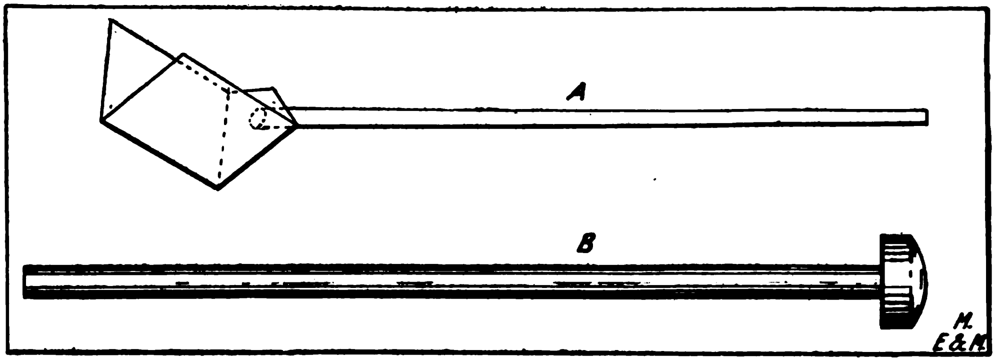


FIG. 8.—THE POWDER SPOON AND DRIVING ROD, USED RESPECTIVELY FOR HANDLING THE POWDER AND RAMMING THE CHARGE

ment is shown in fig. 7. It will be seen that when the string is pulled, a circuit is completed through the dry cell and across the fuse wire, which is attached between the brass post *A* and the body of the cannon.

The implements required for charging the cannon are shown in fig. 8. *A* is a spoon for handling the powder. This spoon is cut from a single piece of sheet brass, bent to the form indicated, and soldered. A brass rod riveted or soldered on, serves as a handle. The sheet brass should be so cut as to make the sides of the spoon measure about 7/8 by 1 1/8 inches. *B* is a driving rod for ramming down the charge. It consists simply of a 1/4-inch steel rod about 7 inches long, with a head attached to one end.

Ordinary black gunpowder is to be used for charging the cannon. Do not attempt to employ smokeless powder, as its explosive power is so great as to render the use of it dangerous. All powder should be kept securely sealed in a glass jar or can. To prepare the cannon for firing, stand it on end and pour in a spoonful of the charge. Then push down pieces of paper with the ramming rod until the bore is full to the muzzle; after which force the paper down with a few blows from a hammer. Now, having set the cannon in a horizontal position, fill the fuse hole with powder. Draw a length of the fine wire between the spring clips and sprinkle powder over it. *Great care should be taken during this operation to see that the battery circuit is not accidentally closed.* Now by retreating to a suitable distance, and pulling the string, a rousing explosion should occur.

The size of the cannon may easily be made other than that indicated, if desired. For example, 1/8 or 1/2-inch pipe may be employed by simply altering the general dimensions of the casting proportionately. If the experimenter does not wish to undertake the construction of the electrical firing mechanism, the cannon may be mounted upon a solid base and discharged by means of ordinary fuses. A simple expedient for accomplishing this purpose is to use ordinary cotton string dipped in kerosene. This will burn with a fairly dependable rate of speed, and is readily obtainable. There is nothing quite so fascinating, however, as to be able to step back and see the explosion occur by merely drawing the string of the electrical firing device.

A CORRECTION

In the May issue on page 574 there appeared an article entitled, "Curing Human Ills by Magnetic Waves." Unfortunately, an error was made in the diagram accompanying this article. In fact, as it was published the diagram is almost all wrong.

The coils of the Bachelet apparatus are connected to the source of current supply by means of double conductor cords which were not shown in the diagram published. Furthermore, the coils are all connected in parallel to both sides of the alternating current supply. A pilot lamp is connected across the alternating current mains.

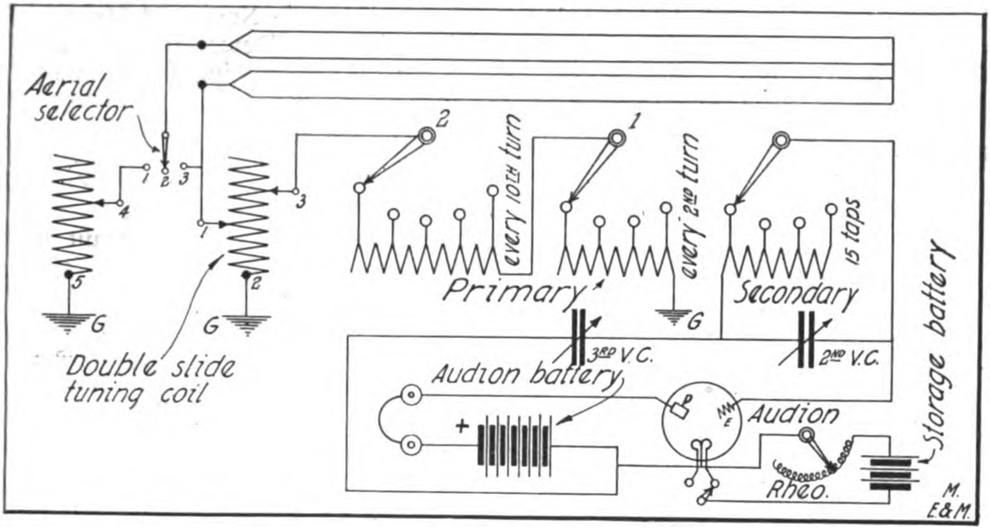


FIG. I.—COMPLETE WIRING DIAGRAM FOR CONNECTING THE RECEIVING SET.

A GOOD RECEIVING SET

A Continuation, in the Form of More Explicit Instructions, of a Recently Published Article

By B. N. Burglund

EDITOR'S NOTE.—Many readers have constructed receiving sets according to the instructions published in the article entitled "A Good Receiving Set," that appeared in the October issue of MODERN ELECTRICS. However, several points not clearly understood have been encountered by readers and numerous requests received for more explicit directions on the operation of this receiving set. Mr. B. N. Burglund has noted the points which were in doubt and accordingly wrote this article. Most of the explanations that follow refer to the text matter and diagrams that appeared in the original article, and will therefore be unintelligible unless the October issue is in the possession of the reader.

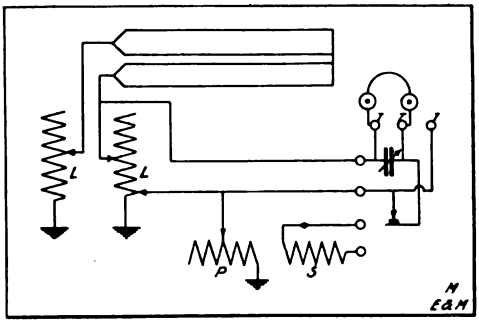
AT the request of a number of readers, the author has decided to furnish more elaborate details on the construction of the wireless receiving set published in the October, 1913, issue of MODERN ELECTRICS.*

To begin with, many of the correspondents do not seem to understand what binding posts A G A and binding posts 1-2-3-4 and 5 are used for. The accompanying sketch, Fig. 1, indicates the functions these binding posts perform.

The complete set is designed for use as a wave meter as well as a testing instrument for measuring any unknown conditions, such as the inductance of a loading coil or the capacity of an extra condenser, in fact, any X-circuit which is to be compared with a standard, providing the secondary of the loose-coupler and condenser No. 2 have been calibrated with a standard wave meter. It is also necessary to determine the correct values of capacity of the condenser and the correct values of inductance of the secondary. Here we have the principal components of a wave meter, and if the secondary winding is properly spaced a very sharp wave meter is obtained. (The description for winding this secondary follows later.) For instance, connect a double slide tuning coil to binding posts 1-2-3. Ground to 2 each slide to 1 and 3. Now this tuning coil can be used as an extra loading coil or a syntonizer, and by using switches marked "Circuit Selector Receiving,"

* Copies of this issue can be secured at 15 cents each while the supply lasts.

this double slide coil can be used for a standby circuit for open or rough tuning. On position 2-2 you are receiving from one slide to ground or only as a single slide tuning coil to ground. In position 3-3 one is receiving from both slides of the tuning coil and center ground with the secondary of loose-coupler cut out. Placing the switch back on 1-1 permits of receiving from secondary of loose-coupler and using double slide tuning coil as syntonizer or loading coil, depending upon the position of sliders.

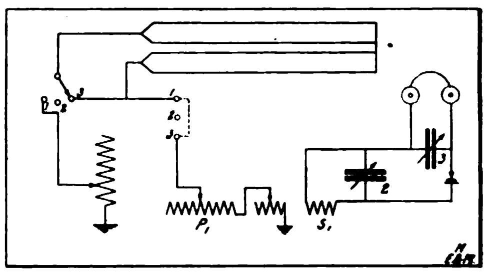


DIAGRAMMATIC WIRING DIAGRAM SHOWING THE FUNCTION OF THE DIFFERENT PARTS

The switch marked "Aerial Selector" is only used when a loop aerial of the United type is employed. This switch controls the "off" leg of the aerial. In position 1 the off leg is connected through a single slide loading coil attached to binding posts 3-4. This acts as an extra loading coil only when a loop aerial is used. In position 2 the off leg is entirely open and is excellent for long wave tuning. On 3 both legs are connected together making a straightaway aerial as is most commonly used by the Navy and Marconi.

The "Selector Detector" switch is used for rapid changing from audion to crystal detectors. In this switch a slight mistake has been made in the drawing published. The wire leading from condenser No. 3 to right-hand pole of the switch and the wire leading from the right-hand pole of circuit selector-switch should be on the right-hand pole of the selector detector switch instead of the left as is shown by the drawing. The author finds it best to leave out Condenser No. 1 entirely and if a condenser in the aerial is needed, place it in circuit through binding posts 1-3.

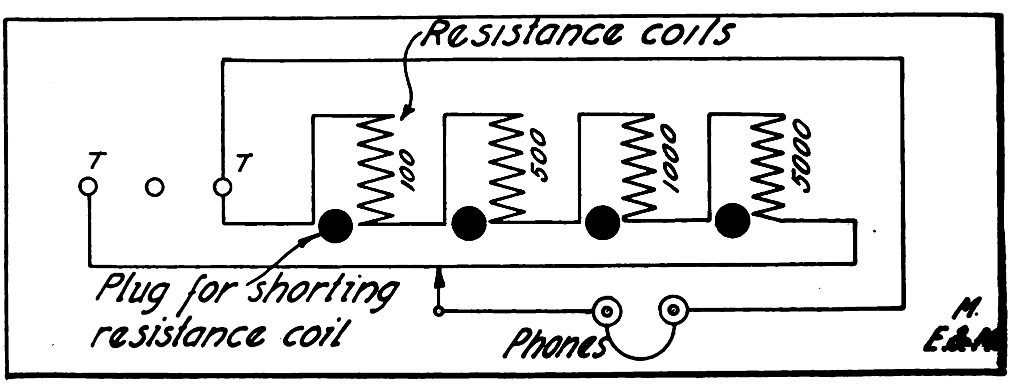
The audion filament switch is self-explanatory for, as most audions have two filaments, it is necessary to provide a suitable switch. Here the author has left the center button as off position for the sake of convenience.



SIMPLE DIAGRAM SHOWING HOW TO CHANGE OVER FROM A LOOP TO A STRAIGHT-AWAY AERIAL

Always place the pole changer on O-O before changing from audion to crystal, otherwise there is danger of ruining a sensitive crystal by passing

(*Continued on page* 800)



WIRING DIAGRAM FOR THE POTENTIOMETER ARRANGEMENT THAT MAY BE USED IN CONNECTION WITH THE SET AS A DECREMETER AND DISTANCE MEASURER

THE NEW CABLE TELEGRAPHY

An Account of What is Being Done by Cable Experts in an Effort to Keep Pace with Wireless Engineers*

By Donald McNicol.

Illustrations from drawings made by the author.

IF, then, a sufficiently sensitive receiving relay is employed at the distant end of the cable, it is apparent that ordinary Morse land line sounders and repeaters may be operated therefrom by means of local batteries.

The Gott arrangement, while its employment has practically the same purpose in view, has a somewhat different action from that of the Picard arrangement. Fig. 5 depicts theoretically the Gott transmitter circuits. PR is a polarized relay, the armature tongue of which remains in contact with the right hand or left hand stop after being moved there until the current traversing the coil windings of the relay has been reversed, whereupon the tongue moves over to the opposite contact. Closing the key K places the positive terminal of the main line battery in contact with the cable. Releasing the key lever permits the discharge from the cable to find a path to ground via the windings of the polarized relay (the armature lever of T having now moved into contact with its backstop), the result of which is that the tongue of PR is shifted to the opposite contact, and as the latter is connected with the negative terminal of the main line battery, the next forward movement of the tongue T will send to line a negative impulse. In transmitting the letter K, consisting of a dash, a dot, and a dash, the first dash would be made by a positive impulse, the dot by a negative impulse, and the second dash by a positive impulse. In the transmission of each letter, therefore, each element of the letter is made by an impulse having the opposite sign to that of the element preceding it.

It remains now to describe what has been accomplished in the way of developing receiving instruments capable of translating these impulses into intelligible signals.

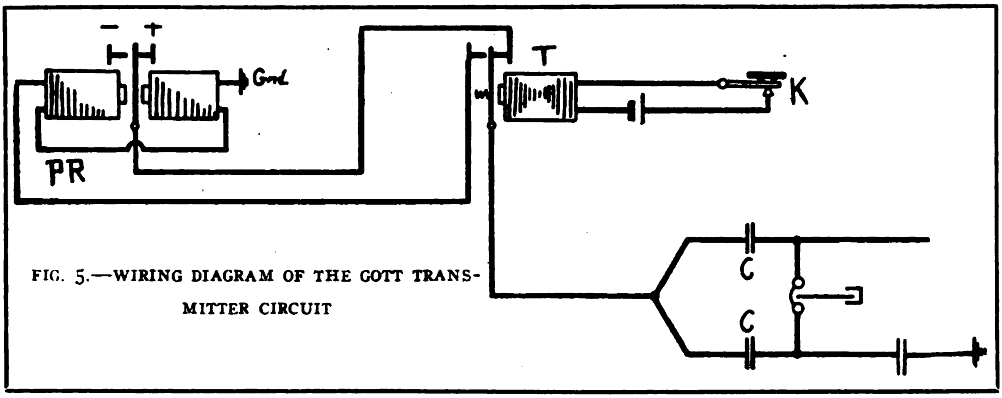


FIG. 5.—WIRING DIAGRAM OF THE GOTT TRANSMITTER CIRCUIT

Fig. 6 shows a theoretical view of the arrangement of the mechanism and the circuits of the Brown drum cable relay, invented by Mr. S. G. Brown, of London. This instrument resembles the siphon recorder insofar as the moving coil S, permanent magnet M, and laterally moving lever L are concerned. The operation of the relay might be described as follows: A received positive impulse passing through the suspended coil S deflects the coil to the right, which movement is, by means of two silk fibers R and R′, communicated to the tree T, which in turn controls the movement of lever L, causing it to move off the insulated segment (the shaded section) of

* Continued from the May issue of Modern Electrics and Mechanics.

the drum, and into contact with the metal section D, thus closing a local circuit including a battery and the coil windings of an ordinary polarized relay PR. When an impulse of the opposite polarity is received, the suspended coil is turned to the left, resulting in the movement of lever L, to the right, or into contact with the metal section D', of the drum, which in turn closes a circuit through local battery B, and polarized relay PR'. The drum is rotated mechanically at the rate of about 150 r.p.m. It will be noted that the drum is made in three parts, consisting of two outside (the dot and dash making contacts), and a center insulated section upon which the lever point rests normally when the suspended coil is not energized by current passing through it. It will be easily understood that the local contact points of the polar relays thus operated may be employed to open and close secondary circuits which may include reading sounders, or repeater transmitters.

The continuous rotary motion of the drum aids the lever pointer to slide or "skate" to the left or right in response to the movements of the suspended coil. The friction encountered is, therefore, much less than it would be were the drum held stationary.

Owing to the light contact existing between lever point and surface of drum, the electrical resistance varies somewhat, and at times is quite high. To overcome this difficulty and in order to insure that at all times a sufficient current value will obtain in the polar relay circuits to operate those instruments properly, condensers C^1 and C^2 are connected around the drum contacts. Another advantage of the condensers is that sparking and its related ill effects are reduced to a minimum. Each condenser has a capacity of two microfarads.

On short cables and where ordinary cable transmission (Fig. 2) is employed, a 30-ohm shunt having large self-induction is connected around the winding of the suspended coil, the presence of which produces a controlling and curbing effect upon the movements of the coil, resulting in clearer definition of signals.

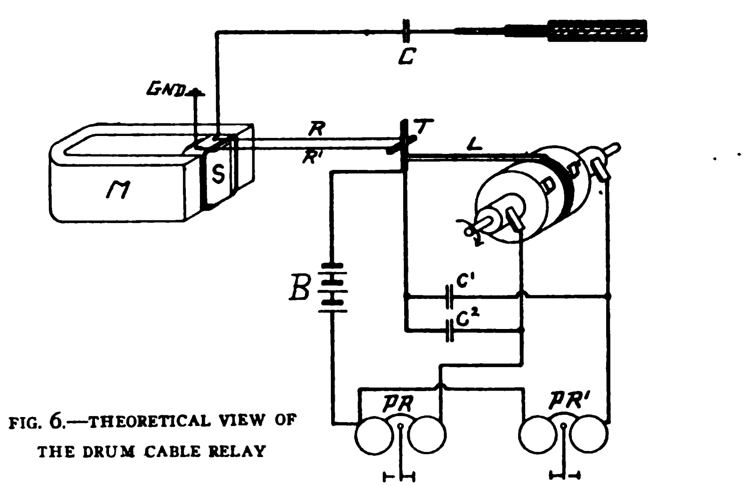


FIG. 6.—THEORETICAL VIEW OF THE DRUM CABLE RELAY

It might reasonably be surmised that the substitution of the drum relay in place of the siphon recorder does not give us a cable receiving instrument which by its self prolongs the length of a received impulse in such a manner that a dash may be distinguished from a dot by varying the duration of contact at the sending end. And it is true that where the ordinary methods of transmission are employed, the drum relay has no advantages over the siphon recorder. In fact, on long cables the former is not very successful, due to the varying zero line. But, where the newer methods of transmission (such as the Picard and the Gott systems) are employed, the availa-

(Continued on page 776)

SMALL ALTERNATING CURRENT MOTORS

Complete Working Instructions for the Building of Small Alternating Current Motors in Several Sizes*

By A. E. Watson, E. E.

Illustrations from drawings made by the author.

HAVING proved by the preliminary trials that the motor is properly constructed, the auxiliary starting devices mentioned in the first article for "splitting the phase" can next be provided. These are to consist of a simple resistance to be inserted in the starting coil circuit, and a choke-coil, or reactance, for the running coils.

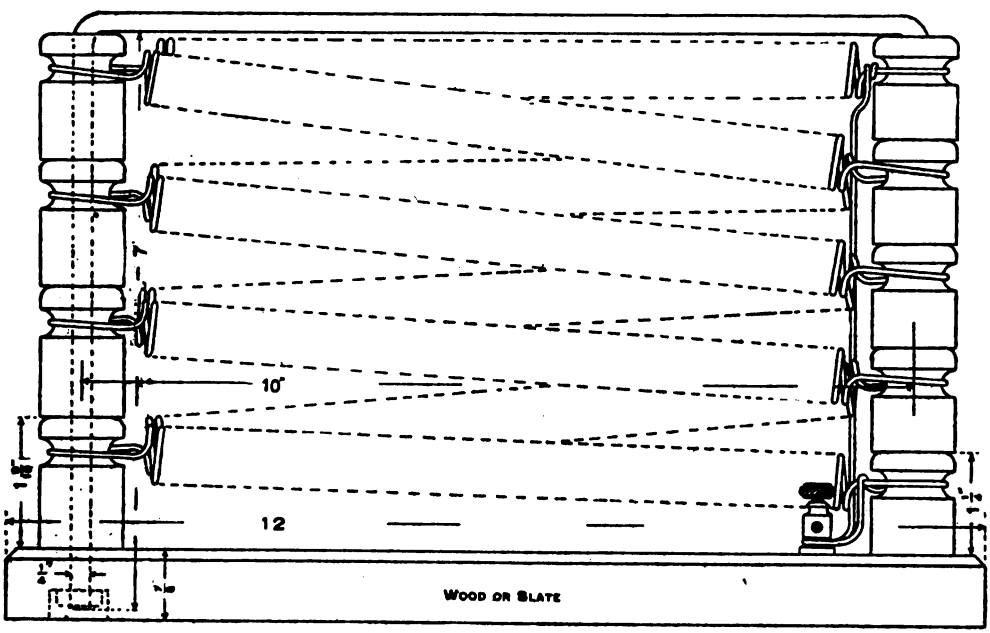


FIG. 21.—RESISTANCE TO BE USED IN CONNECTION WITH STARTING-COILS

The normal running current of the motor will be about 7.5 amperes, and if double that value be allowed for starting, and the apportionment be made that twice as much current shall flow in the temporary starting circuit as in the other, about 12 amperes and 6 amperes, respectively, will be their actual strengths. These combined in proper regard to their phase relations will represent a draught of about 15 amperes from the line. Without load this amount should suffice to start the motor, but under unfavorable conditions even larger currents may be insufficient. This weakness of the single-phase motor is one of its most serious defects and for many applications removes it from adoption; some sort of commutator or slip-ring machine being required in its place.

The resistance of the starting-coil circuit will be only about .6 ohm, its reactance perhaps of about the same amount, and to limit the current to 12 amperes when an electromotive force of 110 volts is applied, a resistance that is devoid of self-induction and amounting to upwards of 9 ohms should be used. Some ordinary direct current motor starting-rheostat may be available, or any one of numerous constructions will be found acceptable. An essential condition is

* This series began in the February issue. It is necessary to refer to the February, March, April and May issues for complete working details and drawings.—THE EDITOR.

that the resistance wire be not of iron nor wound upon an iron core, for the use of such metal would introduce an undesired magnetic effect. A construction is given in Fig. 21 that fairly well complies with the requirements. An iron rod ¼ inch in diameter is bent at a right angle in two places, four long and five feet long without requiring a cut. If the builder lacks other means for accomplishing this winding, he can put a crank on one end of the rod, saw a slot or drill a hole in the other end in which to fasten the end of the wire, then by turning the rod in a block held in a vise and letting the wire crowd against the block as the

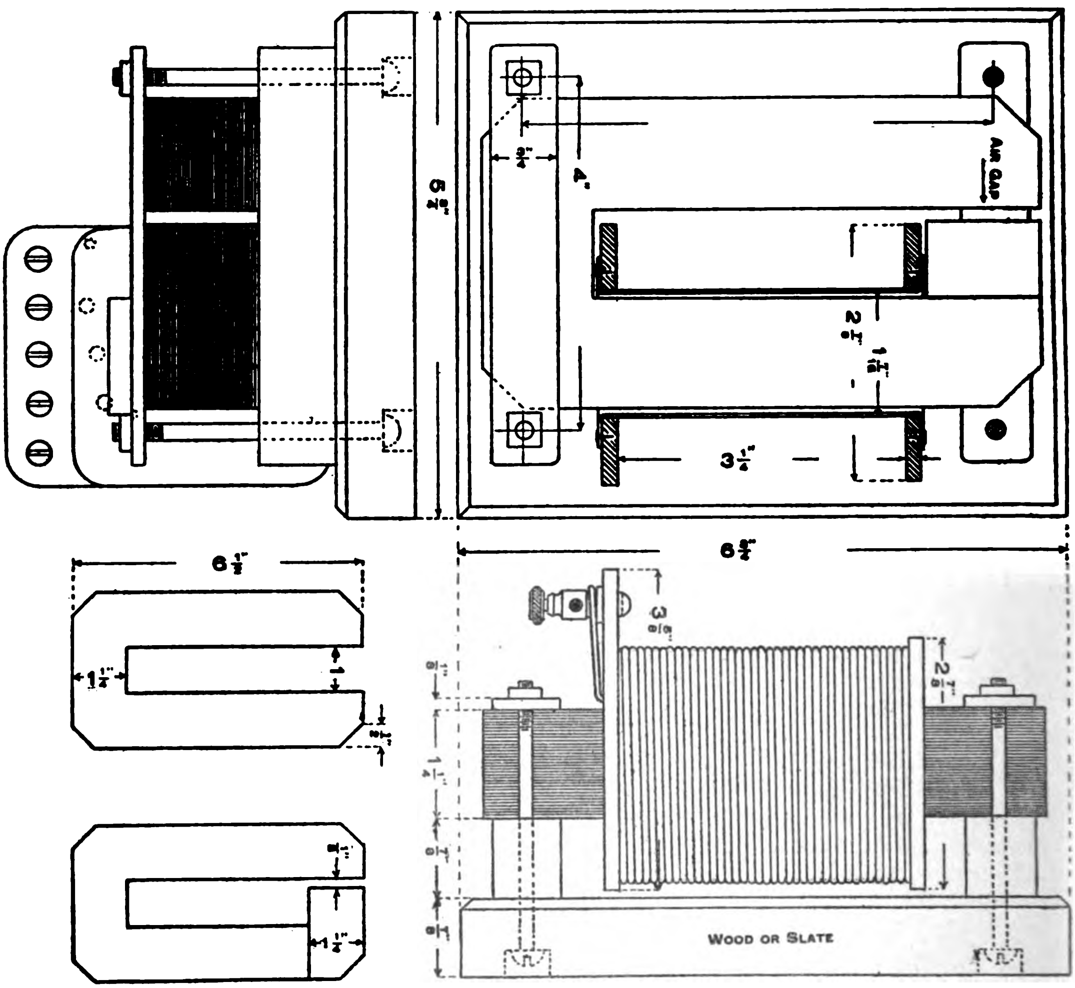


FIG 22.—REACTANCE TO BE USED IN CONNECTION WITH RUNNING-COILS

short, standard porcelain insulators slipped on, and the assemblage mounted on a slate or wooden base. A binding post can be provided for each terminal of the resistance wire.

One pound of No. 16 German silver wire of the 18 per cent. grade, *i. e.*, having a resistance about 18 times that of copper, will suffice. It can be wound upon a ½-inch diameter iron rod 5 winding proceeds, as much tension can be given to the wire as desired without any opportunity for bending the rod, and a tight spiral will result. When slipped from the rod, the coil should be marked off into eight equal lengths, and a length of about two inches in each place unwound. As seen from the drawing, these portions are to provide for transferring the resistance to the insulators on the frame. The terminals should be soldered to the necks of the two binding posts.

A resistance of this sort is easily made and though of apparently fixed value is not really so, for any desired portion may be short-circuited by use of sheet copper strips inserted between the spirals. It is rugged, not easily burned out, and by slipping over it a cage made of galvanized wire netting it fully complies with insurance rules. In final position it may be at will fastened to table, wall, or ceiling.

For the reactance just the opposite properties are required, for a magnetic field is to be established in a device that, as far as possible, shall have no ohmic resistance. The winding must therefore be of copper wire, and the core of iron, and in consequence of the condition of alternating currents, must be laminated. While the resistance of the running coils may be about 1.2 ohms, and the reactance perhaps 2 ohms, with a resulting impedance of about 2.3 ohms, this will be quite insufficient to limit the starting current to the proposed 6 amperes, for a total impedance of 18.3 ohms will be necessary. In Fig. 22 a construction is shown consisting of a stack 1¼ inches thick of U-shaped sheet iron wound with 2¼ lbs. of No. 14 copper wire. Instead of the magnetic circuit being continuous there is an air gap of about ⅛ inch. This is an important provision for such a reactive coil, since otherwise the iron would be saturated with magnetism with too small a current, while the full strength of current would drive the iron through cycles of extreme hysteresis and eddy current losses, with consequent expenditure of power and diminution of the desired angle of lag. As shown, there is room for 8 layers of wire, with 43 turns per layer, giving a total of 344 turns. With 6 amperes flowing a flux of about 70,000 lines will be established, and at a frequency of 60 cycles the reactance will be 18 ohms. The resistance itself will be only .45 ohm. Combined with the impedance of the motor itself, this external amount is a little excessive, but in two ways provision is made for adjustment to fit the conditions of use—either the air gap or the number of turns of the winding may be varied.

In the lower portion of Fig. 22 is shown the sort of sheet iron required for the core, presumably of the same thickness and quality as used for the motor itself. The pieces are first to be cut to a size measuring 3½ inches x 6½ inches, then two cuts made lengthwise for dividing off a tongue. To remove this central piece by cutting across the 1 inch remaining at the bottom will not be possible with ordinary shears. A simple expedient is to clamp the sheet in a vise with the edge of the jaws just on the line, then with a sharp cold chisel and light hammer a progressive cut may be made in a very neat manner. One half the sheets are to be made with the leg on one side shorter than on the other, and some very short pieces so cut as nearly to bridge across the top as shown. Whether still smaller filling-in pieces, measuring 1¼ inch x ⅞ inch, are provided, is a matter of choice for the builder. For appearances' sake the outer corners of the sheets may be clipped, as represented.

After cutting the desired number of sheets—about 110 if .014 inch iron is used—they should be tightly clamped together and filed to a uniform size. They can then be given a very thin coat of asphaltum varnish on one side.

A spool is to be made from fiber, consisting of two flanges of 3/16 inch stock, one 2⅞ inches square, the other ¾ inch wider on one side for holding a row of binding posts, both having a center hole measuring 1 7/16 inches square. The connecting member is also of fiber, about 1/32 inch thick. Only under one condition could metal be properly used in making the spool, and that is it should not be continuous, for otherwise it would amount to a single short-circuited turn of a transformer, with consequent extreme flow of induced currents. Iron would be quite inadmissible under any conditions, for eddy currents would be added to the circulating. If brass or copper is preferred, the metal can at first be continuous, then a radial saw cut made through both flanges and the neck, whereby the circular path will be completely broken. The drawing shows the use of fiber, and this is entirely satisfactory. A stick of any desired length, and measuring 1 5/16 inches square in section is to be used for an arbor and the sheet fiber bent around it, sharp corners being readily attainable by cutting halfway through on the line of bending. The square tube should be about 4⅜ inches long. Onto its ends should be slipped the two washers, spaced apart by two blocks 3 3/16 inches thick. The ends of the fiber are bent over and tacked, as shown. As a further precaution for holding the fiber, a strip of Manila paper may be wrapped around it and fastened with shellac. By nailing or screwing some blocks of wood up against the outside of the flanges, good additional support can be given for the winding process.

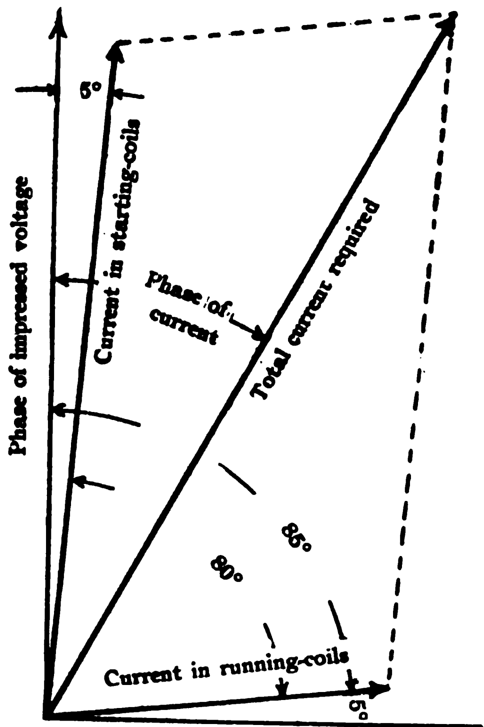


FIG. 23.—GRAPHICAL DIAGRAM REPRESENTING INITIAL STARTING CONDITIONS

In the large flange, five holes shown by dotted lines are to be drilled for passing the copper wire; two of small size for the beginning and end, and the other three of larger size for taking a loop. In addition, five holes are to be drilled in a row for the binding posts, but of course ordinary machine screws will entirely suffice as a substitute for such conveniences. Indeed, for permanent use the screws will be more reliable.

After two layers are placed, a loop can be brought out that can later be connected to No. 2 binding post; then, after the fourth layer is placed, a second loop is provided for the next binding post; similarly after the sixth layer and the very end to the last post. The builder can as well make both flanges the same size and put part of the binding posts on the upper end, thus permitting taps from other layers. Possibly those leading from layers six, seven, and eight will be the ones most likely to be used, but for general experimental purposes the others may find some applications.

When wound and duly protected with several coats of shellac, the spool can be slipped onto the iron core, or the sheets of iron assembled in the spool until the space is tightly filled, the short top pieces fitted in place and the structure clamped onto the baseboard. Two wooden strips ⅞ inch thick separate the iron from the base at top and bottom, while two clamps held by stovebolts secure it in place, not alone from slipping but from vibration under the action of the reversing magnetism. While the bottom clamp can be of strap iron, that at the top must be of non-magnetic material, presumably brass, but thicker strips of wood will be entirely acceptable.

With both the resistance and the reactance coils made the adjustment to fit the motor can next be accomplished. If an alternating current ammeter is available, of course it will be of great assistance. Without it, the builder will have to content himself with trials involving the use of fuse wire. With sizes rated as of 5, 6, 10, and 12 amperes capacity, he should be able to reach quite satisfactory adjustments. In circuit with the starting coil and resistance, temporarily insert a short piece of the 10-ampere size. With the rotor kept stationary, close the switch and adjust the resistance until the fuse melts. Substitute a piece of the 12-ampere size and see that although the current may be kept on for several minutes, it does not "blow." The conclusion may then be safely reached that the current will be about 10 or 12 amperes. Now disconnect that circuit and put the reactance coil in proper connection with the running coil, temporarily inserting a fuse, this time one of the 5-ampere size. Adjust the air gap of the iron or the number of turns of the winding until this fuse melts. See that with the same adjustment a 6-ampere fuse will hold. The current will then probably be of the desired value. Now without fuses in either circuit, or else those of liberal size, try the motor for its hoped-for self-starting qualities. Certainly there will be joy in the heart and face of the builder if the machine exhibits no hesitation. Five seconds should suffice for holding the switch in the lower position, then it should be quickly thrown over into the other or running position. If the motor starts too slowly, the amount of resistance and reactance may be reduced, but without the application of any sort of load the described preparations should suffice.

It may be of interest to illustrate the starting conditions within the motor by use of a graphical diagram, as given in Fig. 23. Two lines can be drawn at right angles, to serve as axes, the vertical being a sort of origin, and representing the "phase" of the electromotive force impressed upon the two circuits. Whether maximum values of the quantities represented are indicated, or "effective" values, makes no difference to the appearance of the diagram—the angles would be the same. The line drawn at right angles to the vertical represents the maximum angle of lag—really a time interval—that can elapse after the electromotive force acts with its maximum value before the current reaches its maximum. The greater the reactance and the smaller the resistance, the more nearly will this extreme value be reached. In the diagram a radial line is shown at an angle of 85° from the vertical to represent particular conditions in the running coil when the external reactance is included, and before rotation has begun. The length of the line may be taken as representing the number of amperes.

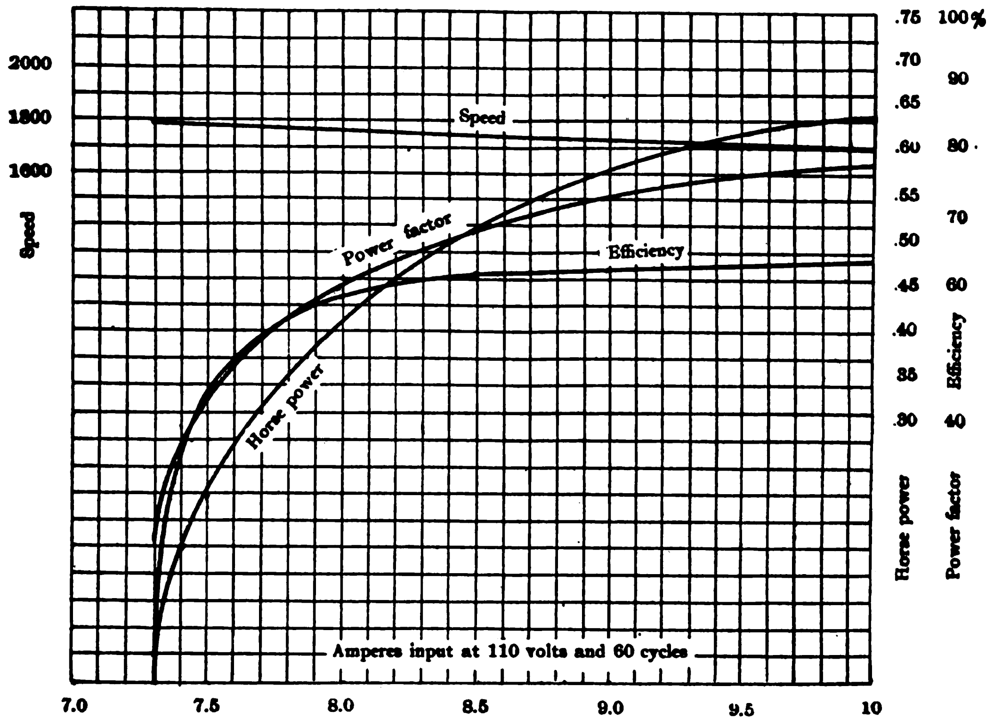


FIG. 24.—CHARACTERISTIC CURVES INDICATING PERFORMANCE OF MOTOR

Similarly a line may be drawn at an angle of about 5° from the vertical to represent the current in the starting coil when connected with its external resistance. In consequence of its small reactance the lag is small, but to represent the required double strength of the current, the length of this line is twice that of the other. Now both these currents do not have their maximum values at the same instant, so their sum is not correctly obtained by directly adding the 6 and the 12 that have been proposed. The addition must be of the geometrical sort, and this is clearly shown by the length of the diagonal resultant, and if the two sides are 6 and 12, this line will measure about 15. So if three ammeters are connected in circuit to show the three currents—one in the starting circuit, one in the running and the third in one of the supply mains—these three values or those in something of the same proportion would be indicated. If the instruments were as sensitive as oscillographs, the readings would follow the instantaneous values of the currents, but the movements would be so rapid as to be interpreted only by photographic methods. In ordinary instruments the moving parts are so cumbrous as to indicate "effective" values of the alternating currents, quite as if they were direct currents. The angle represented between these two current lines is the difference of phase, or time, between the two branches of the circuit into which the main current is "split." If less resistance and reactance are used than those proposed, both of the current lines will be longer, therefore indicating that stronger magnetism will be set up in the machine, but the important phase difference will be reduced. At some particular values the phase difference with the corresponding currents will exert the maximum starting torque, and if required, the builder would have to experiment until he ascertained them by actual test. In practice, it is common to permit the total starting current to be three times the normal running value. In this description only twice the running value is proposed, but provision is made for arranging for other values that may be required.

Finally, it will be of interest to predict what may be expected of the motor in regard to its efficiency and output. In Fig. 24 is shown a set of representative curves for a motor of this size. A close examination will bring out some disquieting facts. One is that quite a large current is required to run the motor when entirely free from load, namely, 7.3 amperes. The saving condition, however, is that this current is quite out of step with the voltage, and that therefore the power absorbed is not 110 x 7.3 watts, but this product still further multiplied by the power-factor, so the real power is brought down to 180 watts. Still, this is larger than desirable—twice as much as would be the case with a direct current motor of the same capacity. To use more turns of wire on the stator and thereby reduce this "exciting" current, as it is called, would be to introduce undesired conditions for full load. Really the size of wire would have to be reduced, and this would reduce the power of the motor. As load is applied to the rotor, the current does not greatly increase. This is quite unlike the case of a direct current machine, for in that the current would be quite proportional to the load, so an additional peculiarity of single phase alternating current motors is illustrated, i. e., the current is nearly the same at no load as at full load, but it is the angle of lag of the current behind the phase of the voltage that shows the most change, and the importance of the amperes is not alone their numerical value but also their phase relation. The cosine of this angle is technically denoted as the "power factor." An inspection of the curves will also bring out the fact that such a motor is of the constant speed class and quite imitates the behavior of a direct current shunt motor, for that, too, falls off in speed only slightly as the load is applied. Synchronous speed at 60 cycles and with 4 poles calls for 1800 revolutions per minute, and at no load the motor almost attains this amount, while at overload the reduction is only 100 revolutions.

At the rating of one-half a horsepower the power-factor is slightly over .72, which means an angle of lag just under 45°; the efficiency at this particular load being 60 per cent. This is admittedly low, but as high as can readily be secured in a commercial motor of this size. By using a shorter air gap than the 1/32 inch specified, and having the rotor slots entirely closed over the rods, the efficiency might be brought up to 65 per cent., but the one device has mechanical disadvantages, while the other reduces the already feeble starting torque.

In a succeeding article the adaptations for operating the motor on two-phase and three-phase circuits will be considered. The result is a machine of higher efficiency and about twice the power, but for the builder who has single-phase current only, nothing simpler or on the whole more satisfactory than the construction already described is likely to be offered.

WIRELESS TELEGRAPHY

A Treatise on the Radiation, Propagation and Detection of the Electric Wave

By A. S. Blatterman

EXPERTS in radio-telegraphy are well aware that many of the scientific phenomena are imperfectly understood. Great distances have been covered, distances involving considerable fractions of the earth's circumference, and this fact, from the scientific viewpoint is of extraordinary interest, since it brings into prominence the possible effects of diffraction, reflection, and so forth, to account for the passage and detection of the electric wave around the curvature of the earth. Also the extraordinary variation of signal strength with light and darkness has received considerable attention, but as yet no very adequate explanation.

The theory of the transmission and propagation of the electric wave seems to be intimately concerned with the nature of the earth, the conditions of the medium above the earth, atmospheric ionization, natural electrification, and the curvature of the earth itself; and apart from this the wave itself may be of more intricate nature than the ordinary Hertzian radiation which is so often taken to explain radio-telegraphic effects. Of these scientific aspects we shall speak at greater length.

With the exception of a small number of stations using the Duddell-Poulsen arc generator, all the practical wireless telegraphy in the world is at present conducted with the following apparatus:

At each station there is the transmitter which comprises three elements:

1—A source of high electromotive force which may be continuous and obtained from an electric generator of direct current or high voltage battery; pulsating, as from a battery and induction coil; or alternating, direct from a special alternating current generator or generator and high tension transformer.

2—A condenser which is charged by the high-tension generating device and which is discharged by a spark gap through an inductance coil in series with the condenser.

3—An open or radiative circuit, the antenna, which is coupled to the condenser circuit, and comprises a system of elevated insulated wires and an electrical counterpoise placed near or in the earth.

At the receiving station we have also three elements:

1—An absorbing antenna by means of which the electric wave is picked up, and in which high-frequency oscillations are produced.

2—A condenser circuit containing variable capacity and inductance, which is syntonized with and coupled to the antenna circuit, and in which energy accumulates.

3—An oscillation detector which is affected by the accumulated energy of the condenser circuit, and sets in operation a recording or indicating device which makes a visible or audible signal.

Generally speaking, the radiating and absorbing antennæ are the same, and are used for both purposes with sending and receiving apparatus. The functions are, however, not identical. What is required in the sending antenna is a certain height and free or insulated ends, but the receiving antenna must have not only height, but surface, though it may be laid parallel with and close to the earth and earthed at both ends; but provided it is a half-wave length in length it will still absorb considerable energy from waves arriving in its own direction.

The antenna is formed from a number of hard-drawn copper or bronze wires held aloft by poles or towers so that they form a fan-like structure; or they may be bent down on all sides like the ribs of an umbrella; or, as is the case on shipboard, they are parallel wires held horizontally and apart from one another by the masts and spars attached thereto. Marconi has constructed antennæ of parallel vertical wires bent over at the top and running horizontally for a distance four or five times their height above the earth.

In long-distance stations it is usual to employ steel or wooden towers to sustain the antenna, and these structures must be well stayed to resist the wind.

Associated with the antenna is the counterpoise, which may consist of a number or network of wires held parallel to and insulated from the earth, or laid on the earth, or even buried below its surface. Its purpose is and construction must be such that its electrical capacity will be sufficient to produce a node of potential at the bottom of the antenna. At sea the metal hull of the ship is excellent.

The counterpoise is connected to the antenna through an induction coil, and in virtue of the capacity of the antenna with respect to the ground or counterpoise the whole system has a natural period of vibration. It may be compared to an elastic strip of steel held at the bottom in a vise and loaded at the top, which can be set in vibration by small blows administered to it at the proper rate.

In nearly all cases the oscillations set up in the antenna are due to impulses arising from the intermittent discharge of a condenser through a spark gap. Hence they are damped or decadent trains of oscillations separated by intervals of silence, and their group frequency is the number of condenser discharges per second. This group frequency is now usually 500 to 1,000. Each train of impulses may contain 20, 30, or 50 oscillations, each having the antenna frequency. The antenna is, therefore, set into vibration with oscillations occurring in groups of, say, 500 in a second, and each group is made up of 20, 30, or 50 alternations which run to and fro up and down the antenna.

In the most modern apparatus these high-frequency currents in the antenna are created by the nearly "dead beat" discharge of a condenser. This condenser may consist of a number of Leyden jars in multiple or series multiple, or, preferably, of glass plates interleaved with zinc or brass sheets and immersed in oil. Marconi uses large metal plates hung up on insulators in air in some of his high-power stations. At Nauen and at the Eiffel Tower stations tubular or glass plate condensers are used, and at Arlington the dielectric is compressed air at 300 pounds per square inch.

The condenser is charged by the source of high electromotive force and is discharged with or without oscillations through an inductance, part or all of which may form one coil of a two-coil air-core transformer, whose second coil is in circuit with the antenna; or else a single coil, whose turns are common to both condenser and antenna circuits.

An important element is the spark gap. In early days this consisted simply of two brass balls; but with the introduction of higher powers it was quickly discovered that an arc was established which had to be destroyed before the condenser could again charge. Numerous expedients were tried to overcome this defect. Air blasts were applied to quench the arc, and with the same purpose in view transverse magnetic fields were brought to act upon the discharge. Fleming devised a discharge with slowly revolving electrodes which was partially successful. Later on Marconi invented the high-speed studded disk discharger which produces a spark of the required character. The kind of discharge desired is one in which rapidly repeated, strong, highly damped discharges take place in the condenser circuit, and these excite prolonged trains of free oscillations in the antenna. This is only possible when any true arc in the spark gap is entirely prevented.

The effect is also obtained by the Wien or Telefunken, Peukert, and Lepel dischargers, consisting of flat, or, as sometimes in the Telefunken gap, concentrically ribbed metal plates in close proximity. With these gaps the discharges succeed each other with great regularity and at the rate of several hundred or a thousand per second, and when the condenser circuit is properly coupled to the antenna (about 20 per cent. coupling) powerful intermittent oscillations are set up in groups in the antenna, each group being feebly damped and of uniform oscillation frequency. Although nearly all the radio-telegraphy in the world is at present conducted by means of the condenser discharge method, great efforts are being made to produce high power, high frequency alternators, and the advent of such a machine will, no doubt,

(*Continued on page 796*)

Experimental Department

This department is maintained for the purpose of encouraging the experimenter to develop new ideas. Every reader is welcome to contribute to this department. Contributions should be written on one side of the paper only, using as many sheets as are necessary. Typewritten contributions employing double spacing are preferable. Good sketches are not necessary, as our art department can work up rough sketches that are clear enough to illustrate the idea. Sketches must be made on separate sheets from those containing the description. Return postage must be enclosed if return of unused manuscript is desired.
Three prizes of Five, Two and One-Half Dollars and One Dollar are awarded for the three best ideas published each month. Other contributions are paid for at space rates.

FIRST PRIZE

AN INSTRUMENT FOR DETERMINING HEIGHT OF AERIALS

Sometimes an amateur is confronted with the problem of determining the height of his aerial, or perhaps, the height of a building on which he wishes to erect an aerial. The instrument described below will, with the use of a table of trigonometric functions, quickly determine heights of aerials, buildings, etc. In the first part of this article the author will cover the construction; the operation of the instrument being taken up later.

CONSTRUCTION

A general view of the instrument is shown in fig. 1. The main part needed is a camera tripod, which can be usually found among the average experimenter's possessions, although an equivalent can be substituted if necessary. A round block is cut from oak of the dimensions shown in fig. 4. On the bottom of this block two diameters are drawn at right angles to each other and at their intersection a nut, tapped to the size of the screw in the tripod head, is imbedded. The supports are shown at *A* in fig. 3, and are of the dimensions stated. The uprights are of brass and the block between is of oak. The uprights are clamped together in line and a 3/8-inch hole bored near the top as shown in the sketch. A hole is bored and tapped to take screw *B*, in one only. Holes are now bored at the bottom to admit screws to fasten to the block.

In fig. 5, *A* is a hardwood block 12 inches long. In this is inserted a hard rubber tube 12 inches long, and with an inside diameter of 1/4 inch. On opposite sides of this block are fastened supports as shown in fig. 3. On top and in the exact center of the block is imbedded a level. Two levels are also imbedded in the base, at right angles to each other. Four inches from each end of *A*, fig. 5, a line is squared around. Setting a carpenter's gauge to one-half of the width of the block, lines are drawn crossing the others in the center of each face of the block. At the intersection of these lines, holes are bored through the block and tube, 1/32-inch in diameter. Through these holes are inserted No. 40 black enameled wires crossing each other in the center of the tube and fastened tightly in some convenient manner. This is repeated at the opposite end. When this procedure is completed, two sets of crossed wires or "hairs" four inches from each end, are obtained.

The supports are now fastened to the block which is centered on its round base, and the instrument is mounted. A typewriter knob is fastened on at *A*, fig. 4, and the set screw inserted in the hole at *B*.

A scale as shown in fig. 6, is fastened on the left-hand support. The scale must be fastened accurately; that is, the 90° mark must be at right angles to the center of the pivots or supporting rods. This scale, for the sake of convenience and to lessen the amount of calculation, is to be calibrated different from the common protractor, as shown at fig. 6. A blank celluloid scale of the same size and shape as a common protractor is first procured. A calibrated protractor is now placed over it as shown and the degree lines marked. The purpose of this scale is to read the angle at *A*, fig. 7, direct, without calculations. Since the sum of three angles of a triangle is equal to 180°, it is only necessary to take the angle at *B*, which is always 90°, add to this the angle at *C*, and subtract the result from 180° to get the angle at *A*. Now to calibrate the scale: Opposite 5° for example, 90 + 5 = 95 and 180 — 95 = 85° which represents the angle at *A* when the angle at *C* is 5°. 85 is then placed on the blank scale opposite 5 on the calibrated one. Now again at 15°, 90 + 15 = 105 and 180 — 105 = 75°.

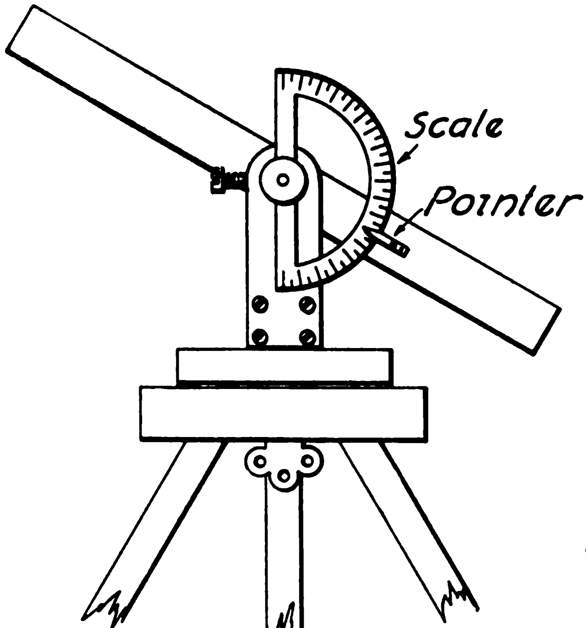


Fig. 1

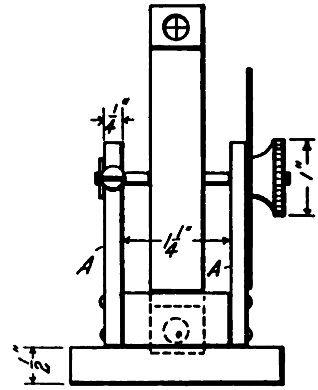


Fig. 3

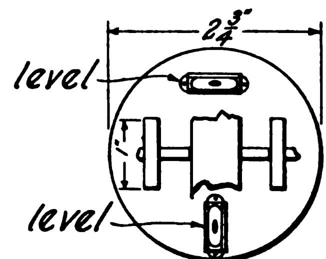


Fig 4

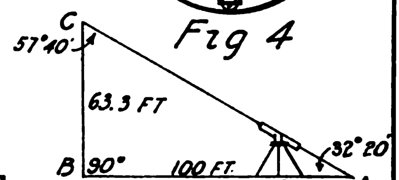


Fig. 8

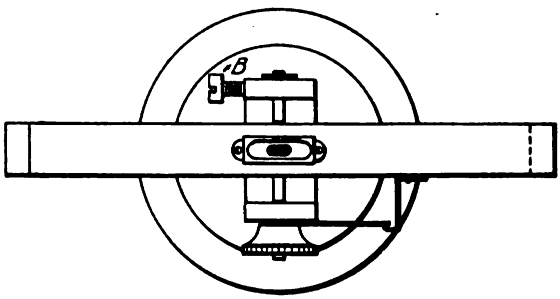


Fig. 2

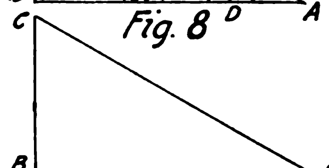


Fig. 7

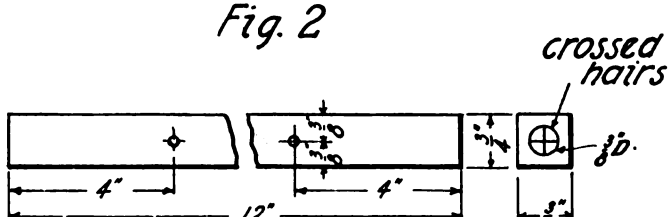


Fig. 5

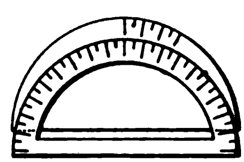


Fig-6

M. E&M.

This is the angle at *A* when the angle at *C* is 15°. This is put on the blank scale opposite 15° and so on. No scale is needed on the instrument to show the angle at *C*, since one can now read the angle at *A* from the scale and that is all that is necessary.

A pointer of brass or other suitable metal is made as per *C*, fig. 2, and is fastened exactly in the center of the rectangular block as shown in fig. 1. The wood is now finished to suit the taste of the individual.

OPERATION

Set up the instrument at some convenient distance from the aerial. Adjust it until the two sets of crossed hairs and the top of the aerial appear to coincide. Tighten the setscrew and sight through the opposite end of the tube. Where the crossed wires appear to coincide with the ground a stake is placed. Measure from this stake to the foot of the aerial. Multiply this distance by the tangent of the angle shown on the scale. The result is the height of the aerial.

EXAMPLE: Looking at fig. 9, let *CB* represent the aerial of unknown height. Let the instrument be set up at *D*. Point *C* is then sighted up and the setscrew tightened, after which point *A* is sighted and marked. Measure from *A* to *B*, in this instance say 100 feet. Now read the angle as shown by the scale, say 32° 20′. Look in a table of trigonometric functions (found in any trigonometry textbook) for tangent of angle of 32° 20′. The number .6330 is found and this is multiplied by the 100 feet. The result is 63.3 feet, the height of the aerial. In a like manner any height may be found.

Contributed by

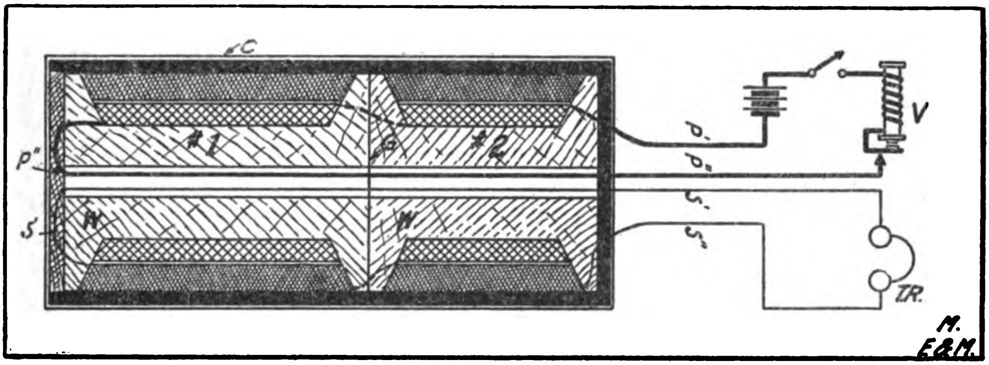
Herbert G. Messer.

SECOND PRIZE

AN ELECTRICAL INSTRUMENT FOR DETECTING MINERAL DEPOSITS

In the accompanying illustration is shown a most useful form of exploring instrument for detecting the presence of mineral deposits and consisting of an induction balance, telephone receiver, vibrator and batteries. By means of this instrument, it is possible to locate iron, steel, nickel, cobalt, manganese, platinum, paladium, etc., in obscure places such as caves, cliffs, wells, rivers and lakes. Such an instrument can be readily made at but slight expense and will prove very interesting in actual use.

The induction balance consists of two wooden spools, *W W*, glued securely together at *G*. No. 8 thread spools will be found quite suitable. No. 22 B. & S. gauge enameled wire is then wound on in three layers on spool No. 1 in a *right-hand* direction, the number of turns being counted as they are wound on. After this has been accomplished, the wire is passed on to spool No. 2 and an equal number of turns are wound in the *left-hand* direction. It is of prime importance to have an equal number of turns on both spools.



P′ and *P″* designate the ends of the two coils which may be termed the primary of the induction balance. The wire *P″* passes through the opening in the center of the spools. Cover the primary windings with a layer of paraffine paper and then proceed to wind No. 36 B. & S. gauge, s.c.c. wire over the primary winding of spool No. 1 in a *right-hand* direction. In this case as before, it is necessary to count the number of turns and layers and when spool No. 1 is filled, the wire is passed to spool No. 2 and as many turns and layers are wound in the *same direction* as on spool No. 1. *S'* and *S''* designate the ends of the two coils which may be termed the secondary of the induction balance. The wire *S'* passes through the opening in the center of the spools. Secondary wires *S'* and *S''* form the receiver circuit and are connected to an 80-ohm watch-case receiver. The primary wires *P'* and *P''* form the supply circuit and are connected in series with three dry cells, a switch and vibrator. An ordinary electric bell will give excellent results as a vibrator for this purpose if the hammer is removed from the armature. The two spools are placed in a neat tin case *C*, which is then filled with melted sealing wax so as to render the induction balance waterproof when lowered in water. The wires *P'* and *P''*, and *S'* and *S''* may be 50 feet long, more or less, depending upon the depth to which the cell *C* is to be lowered.

In using this instrument, the switch is closed and the casing containing the windings is moved over the region to be searched. When brought in the vicinity of materials possessing magnetic qualities, a strong clicking noise will be heard in the receiver.

Contributed by

C. L. Volz.

THIRD PRIZE

A MERCURY AIR-PUMP

This instrument is very simple and easily made, yet it is capable of producing a very high vacuum. Almost any degree of vacuum can be produced and preserved, at the same time being accurately indicated.

The glass tube *A* is a piece of barometer tubing about 32 inches long. A glass T, which need not be of the same diameter, is connected to its upper end by a short piece of rubber tubing. To the other end of the T is connected a funnel by means of a longer piece of tubing. On this longer piece of tubing some device, such as a pinch cock, is placed to open and close it.

To make the connections the ends of the glass tubing are smeared with vaseline since the rubber tube, which must be as heavy as possible, is so small that without this lubrication it could not be forced on the glass tubing. In this way an airtight joint is sure to result.

To the lower end of the tube *A* is fastened a test tube having a hole *B*, made with a pointed flame. The lower end of *A* must be about an inch below *B*.

The whole apparatus is securely held in position on a board of the required size by some such means as is shown in fig. 2. Three or four of these will be sufficient. The vessel to be exhausted

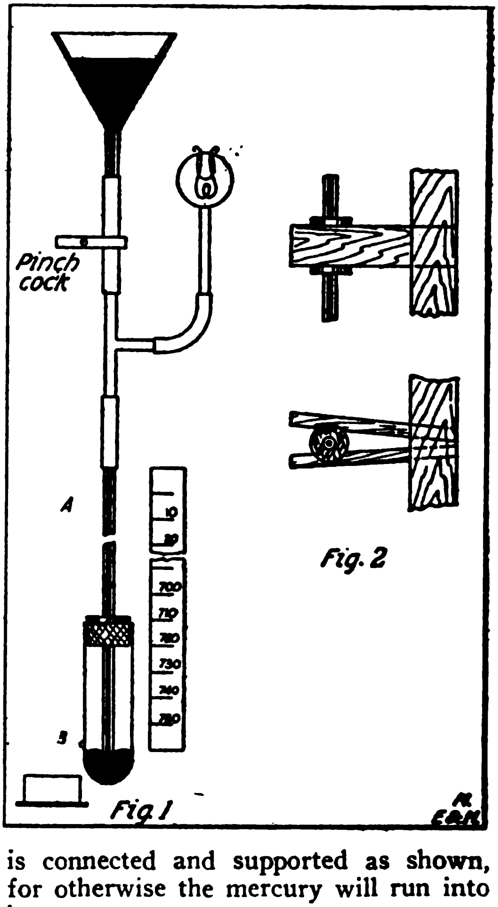


Fig. 1

Fig. 2

is connected and supported as shown, for otherwise the mercury will run into it.

At least one pound of mercury will be needed to operate the pump, but this need not be chemically pure or boiled to exclude air.

It is placed in the funnel and allowed to run down the tube *A* in drops. As soon as the mercury has covered the end of *A* the action is as follows:

As a drop of mercury falls down the

tube, it carries before it the air in the tube, thus leaving less air behind, which must fill the same space, and therefore become rarer. The next drop further rarefies it, and so on.

As the air inside the tube becomes less dense, the mercury rises in the tube, until it reaches a height of about 30 inches above the mercury in the test tube, beyond which point it will not rise. A scale graduated in millimeters, beginning at this point and reading down will indicate the degree of vacuum down to 1 mm., beyond which the experimenter will have to resort to calculations.

If, after the first drop the mercury level is 3 inches, or 1/10 of 30 inches, 1/10 of the air has been removed, leaving 9/10 of the air, which is therefore at 9/10 atmospheric pressure. The next drop leaves it at 9/10 of 9/10 atmospheric pressure. Supposing ten drops have passed, the pressure will be $\frac{9/10}{10/10}$ of an atmosphere, or .348+ atmospheres. An atmosphere being 760 mm., the pressure would be 264.4 mm. This, of course, is large enough to be measured on the scale, but the method is the same as that used for low vacua.

As the mercury flows out of *B* it is caught in a cup and poured back into the funnel. Thus the exhaustion can be carried on to very low limits. It was with this type of pump that the first Crookes tubes were exhausted.

Contributed by

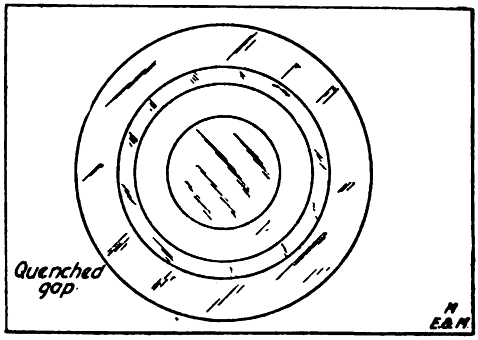
Brentford Mackey.

QUENCHED GAPS FOR SPARK COILS

Although it is usually said that quenched gaps will not give very satisfactory results in connection with spark coils, the author has been using such a gap in connection with a one-inch coil for the past four years with excellent results.

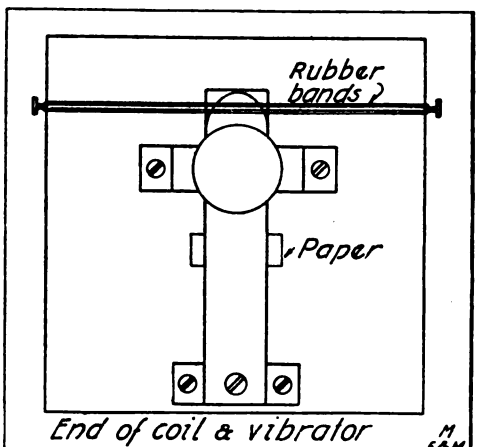
The writer has found that an electrolytic interrupter was not as efficient as a high speed mechanical interrupter or vibrator. He is now using 110-volt direct current through ten 16-c.p. lamps as shown in the illustration. This arrangement insures a regular current of five amperes, which never varies, as would be the case if storage batteries were employed. The vibrator on the one-inch coil is of the ordinary spring vibrator type, having platinum contacts which are still in good condition despite the fact that strong current has been used on the coil for over a year.

To obtain high efficiency with a quenched gap, high frequency is required.



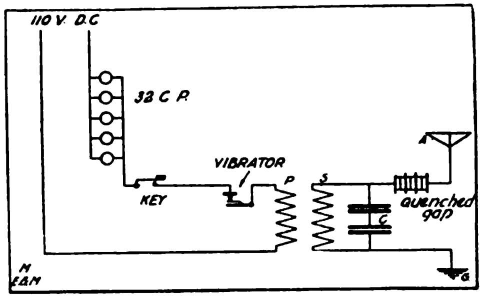
This may be obtained by inserting a piece of paper between the leaves of the vibrator as well as tying the vibrator with rubber bands so as to give it greater elasticity. When properly adjusted, the vibrator will hum and the spark will have a high pitch. In fact, the author has been asked by many wireless friends whether or not he was employing a high frequency rotary converter, because of the excellent tone of his spark.

The quenched gap plates, as shown in



the illustration, are made from copper turned on a lathe. The author uses five gaps separated with mica. Each gap is about 1/64 inch. The plates measure 3½ inches outside diameter with a sparking surface one inch in diameter.

Four glass plates measuring 8 x 10 inches covered on both sides with tin-foil, comprise the condenser, which is shunted across the secondary of the spark coil. The writer has found the



quenched gaps to work better in series than in shunt.

Experimenters will be surprised at the results obtained by connecting their sets as shown in the illustration and employing a quenched gap. The range will be considerably increased, the frequency much higher and the wave emitted will be sharp and pure—a feature that is necessary in order to have a station comply with the wireless laws. Although the writer does not employ an oscillation transformer, one may be used with the system above described if desired.

Contributed by

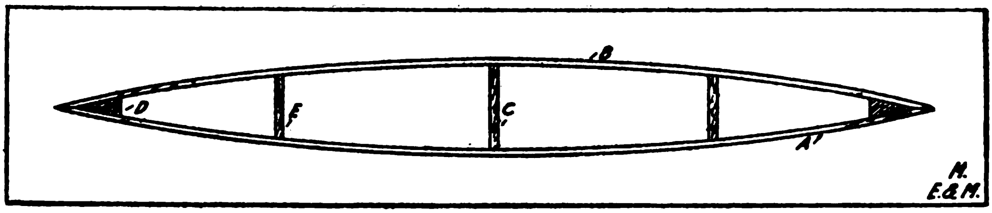
H. P. Pearson.

AN EFFICIENT AERIAL SPREADER

The spreader which I am about to describe is of truss construction, built of strong, light wood. I used cypress, which is fairly strong, easily bent and almost weather-proof. The stock should be 3 x ½ inches for short spans and 3 x ¾ inches for long spans. Make the strips *A* and *B* several inches longer than the intended length to allow for bending. The length of the center brace *C* should be one-tenth of the total length of the spreader. Screw *A* and *B* to *C*. Don't spare the screws. Bring the ends together and miter them so that they will come to a fairly sharp point. Screw the end well and screw in the triangular piece *D*. This should be three inches thick and six or eight inches long. The other end is treated in a like manner. Make the braces *E* long enough to make the spreader eliptical rather than diamond shaped. Paint the entire spreader the color of its surroundings.

To get the full benefit of the truss it must be wired in this way. If side *A* be toward the aerial, the wires must be connected—preferably wrapped—to side *B*, through very small holes in side *A*. The ropes or wires supporting the aerial are fastened through holes in strip *B* to strip *A*.

These spreaders are light and exceedingly strong. Mine have been up over six months through the hardest kind of weather. Some mornings the wires have been covered deep with wet snow. Heavy wind storms have no effect on the aerial using such spreaders, other than making it rock and jump harmlessly.

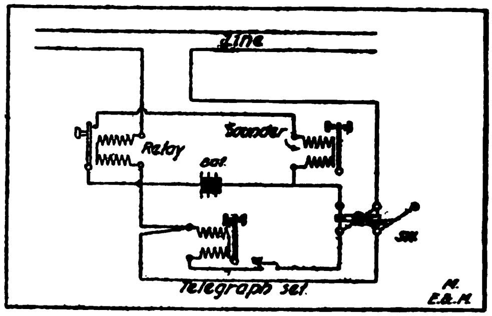


Contributed by

Robert A. Cushman.

A NOVEL TELEGRAPH STATION ARRANGEMENT

The following is a description of a novel telegraph station arrangement.



Every operator should employ such a wiring diagram in his telegraph office, since it enables him to practice on his own apparatus without disturbing the traffic on the main line.

By using the arrangement shown in the diagram, both the regular main line apparatus as well as the practice set can be used at the same time and operated by a common battery. If the operator is practicing on his own instruments and hears his call letters on the main line sounder, he has only to throw the switch to the left and his own apparatus will then be connected to the main line circuit, ready to answer the call. After the message is received, the switch can be thrown to the right and the operator is once more ready to continue his practice without affecting the relay and sounder that are connected to the main line.

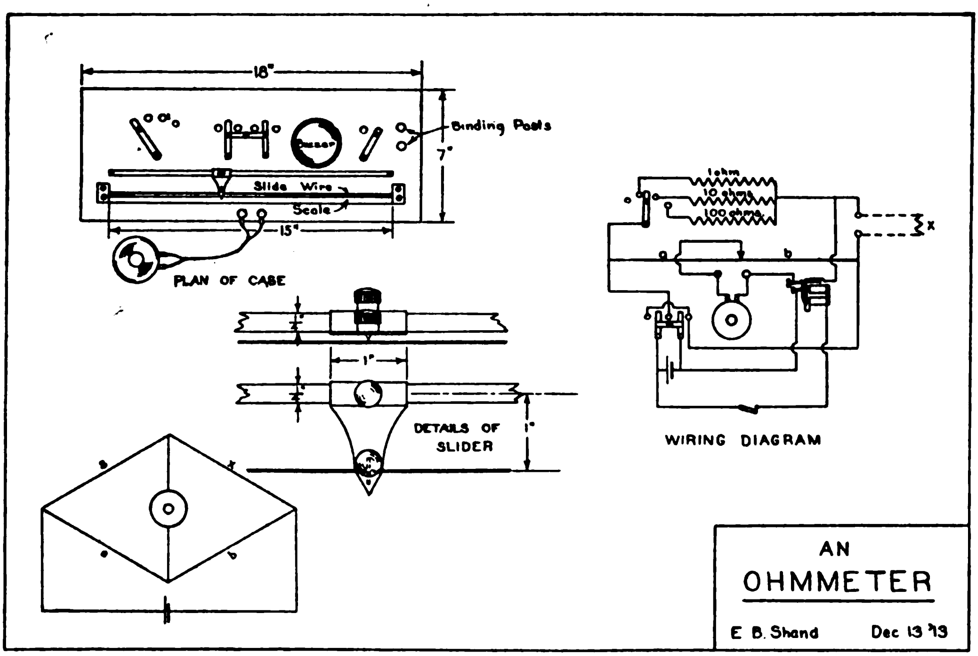
Contributed by

Bro. Avila, C. S. C.

Probably the best method for making the 1 ohm coil of small wire is to take several strands of wire, wind these in parallel and solder them to the terminals of the coil. Care should be taken that the resulting resistance is slightly greater than 1 ohm. The resistance is then measured accurately and from the equation

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$$

the proper length of wire to be soldered in parallel with the others—in order to bring the resistance to 1 ohm—is obtained. These precautions are not so necessary for the other coils which consist of longer wires.



A READILY MADE OHMMETER

The following is a description of an instrument for measuring resistance.

The first step in the construction of this instrument is to make three resistance coils of 1, 10, and 100 ohms. The wire used may be about No. 28 insulated German silver. It will be a great advantage in making these coils if access can be had to a good measuring instrument so that the resistance of the coils can be accurately calibrated. If this cannot be done, the coils can be roughly calibrated from the tables of the wire manufacturer.

The resistance coils should be made of double or non-inductive windings; the two ends of the wire being fastened to the terminals and the sides of the loop wound together as a single wire.

The case measuring 18 x 7 x 4½ inches may be made of any common wood. On the upper side of the case is mounted bare German silver wire, about No. 22 gauge, running between two brass or copper blocks, spaced exactly 15 inches apart. A slider is arranged so as to run parallel to the wire, making contact with the latter only when it is pressed down. On the case are also mounted a three-way switch, a single point switch and a reversing switch; also various binding posts for the necessary connections.

Besides the requisites mentioned above, a watch case telephone receiver and a buzzer are also necessary. The buzzer armature should be fitted with an insulated contact which is connected to the rest of the circuit by a light coiled wire, as well as a corresponding stationary contact which is also insulated.

A diagram of all the necessary connections is given in Fig. 2.

It will be seen by the reader that the instrument is simply a form of Wheatstone bridge. A scale may be placed alongside the wire to indicate the ohms. This scale may be calibrated from the formula

$$\frac{S}{X} = \frac{a}{b}$$

where S is the resistance of the standard coil used, X is the unknown resistance and a and b are the respective lengths of the wire on each side of the slider. By substituting different values for X, in the formula, the ratio

$$\frac{a}{b} = \frac{a}{15 - a}$$

where a and b are in inches; that is, a + b = 15.

To measure a resistance the slider is moved up and down along the slide wire until the noise in the receiver ceases. Then, if the scale has been calibrated accurately, it will read the correct number of ohms opposite the slider. When the slider balances on the middle point of the wire, X will equal 1 ohm if the 1 ohm standard coil has been used, 10 ohms for the 10-ohm standard, or 100 ohms for the 100-ohm standard.

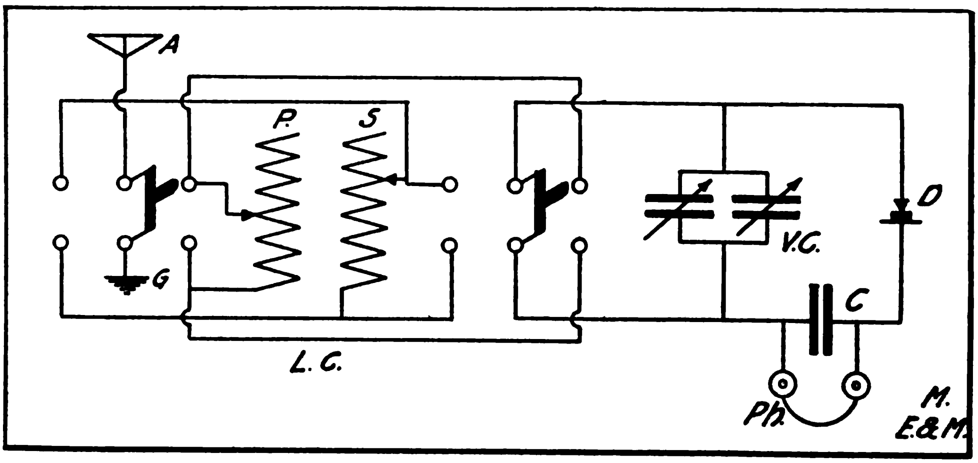
For accurate reading the slider should have a narrow edge only presented to the wire and at right angles to it.

Contributed by

Errol B. Shand.

AN UNIQUE WIRELESS HOOK-UP

Recently, while experimenting with my set, I discovered that by using the primary of my loose-coupler as the secondary, as shown in the sketch, I could increase my wave length quite considerably and bring in stations that otherwise I was unable to hear. To bring both circuits back to resonance, two variable condensers in parallel should be connected in circuit. The sketch gives the complete hookup for a quick change and makes everything clear.



Contributed by

Stanley F. Patten.

A MAGNETIC BRAKE FOR A ROTARY GAP

High speed rotary gaps generally run a minute or two after the circuit is broken. This is very annoying, especially when some distant station is answering. The following is a description of a magnetic brake, designed by the writer, which has proven very efficient in eliminating this source of trouble.

The lever *A* is cut from a piece of soft iron about 3/8 inch square. The length

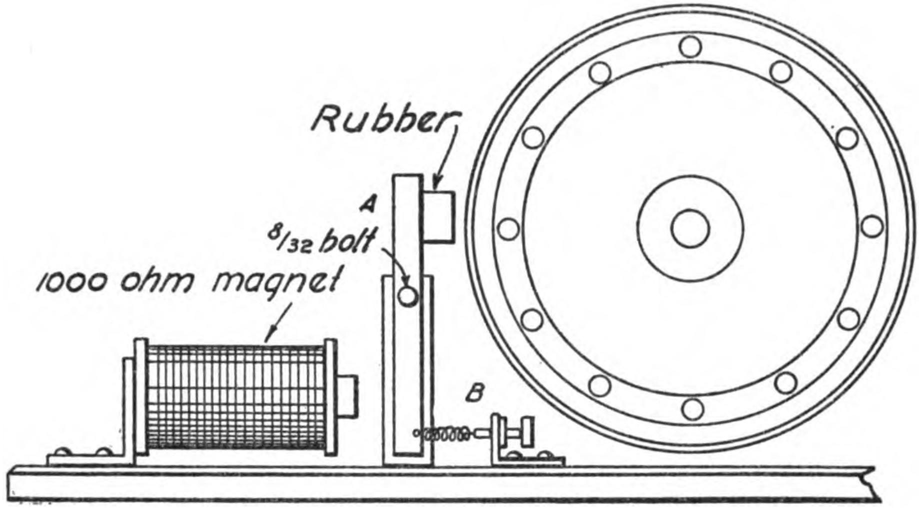


Fig 1

M. E&M.

will depend entirely upon the height of the gap it is to be used on. In the center of the lever, drill a hole large enough

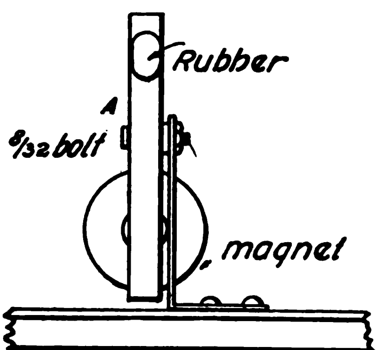


Fig. 2

M. E&M.

for a battery screw to pass through freely. On one end of the lever fasten a small piece of rubber as shown in the drawing. The arm *B* holding the spring is cut from a piece of heavy sheet brass. The magnet may be procured from a 1,000-ohm telephone ringer. The rest of the work is clearly shown in the drawing.

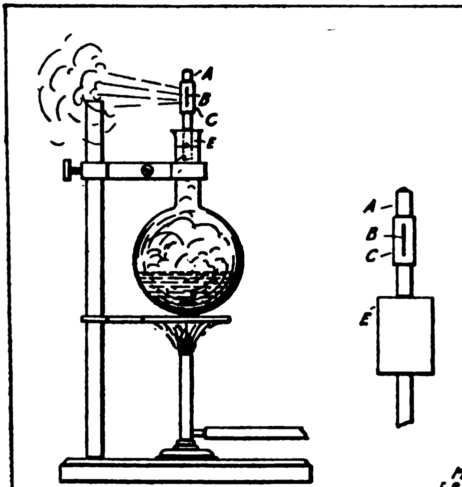
Contributed by

Ray Yates.

AN AUTOMATIC SAFETY VALVE

While performing some experiments in chemistry the author found need for a safety valve. After trying various devices, the scheme shown in the accompanying diagram was resorted to as the most satisfactory.

In the diagram, *E* is a cork which fits into a bottle. Through the hole of the cork is placed a glass tube opened at both ends. At the outer end of the glass tube is placed a short section of rubber tubing, *C*. At the other end of the rubber tube is a glass tube, *A*, which is sealed in at the outside end. *B* is a slot in the rubber tube made with a sharp pen knife.



The operation of the safety valve is quite simple. As the pressure of the gases within the flask increases, the slit in the rubber tube opens and allows the surplus pressure to escape.

Such a safety device as is described above may be the means of preventing serious explosions that might occur otherwise.

Contributed by

Harry Faver.

The heavy storms in southern California during the past rainy season wiped out many miles of trails in the national forests of that part of the State. They are now being rebuilt for the coming summer, for use in fire protection. They are also of great use to tourists, campers, and prospectors.

THE ADVANTAGES OF TRADE MARK REGISTRATION

By George William Miatt.

AS heretofore intimated the right to the exclusive use of trade marks has existed from time immemorial. It is and always has been recognized and sustained by the Common Law, and is not a creature of Statute. In the words of the Supreme Court of the United States: "The right to adopt and use a symbol or device to distinguish the goods or property made or sold by the person whose mark it is, to the exclusion of the use of other persons, has long been recognized by the common law and the chancery courts of England and this country. It is a property right for the violation of which damages may be recovered in an action at law, and the continued violation of it will be enjoined by a court of equity with compensation for past infringements."

Thus a trade mark may be legally recognized and sustained even though not certified as provided for under the Act of 1905, which is the Federal Law under which such marks are registered in the United States Patent Office. But there are certain practical advantages to be attained by such registration, the statute having been designed and passed with the object of systematizing and codifying trade mark practice, and simplifying and rendering more effective the remedies incident to infringement.

For instance, the owner of a trade mark *not* registered in the Patent Office, in case of litigation relating thereto, must prove priority of use and ownership, which is frequently a difficult thing to do, whereas a certificate of registration issued by the Patent Office is *prima facie* evidence of priority and ownership, and the owner of such registered trade mark does not need any other than his certificate as evidence to establish the date of his first use of the mark.

Furthermore, if the trade mark is not registered according to Statute legislation relating thereto, it does not come within the jurisdiction of the Federal Courts unless the opposing parties are citizens of different states; and obviously a decision or injunction in a State Court has no force outside of that State, whereas all suits relating to trade marks certified by the Patent Office are within the jurisdiction of the Federal Courts irrespective of residence of parties, and an injunction secured in one Federal Court will be recognized and enforced in the Federal Courts of other States.

In other words, every registered trade mark is a part and parcel of the *public records* of the nation, is *prima facie* evidence of ownership, and is enforceable throughout the United States through the medium of the Federal Courts; and the crucial test to which the mark is subject in the Patent Office before the issue of a certificate of registration thereon practically precludes the possibility of error, so that the registrant may safely exercise his rights and prerogatives without fear or favor.

Another advantage of certification of a trade mark by the United States Patent Office is the right to use the words "Registered in United States Patent Office," or the abbreviation, "Reg. U. S. Pat. Off." In fact this is not only a privilege but a necessity, since, if such notification is not used in connection with a trade mark, in case of infringement the owner of the mark can only collect damages from the date of actual notice served upon the infringer.

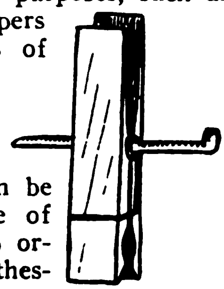
(Continued on page 794)

Practical Hints

This department is devoted to contributions that deal with new tools, machinery, methods of simplifying different tasks and other similar subjects of interest to the electrician and mechanic in particular, and everyone in general. Contributions to this department should not exceed 200 words. A rough sketch is desirous in instances where the idea will be rendered more comprehensible by its use. All contributions will be paid for at regular space rates on publication.

ADJUSTABLE HANGERS

A hanger of simple construction that is suitable for many purposes, such as to hang prints, papers and various articles of



wearing apparel, can be made from a piece of heavy wire and two ordinary spring clothes-pins.

This wire is placed through the spring coil openings; the clothes-pins then being adjusted to desired positions by sliding them along the wire. The wire is bent at both ends to prevent the pins from coming off.

Contributed by

B. W. Verne.

HOW TO SOFTEN PUTTY

Many amateur craftsmen have trouble with putty hardening before they are ready to use it.

There are many ways to soften putty, but after trying most of them I have found that the best way to soften it is by the use of kerosene oil.

To soften the putty take a putty knife or one as near that as possible. Cut the putty into small pieces and then draw the blade of the knife over the putty until it is pulverized.

Now the putty is ready for the oil. Drop a little kerosene oil on it and mix up the putty and kerosene. If the putty is still too hard, add more oil until it can be easily worked.

If the putty is not required for immediate use, it can be placed under water and it will then remain soft and ready for use at any future time.

Contributed by

Willard Parsons.

MAKING COIL SPRINGS

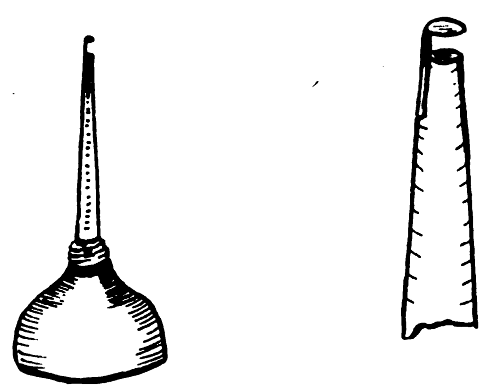
In winding coil springs, take two lengths of the wire to be used and wind them on an iron rod that is a trifle smaller than the desired inside diameter of the finished spring. The two lengths are wound side by side. When the winding is completed, the two springs can be untwisted and it will be found that the convolutions are equally spaced.

Contributed by

C. J. Sedlak.

TO PREVENT DIRT FROM ENTERING OIL CAN SPOUTS

When working around mills and factories where oil cups and boxes are dusty and dirty, the tip of oil can spouts



often becomes plugged with grease and dirt.

To remedy this, solder on the spout a small piece of tin or wire shaped as shown in the illustration. This forces obstructions away from the tip of the spout and thus permits a ready flow of oil.

Contributed by

B. W. Verne.

HANDLING LARGE PLUG GAUGES

Practically all mechanics are familiar with the subject of plug gauges for meas-

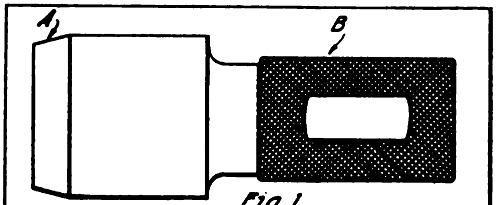


Fig 1
Plug gauge as usually made

uring the diameter of a hole. They are especially familiar with the type shown in Fig. 1, where *A* is the gauging end ground to the correct size for measuring a bored or reamed hole. Such gauges are some times made as limit plugs, in which instance part of the plug will go into the hole and the end nearest the handle will not.

The end *B* of the plug is the handle and, as will be readily seen, this becomes quite heavy in the larger sizes. To reduce the weight and make the large sized plug gauges easier to handle, the gauge

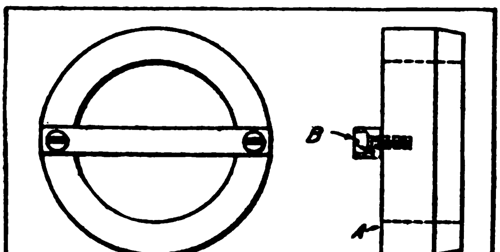


Fig-2
Method of making the large plug gauge

shown in Fig. 2 is far better. It consists of a ring *A* which is used in the same manner as a plug gauge, and the bar *B* placed across the end of the ring and used as a handle. Such a plug is much lighter and may be handled more conveniently than the conventional type.

Contributed by

H. M.

A CONDENSER HINT

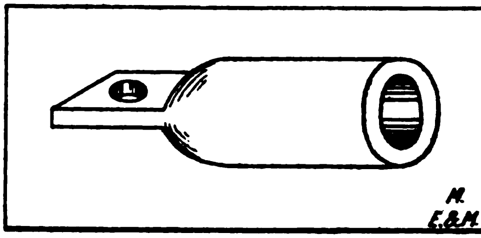
A very good dielectric for fixed condensers, especially desirable in the receiving wireless apparatus, may be had in photographic films. The use of photographic plates is old but the use of films is somewhat novel. Films may be easily had, they will stand the rough handling in the hands of the experimenter without puncture, are ready for use without further preparation, thin enough to insure high capacity, and have very good insulating powers.

Contributed by

J. L. C.

MAKING TERMINALS

Procure several feet of brass or copper tubing with a bore of ⅛ inch. Cut this into lengths ⅞ inch long. These pieces are then annealed in a hot fire and one end pinched together in a vice as shown in the drawing. In pinching the end together a ⅛-inch steel rod should



be placed in the free end to prevent it from losing its shape. A 3/16-inch hole is then bored in the flat end. To remove the black crust left on by the heat, the terminals should be dipped in a solution consisting of one part nitric acid and two parts sulphuric acid.

Contributed by

Ray F. Yates.

TO REPAIR BROKEN LANTERN GLOBES

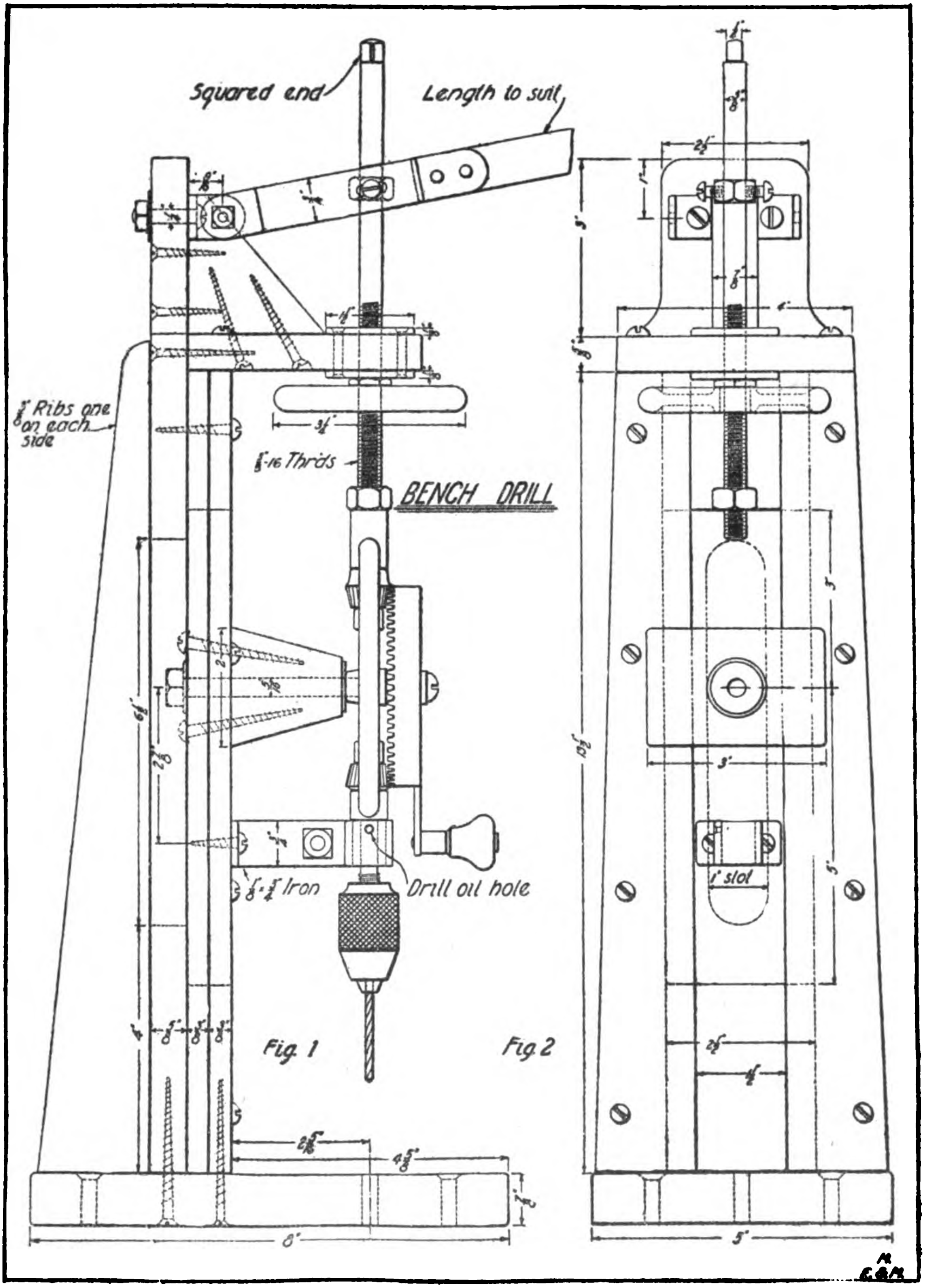
Quite frequently lantern chimneys become cracked and one or more pieces may fall off. If these are carefully replaced and a coat of white shellac applied over the cracks while the globe is still warm, it will be found that the shellac penetrates between cracks and soon sets, holding the pieces firmly together. Surplus shellac can be removed when dry.

Contributed by

B. W. Verne.

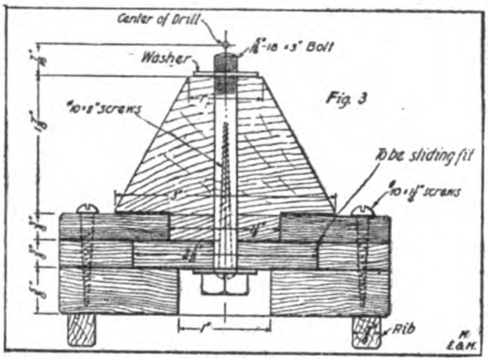
AN EASILY MADE BENCH-DRILL

The bench-drill described below was made by the author after repeatedly breaking small drills, when drilling by hand. The time and effort saved by using one of these tools more than make up for the trouble involved in building one. It was built from odds and ends I found about the house and the cost is next to nothing, with the exception of the drill which must be purchased.



I used a conventional type of hand-drill costing $1.50 and accommodating drills from 0 to 3/16 inch. Obviously a larger drill can be used to suit the builder.

First build up the column and slide preferably of hardwood, although the writer made his of whitewood, which is amply strong for this purpose. Fig. 3 is a section of the column and shows the



construction of the slide, but it can be made either as shown or of a bevel form. The square form was chosen for this drill as it is rather easy to build. The block *A*, fig. 3, should be securely fastened by long screws to the slide and bored for a 5/16-inch by 3-inch bolt with large washers on each end. All parts of the column should be glued and screwed together, especially the head and base, where the greatest strains occur. If figs. 1 and 2 are followed closely, no trouble will be experienced on this part.

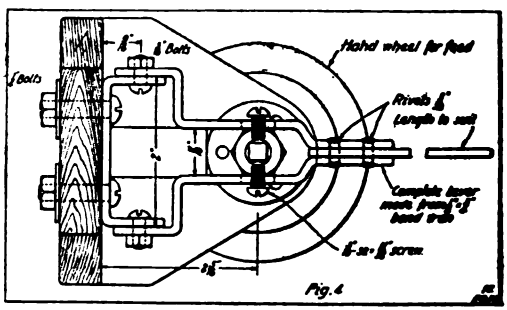
Next, file or turn two washers 1½ inches diameter and drill a ⅜-inch hole through each. Also drill and countersink three ⅛-inch holes and rivet these washers to head of column. Then procure a piece of ⅜-inch diameter soft steel rod and thread it for 4 inches on one end and file the other end square to readily turn it into the drill. The writer took a handwheel from an old 1-inch valve, which had a ½-inch hole in it. He then secured a ½-inch cap screw and sawed off all but ⅛-inch of the head and drove it into wheel and pinned it tight. It was then drilled and tapped ⅜-inch and it made an ideal feed for this drill. The builder can dispense with the handwheel and use the lever, but it is best to have both as it is so much easier using the wheel for feed and the lever for quick return.

Now take the hand-drill and unscrew both handles; mounting it in the frame since the rest of the drilling can be done with it.

Just above the chuck will be found a turned place which comes about right to put an extra support on the drill, thus serving to steady the drill quite a bit and taking considerable strain from the block. It is rather a hard piece to construct unless one has a good heavy vise, but is well worth the trouble of making. It is best to make it a little short from the center of drill to the bottom of the feet and then shim it up so as to get the drill perfectly vertical. It is clamped with a ¼-inch bolt to the drill and an oil hole is drilled right through both, first taking out the spindle.

Next comes the handle which is bent up from ⅛-inch x ¾-inch band iron and no great difficulty will be experienced with this part. A slot ½-inch long should be cut on each side where the screws are, as there is a sliding action here when lowering and raising drill to and from the work. If the handle is used exclusively for feed, it is best to fit a wooden handle on the end.

If the drawings are followed closely no difficulty will be encountered in constructing and using this tool. When the drill is needed for larger work it is easily dismounted and ready for use any time by screwing on the handles again. The writer has under construction an easily made vise built of soft ⅛-inch iron, which screws onto the base. At a



later date this vise will be described and illustrated.

This drill is an excellent little tool for those having a good deal of small drilling and tapping to do. It will be found exceedingly handy for starting and tapping small holes. Without a vise of some sort it is rather difficult to hold small irregular pieces and for this reason a vise is recommended for use in connection with the drill.

Contributed by

H. L. Dearborn.

CUTTING GLASS DISCS

The cutting of a glass disc has always presented more or less of a problem to the average experimenter, and yet it is a simple operation if the following method is employed.

Glass may be cut with an ordinary pair of stout scissors. This may seem impossible, but nevertheless it is readily accomplished, and the only requisite for success besides the scissors, is a basin of water. Hold the plate of glass, which must not be heavier than ordinary window glass, under the water and cut around the edges with a pair of scissors until the glass is of the size and shape desired. This method is not intended for halving a plate or cutting off a large piece, because the glass cut away is, as a rule, reduced to fragments. But this method is quite safe since the main part of the glass will never fracture, providing not more than half an inch or so of the edge is cut away at a time.

Contributed by

C. W. Schwartz.

LACQUERING BRASS

Properly lacquered brass lends a most pleasing appearance to any finished instrument. I have found through experience that if the lacquer is not properly applied, in time it becomes dark and chips off. This is very discouraging, for it necessitates sandpapering off the old lacquer and applying new lacquer, which will not last any longer than the first coat. All this trouble can be avoided in the first place if the lacquer is properly applied. Below is my hard-earned experience in this line.

First, the brass must be given a fine polish. While there are several ways of producing a suitable polish, I find the following very simple:

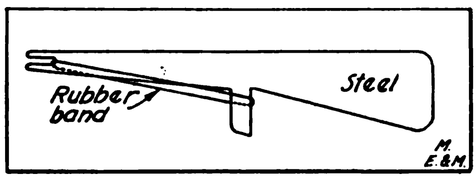
To begin with, cut from some close-grained wood a circle about 10 inches in diameter. Through the center put a ¾ x 5 inch bolt. Next, heat some carpenter's glue and apply a thin, even coat to the surface of the wood. Sprinkle some very fine carborundum dust on this and stand away to dry. After the coating is dry place the circle in the chuck of a lathe and, with the lathe running at high speed, hold a piece of steel against the wheel until the surface becomes quite smooth. After this, the brass may be polished without producing deep scratches in the surface. Round pieces of brass may be polished in the lathe by holding a piece of fine carborundum cloth tightly around it. After the brass is polished, avoid touching it with the fingers, as it leaves greasy spots. Next, place the brass in a clean iron vessel and heat gently. The lacquer is then applied in a thin, even coat with a camel-hair brush and the work set away in a dustless place to dry. The brass is heated for the purpose of expelling all moisture.

Contributed by

Ray F. Yates.

A SIMPLE METHOD OF REPAIRING TIRES

The little tool shown in the accompanying illustration can be used to good



advantage in plugging holes in pneumatic tires.

From a piece of stiff sheet steel, cut out the design shown in the sketch. Although sheet steel is preferable, any other metal will do. Several rubber bands are fastened on the tool as shown in the illustration. As many rubber bands should be used as are necessary to equal the size of the hole to be plugged. The tool is then dipped in rubber cement and placed in the puncture. The rubber bands are unhooked from the arm and the tool removed. After the cement has dried, the plug can be trimmed and the tire is again ready for use.

Contributed by

W. J. Goreham.

HIGH FREQUENCY CURRENT APPARATUS

A Series of Articles Covering the Theory, Making and Operation of High Frequency, X-Ray and Ozone Apparatus

By Frank Brewster

CHAPTER V—HIGH FREQUENCY TRANSFORMER

APPARATUS for the production of Tesla, Oudin or D'Arsonval high frequency current for electrotherapeutical purposes is not very hard to construct and requires but little material in its makeup, the prices asked for this class of instruments, however, remaining high, as usual.

For those who already have an X-ray machine of the induction coil or transformer type, the following small-sized high frequency transformer, suitable for light treatment work, will be found quite efficient and is the same as those furnished with all X-ray generators as an accessory.

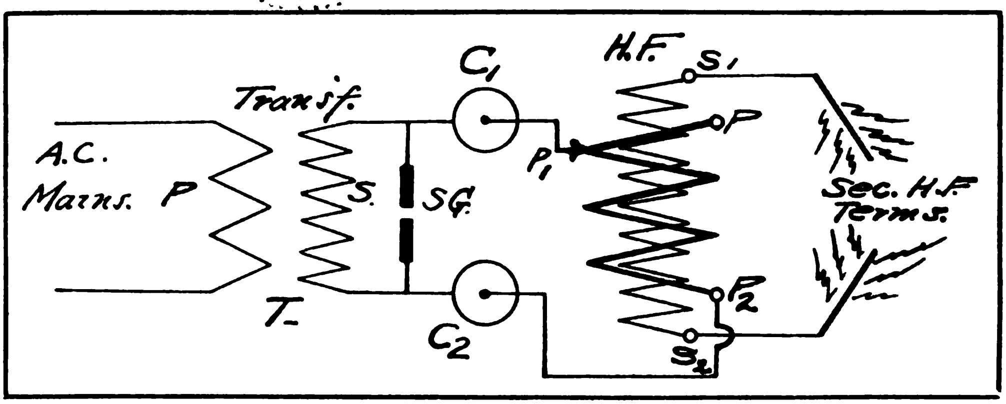


FIG. 23.—DIAGRAMMATIC VIEW OF THE CONNECTIONS USED WITH A TESLA COIL

The coil is of the Tesla transformer type, air-insulated, having a primary of few turns of well insulated wire wound on a fibre or glass tube, and a secondary coil of several hundred convolutions of fine silk-covered wire, each coil consisting of but one layer only.

An idea of the construction of the coil will be had from Fig. 23, where T is the regular induction coil or transformer; S G a spark gap made out of two ⅜-inch zinc or brass rods; C1 and C2 Leyden jar condensers of about ½ gallon capacity each, or a condenser composed of twelve 16 by 19-inch glass plates with 10 by 13-inch tinfoil on either side, may be substituted for each jar. H F is the high frequency or Tesla coil, P1 and P2 representing the terminals of the primary or outer winding, while the secondary or inner coil ends are at S1 and S2. The primary winding is formed of a stiff paper or glass tube 12 inches long and 6 inches in diameter, with a layer 10 inches long of No. 14 rubber covered wire, of about ¼-inch diameter, similar to that used for electric light wiring. The secondary coil consists of a 12-inch layer of No. 31 or 32 B. & S., double silk-covered magnet wire on a fibre or paper tube 12 inches long and 4 inches in diameter.

The current charges the condensers, which discharge across the spark gap in the form of a short, fat, blue-white spark, and this action, coupled to the capacity effect of the Leyden jars and the inductance of the Tesla coil primary, causes oscillations of extraordinary high frequency to be set up and sent surging back and forth through the circuit comprising the spark gap, condensers, and Tesla primary; this circuit being termed the closed oscillating circuit.

The potential is raised to a very high value also, due to the transforming action in the Tesla coil; one coil having many more turns than the other. The electro-magnetic action in this case takes place through the air, no iron being used as it could not reverse its magnetic polarity quick enough.

The current produced at the secondary terminals of the Tesla coil is thus a very high frequency, high potential one, but is harmless and can be handled as safely as the current from a few dry cells. The voltage may be half a million or more, but the discharge can be taken through the body without harm, as these high frequency currents usually oscillate with a frequency of a million or more cycles per second, and for this reason they only travel over the surface of any body they pass to, possessing the phenomenon technically known as the "skin effect," that is, they are surface currents.

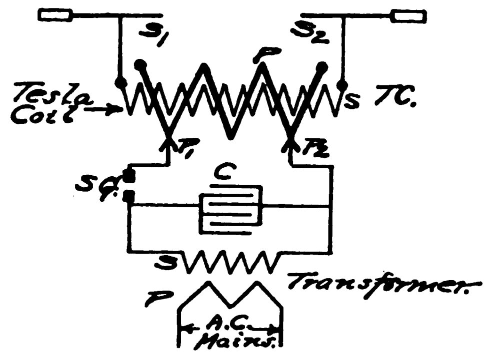


FIG. 24.—CONNECTIONS FOR A TESLA COIL

If the output of an X-ray machine were to be taken by a person as it came from that machine—even though the potential were a million volts—the frequency would be but 60 or 120 cycles per second and the result would be instant death. On the other hand, if a suitable high frequency set is employed, it is possible to take the whole output into the body, as when using the auto-condensation couch.

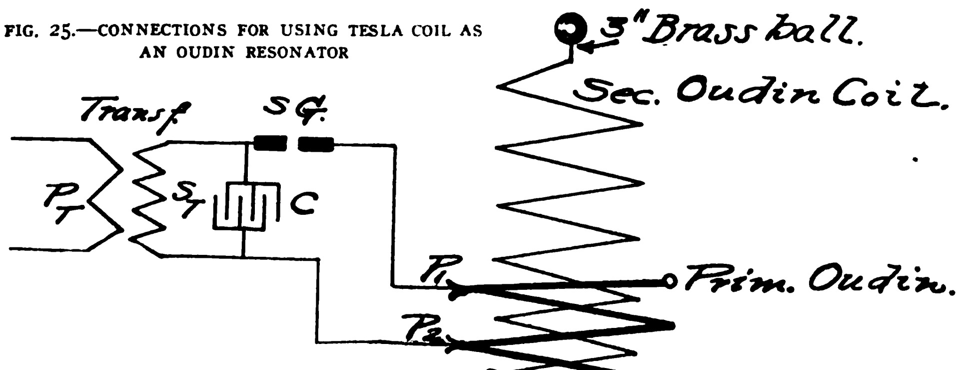
Such is the nature of the electrical current made use of by those giving demonstrations and lectures, some of whom delight in mystifying the uninitiated of their audience by loudly proclaiming that they pass half a million or more volts through their body. But if they didn't lower the frequency by lengthening the spark gap, as they most always do when the committee gets near enough, any one could duplicate their little stunt.

The figures given below are for a large sized Tesla coil used by Prof. H. La V. Twining. It is possible to produce high frequency sparks 36 inches long with this coil when excited by only a 1-kw. transformer, the secondary voltage of which does not exceed 20,000. If it is used on a high voltage X-ray machine, its potential should be lowered by cutting in sufficient primary inductance.

Looking at the sketch Fig. 24, T C is the 36-inch spark Tesla coil; C a glass plate condenser, and S G the spark gap. The primary of this coil is of 10 turns of No. 5 B. & S. spring brass wire or No. 4 aluminum wire, wound on a wooden cage 23 inches outside diameter, and 10 inches long, spacing the turns ¾-inch apart.

The secondary drum is built up of light wood strips and then covered over with a layer or two of stiff paper or thin

FIG. 25.—CONNECTIONS FOR USING TESLA COIL AS AN OUDIN RESONATOR



fibre. On this the single layer of wire comprising the secondary coil is wound. The dimensions of the drum are 11 inches inside diameter and 48 inches long. The secondary wire is No. 24 B. & S., single cotton covered copper, wound on evenly, there being 900 to 1,000 turns in all, leaving a space between every turn equal to half the thickness of the wire.

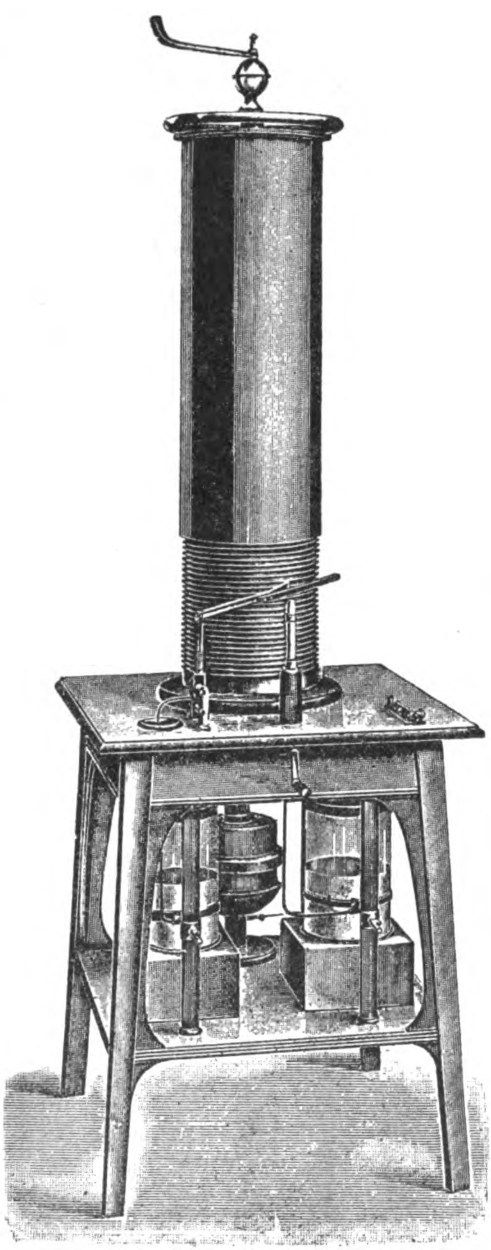


FIG. 26.—A COMMERCIAL TYPE OF OUDIN RESONATOR FOR HEAVY DUTY WORK

The condenser is built up of 40 glass plates 16 by 19 inches, coated on both sides with tin or aluminum foil 10 by 13 inches in size, connecting every other foil leaf to opposite terminals; half the leaves connecting to one terminal and half to the other terminal.

The connections for this set are indicated by the diagram, Fig. 24. In operating it, the primary inductance of the regular transformer, the length of the Tesla primary spark gap, the number of condenser plates in circuit and the number of turns of Tesla primary cut in, should all be varied one after the other, until the maximum effects are attained.

A rotary spark gap will much enhance the operation of any high frequency set, as it prevents the arcing and hissing at the spark gap, due to the heating effect of the discharge. Details for the construction of a satisfactory rotary spark gap are given in the following chapter.

The large Tesla coil may be used as an Oudin Resonator, by simply changing the position of the primary coil to one end of the secondary cage, instead of at the centre, and connecting the bottom turn of the primary and bottom turn of the secondary together, as shown in Fig. 25.

A slight alteration in the dimensions of this coil produces a very good Oudin transformer. The primary coil and cage remain the same, but the secondary drum is made only 36 inches long and the same diameter as before. The secondary winding consists of about 1,000 turns of No. 26 or No. 27 B. & S., single cotton covered wire, spacing the turns so they do not touch, as explained before. The regular Oudin connections are followed, as in Fig. 25.

A commercial type of Oudin coil for heavy duty is illustrated in Fig. 26, which serves as a generator of proper current for auto-conduction, auto-condensation, etc., and is equipped with a muffled spark gap and Leyden jar condensers of about 1 gallon capacity each, these being substituted if desired by a bank of 30-35 glass plates, coated with 10 by 13-inch foil leaves on both sides, the glass being 16 by 19 inches. This

(*Continued on page 784*)

SIMPLE HOME-CRAFT FURNITURE

The Fifth of a Series of Articles Describing the Making of Various Pieces

By G. Lane

Illustrations from drawings made by the author.

THE chifforobe is designed especially for one whose room lacks closet space, as it takes the place of both a clothes closet and a chiffonier. The top shelf on the left-hand side is for hats. The two small drawers underneath are for ties, collars and other small articles, while the compartment at the side of the small drawers will be found handy for brushes, etc. The remainder of the compartments on the left-hand side are to be used for drawers, wherein will be found ample room to keep quite a supply of clothes. The lower space on the right-hand side is for shoes and house slippers, while the rest of the right-hand side is for the hanging of suits and overcoats. In the illustration, the drawers are not shown in the places designated. On the right-hand side a drawing of the door is shown.

In constructing the chifforobe, first make the two ends. These, it will be noticed from the drawing, are paneled. Get out the stock for both ends at the same time to insure accuracy in securing all corresponding pieces the same length. Groove the inside of the posts and rails, to receive the panels, on a circular saw if possible; if not, use a grooving plane. For the panels, use—if it can possibly be obtained—the veneered or glued stock that is employed in the construction of doors. This will not split or warp as in the case of single thickness wood. If oak is used in the construction of the chifforobe, the cost may be cheapened by having oak simply on the outside of the panels and soft wood on the inside. The joints between the rails and the posts may be either doweled or mortised and tenoned, as the maker may choose. To make a success of this panelling be sure that all joints fit snug; try putting the sides together without glue first. After the clamps are on, be sure the piece is not "in wind."

Next make the pieces for the top and bottom and the partition in the center (see drawing, fig. A). These pieces are not paneled, but simply glued up of ⅞-inch stock, preferably with doweled joints. These three pieces are each 22 inches wide, and the top and bottom are each 42 inches long, with notches at the corners to receive the corner posts. The top edge should come flush with the outside edge of the rail and should be fastened in place either with round head blued screws from the outside, or nailed with 2½-inch finishing nails and the holes filled up. Be sure that the center partition fits tight in its place.

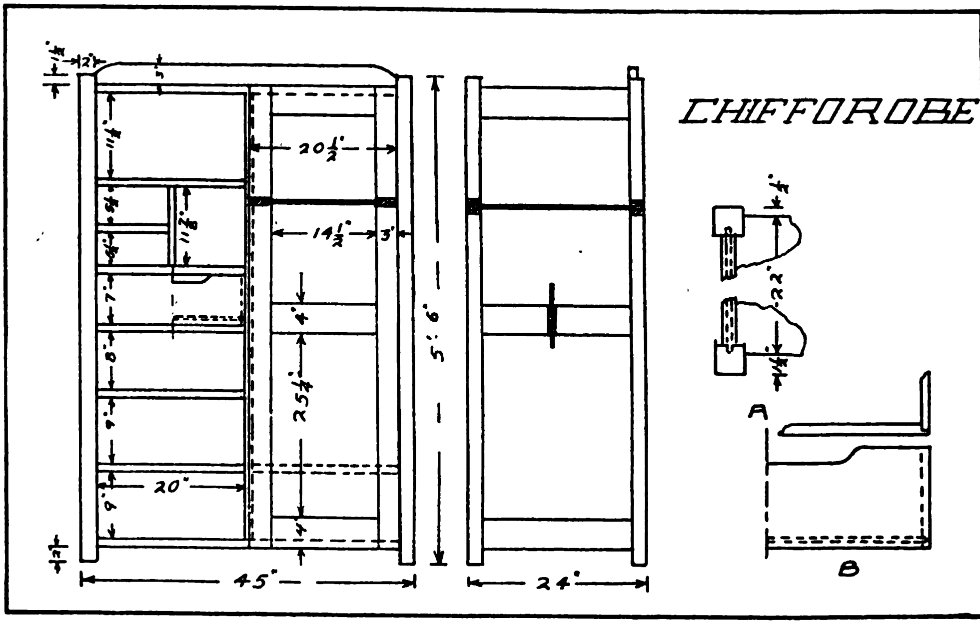
Before these pieces are put together permanently, however, supports for the drawers must be made and put in position. These might be solid ⅞-inch stock, but a frame can be made that will answer the purpose just as well using ⅞-inch by 3-inch stock, making them fit tightly between the posts and the center partition. Frames may be made in the same manner for the two small drawers and the adjoining compartments. A solid board must be used for the bottom of the latter. Fasten these frames to the posts with a ⅜-inch dowel at each of the two corners, and, after all joints are found to be tight, the frames should be screwed or nailed to the partition. Then make the joints between the posts and the frames. At the same time screw or nail into place the top and bottom pieces, and then nail or screw the partition to the top and bottom pieces.

The next step is putting on the back. For this use ⅜-inch or ½-inch pine, matched. Be sure this stock is well seasoned, or the shrinkage will make unsightly cracks. After this has been accomplished, put on the 3-inch piece at the back of the top.

The next problem to consider is the making of the doors. The grooves for the paneling should be ½ inch deep.

It is better to make the doors slightly larger than is necessary, in order that they may be fitted properly. Use double bar clamps for gluing up the doors if possible, to keep them from getting "in wind." In making the doors it is a good plan to groove the stiles the whole length, and make a tenon on the rails to fit the groove; then put ⅜-inch dowels in the end of the tenons. Be sure the glue is absolutely dry before removing the clamps. Wide enough hinges should be used in hanging the doors so that they will swing around far enough to permit the drawers to be pulled out.

The next problem is the making of the six drawers. Fig. B (see drawing) gives the general construction of the



drawers and therefore no detail drawing for each one is given. About ¾-inch stock is thick enough for the front of the drawers, and ⅜-inch or 5/16-inch pine or whitewood should be used for the sides and bottom. In place of putting pulls on the drawers, a curved piece is cut out of the top of the drawer, allowing one to take hold of the drawer front.

After the drawers have been made and fitted, clean the entire piece, sandpapering where necessary, stain, fill, and shellac or wax. Put cupboard door catches on one of the doors and a pull, also a lock, if desired, on the other. Polished steel domes may also be put on the bottom of the posts. Have made at the forge shop, out of ⅜-inch round iron, a sort of hook or support for the coat hangers. This should start 4 inches from the top, at the back, and run parallel to the top for about 18 inches, then be bent at right angles until it meets the top. It should be held in place by two screws at each end.

A TUNGSTEN LAMP RECORD

What is probably a record for a tungsten lamp has been made at the hydroelectric station at Galt, Ont., by one that hangs between the two big switchboards and burns continually for twenty-four hours, day in and day out. This 150-watt lamp was put into service when the department received its first shipment of lamps on March 14, 1912, and it has burned continually since, except when the power was off from the station. Up to April 1, the lamp has burned 17,952 hours, while the estimated life of a tungsten lamp is only from 1,000 to 1,200 hours. The lamp is still giving a good light and there are no signs of it failing.—*Jack T. Gillies.*

INSTITUTE OF RADIO ENGINEERS

AT the meeting of the Institute of Radio Engineers, held on April 1, 1914, in Fayeweather Hall, Columbia University, Past President R. H. Marriot presented a paper upon "Specifications for Steamship Radio Equipment." In this he outlined a set of requirements for radio equipment, both main and auxiliary, such as could be demanded by steamship companies from manufacturers of radio apparatus. The specifications were along the lines of the U. S. Navy 16 R 1 type, and were drawn up for an order of 125 sets of equipment (this being the amount that could reasonably be used by the largest of the American steamship combinations). These sets were to give "ample, prompt and correct radio service, for regular and distress use, and were also to be used for emergency lighting of passageways and life boats from the auxiliary power source of the emergency transmitter."

In his paper, Mr. Marriot took up the desired points in each member of the set in close detail, which this space will not permit of printing; these will be given in the "Proceedings of the Institute of Radio Engineers" in an early issue. However, some of the more interesting requirements are cited below, along with some of the matters discussed.

(A) GENERAL REQUIREMENTS:

1. Ample, prompt and correct service at all times shall be assured, both of regular and distress equipment, and of the arrangements for emergency lighting.

2. Simplicity and good workmanship, without ornamentation, are desired.

3. Strict interchangeability among similar parts of all sets shall be a feature; that is, all of the 125 sets are to be made from similar dies, jigs, templates and so on.

4. All parts of the set shall be exposed to view and accessible, wherever possible.

5. Apparatus shall retain its good condition and efficiency when used, at all seasons, between latitudes 45° N. and 45° S.

6. All parts not easily repairable on shipboard shall be furnished in duplicate or more.

7. Apparatus shall produce as little noise as possible when in operation.

8. Sets shall be self-contained so as to give a minimum amount of wiring and installation labor.

9. All parts shall be permanently marked with their electrical constants, such as K.V.A., K.W., V., L., C., etc.

10. Insulation used in various portions of the set is definitely specified.

11. Conductors in high frequency, heavy current circuits shall be silver-plated copper.

12. All contacts shall be soldered, using non-corrosive flux.

13. A tool cabinet, containing ordinary and special tools for use in shipboard repairs, and containing complete diagrams and necessary information about the set shall be furnished. The cabinet shall have a glass front, the operators' licenses being displayed behind the latter, and shall be fixed in a prominent place upon installation.

14. Auxiliary source of power is to be an Edison storage battery capable of supplying the transmitter (operating at full load) for six hours' continual sending; and it shall also be capable of supplying 500 watts for lighting purposes covering a like period. (NOTE: Before deciding upon the Edison storage battery as an auxiliary power source, Mr. Marriot discussed various other sources, namely: A generator driven by steam, gas or oil engines, or turned manually by members of the crew, and the usual lead storage cells. He gave the disadvantages of these as compared to the Edison battery and decided upon the latter as safest, simplest and most reliable.)

(B) TRANSMITTER:

1. Rating shall be based upon watts present in antenna.

2. Efficiency shall be rated as the ratio of watts in antenna to watts in the motor of the motor-generator.

3. The test for rating shall be carried out in an approved, specified, artificial antenna, in which the energy present shall be at least 1,200 watts at 600 metres wave length.

4. The transmitter shall be capable of continuous operation for six hours, at full load and at all wave lengths.

5. The power taken from the ship's mains shall not exceed 3 KW.

6. Transmitting couplers shall be calibrated for coupling and wave length, and the latter shall be continuously variable from 300 to 600 metres.

7. It shall be possible to change to any one of four wave lengths within 10 seconds, and to do this it shall not be necessary for the operator to leave his seat.

8. Transmitters shall also be capable of use upon 1,600 to 2,000 metres wave length.

9. The tone frequency of spark sets shall range from 800 to 1,200 cycles per second (various tones being assigned to various ships). The design of the set shall be such that a clear note shall not be obtained at just a critical point, but shall be obtainable over a wide range.

10. The sets shall operate properly when fed with any voltage between 90 and 130 volts.

11. A "series condenser" shall be supplied for operation on 300 metres wave length.

12. The power in the antenna shall be variable in five steps (preferably by a loosening of coupling) with a minimum of 50 watts. (The purpose of this arrangement is that at times—at night and in winter—the range of the set is greater than usual, and then less power shall be used. Also, in harbors and places in which full power is unnecessary for communication and in which it would be undesirable, a minimum amount of power shall be used.)

13. Specifications for the low frequency switchboard and instruments are given.

14. Power wiring shall be encased in grounded metal covering, mechanically stronger than lead.

15. Constant amplitude transmitters ("undamped"), when furnished, shall be provided with some arrangement to enable their waves to be received on ordinary receiving sets. Receiving apparatus of such a set shall be arranged for use on either damped or undamped waves.

(C) RECEIVER:

1. The tuner of the receiving set shall be provided with a spring motor for varying wave length continuously from 300 to 600 meters, and also for manual control. At the 600 meter point the motor shall retard for a short space of time.

2. The wave length at various adjustments of the tuner shall be indicated on a scale.

3. The tuner shall be capable of use up to 3,000 meters.

4. One detector, at least as sensitive as perikon and as stable as carborundum shall be provided; the set shall be arranged, however, so that some other detector may be used.

5. Variable condensers shall be of the balanced type, air dielectric.

(D) ANTENNA:

1. With each set there shall be supplied, on the basis of a six-wire antenna:

(a) Two 16-foot steel spreaders.
(b) 2000 feet of phosphor bronze (silicon) stranded wire.
(c) Proper fittings for insulators, lead-ins and so on.

2. Antenna insulators shall be of strain porcelain and shall be so arranged that if they break the antenna shall still be upheld by some metal portion and that breakage shall be such that no large pieces shall fall to the deck (that is, the insulators are to be so designed that they must break into small pieces, if at all).

3. The ground leads shall consist of ½-inch cable.

(E) CONTROLS:

1. Control and testing instruments shall be supplied in sufficient quantity to enable rapid and accurate inspection of the 125 equipments to be accomplished. These would include:

(a) Artificial antennæ.
(b) Wave meters.
(c) Radio frequency ammeters.
(d) Wattmeters.

A long and interesting discussion followed the paper, in which representatives of steamship and radio companies, as well as Government inspectors presented their views upon the subject. With the exception of minor points, all agreed with the speaker in his requirements.

It was announced that a permanent office of the Institute had been established at 71 Broadway, New York City, to which all correspondence should be addressed in the future.

CHAOS OR SYSTEM IN SHOP OPERATION

A Cardinal Issue---One Leads to Absolute Failure While the Other Contributes Materially to Success.

By H. W. H. Stillwell

THE well-balanced and systematic person delights in law and order wherever he may be. And in no place is this more noticeable or the results more important than in the factory. The difference in various shops is so striking that one who has never actually worked in the shop himself or has little or no knowledge of shop operation can readily see at a glance the difference in the general appearance of things. When one enters the doors of a shop where system prevails, he can readily determine, from the orderly manner in which things are kept and handled, that those in charge are men who know and appreciate the value of systematic operation.

In striking contrast with the foregoing are the conditions prevailing about the slop shop where everything is in chaos. The general order of things about such a plant is very evident in every department—even in the office—and it does not require a very keen sighted person to see that there is not much prosperity for those at the head of the business and the ultimatum is only too evident. It is very strange how many of this type are doing business in this country. As fast as one "goes to the wall," another takes its place and carries things along in the same carefree, don't care style until ruin, black and grim, puts an end to the proceedings and the firm is for all time blotted out and plunged into oblivion.

It takes all kinds of people to make up this world and this type is as necessary as any other to compose the great human family. It is nevertheless a pity that things should go on in such a manner when, in many cases, the prospects for the parties concerned were of the most promising and all seemed to point to success.

In these days of strenuous mental, physical and business activity, a man must be in condition to meet any obstacle and conquer it with his superior knowledge and in every way "be on the job." In the slop shop things are never just ready for anything unexpected—the floor is never swept and when materials or tools accumulate to such an extent that they are in the way, a few well directed kicks spread them about and all is again serene. Hiding places for spoiled work abound and the vexed foreman wonders where certain pieces of work have gone which he has been inquiring after.

The shafting greets the visitor with a beseeching squeak which is echoed in the chafing of a lathe belt on the cone. Some of the belts show gaps or hurried patches across their face—premonitions of sudden partings and telltales of neglect and carelessness. Anything will do in getting the job on hand completed and patching up is a common occurrence.

In machining up work from the rough stock, twice the amount of material is placed in the planer, shaper, lathe or other machine and cut away and wasted. The workmen are lavish with oil and waste, use new files whenever obtainable, throw a broken tool under the bench and if they happen to get hold of a good one it is promptly placed in their private box or drawer and locked up, thereby depriving the company of the use of its tools by this miserly spirit of its workmen. If a planer tool is wanted for a certain size of work, a larger one is often ground down to the required size instead of the workman getting his hammer and going to the forge and making the tool as required for his job. This may also be said of the drills; a new one often being ground to suit some particular job and spoiling it forever for anything else. A ¾-inch drill may be wanted and one of 13/16 is ground to size. Possibly some workman shortly after this incident will require a drill of 13/16 and none will be available. It is evident that no supply of drills or other tools can be kept on hand and, of course, not in sets. When inventory

¶ In the slop shop, everything is in chaos. The general order of things about such a plant is very evident in every department—even in the office—and it does not require a very keen-sighted person to see that there is not much prosperity for those at the head of the business and the ultimatum is only too evident.

time comes around the proprietor wonders what has become of the sets of drills and the various other tools which he started off with so sanguinely and hopefully the beginning of the year.

In the machine operations, a job that should be done upon the planer is given to one of the workmen to chip by hand because the planer is in use and three or four hours are therefore consumed as compared to a half-hour which would be required if done under proper conditions. A piece of work that should be drilled in the drill press is taken to the lathe because the former is in use. Considerable time and money is wasted in doing the work. There are no proper places for tools or materials about the various departments and valuable tools are thrown about in a shameful manner, in a very short time being rendered worthless for accurate work.

In a certain shop known to the writer, there is no system regarding tools and their arrangement. In the first place there is no proper place for them to be kept, and no person to devote his time to keeping them in order and in good condition. This company spends a vast amount of money each year to supply its workmen with necessary and unnecessary tools and perhaps half of them are confiscated by unscrupulous workmen and appropriated to their own uses. With a small tool room provided with necessary shelves and racks, drawers, etc., and the paying of a man to look after the room, the greater part of this expense would be eliminated and the company would be many dollars to the good each and every year. The management of a company seldom realizes these conditions or they would put a quick stop to them. As it is, inefficiency reigns for years and the management never suspects that such lack of system prevails in its midst.

In a small town in western Pennsylvania there is a certain copper mill which is conducted much along the slop shop rules. This concern handles a great many commutators for various companies and makes them in a variety of shapes and sizes. Many mandrels and arbors are in constant use ranging from a fraction of an inch to several inches in diameter. These tools, instead of having a rack or cupboard where they could be kept according to size and in order, were thrown together in a heap on the floor. In one instance, which the writer chanced to witness personally and has never forgotten, a workman having finished with one of the arbors stood across the room, a distance of perhaps fifty feet, and threw the arbor across to the heap where it landed with great violence against another larger one and crashed down among the others with a clang. Such absolute carelessness is revolting and should merit severe censure from the foreman, or immediate dismissal.

Jealousy is very noticeable among the men in this shop and tale-bearing is constantly carried on among the workmen.

The foreman in charge of the machine shops is a man of very narrow views and one who has had very little practical experience in this line. Foremen are often to blame for conditions that exist in the rooms under their supervision and the management often do not know the actual manner in which things are handled. In the shop referred to previously, there is manifested little readiness among the workmen to assist each other. The man who knows a little more than his fellow, holds on to his knowledge

¶ In the slop shop, indifference and ignorance go hand in hand. In machining up work from the rough stock, twice the amount of material is placed in the planer, shaper, lathe or other machine and cut away and wasted. The workmen are lavish with oil and waste, as well as with the tools and other shop equipment.

much as a miser clings to his gold. In giving orders, the foreman seems to give them with an air of reproof. This shop is a very good place to take work and get promises for its completion, but when the completed work will be delivered is another consideration.

There are plenty of these slop shops all over the country and although they usually fail after a time, there are new ones starting up all the time and it would seem that the slop shop is probably a permanent institution and a necessary evil.

In arranging the shop, careful consideration is necessary, for the machinery and tools should be arranged with a view to the least possible handling of the material during the various operations. A good example of this arrangement can be found in many of the great steel mills through various parts of Pennsylvania; the iron comes to the mills in the form of "pigs" and is converted into steel, then rolled into rails, plates, sheets or any desired shape; the various operations being arranged in succession, the finished product coming from the opposite end of the mill from where the raw materials entered. This systematic handling of materials in the manufacturing operations causes a vast saving in time and money to the company and the running about of the various employees from machine to machine or department to department is eliminated.

In operating a machine shop economically the head of the department must be a conscientious and systematic man who will have the company's welfare at heart as well as the men's. A foreman who will conduct the business under his charge in the proper manner can easily save the company many thousands of dollars in a year and vastly improve the conditions under which the men labor.

The character of the foreman has a very marked influence upon the men under him. In a way, the men look to the foreman as an example and he should therefore try to conduct himself in the best possible manner. A foreman should realize that his workmen are entitled to his respect, and he should conduct himself in such a manner that when he moves about among his men they will feel in duty bound to show him all the courtesy usually accorded such a position. His personal habits should be such that may with profit be imitated by every man in the shop. If one of the workmen should get into trouble over a piece of work, a kind and sympathetic foreman will consider whether reprimanding is necessary and will help him out of the difficulty with well directed advice. It is too often the case that a foreman, after some little wrong on the part of his man, will reprimand him sharply or go beyond all bounds using language which should never be tolerated under any consideration and thereby losing, to a great extent, the respect of his employee. A foreman should consider what kind of language

(*Continued on page* 782)

¶ Harmony is an all-important factor in good management of the shop. There is no reason whatever why the shop where good intelligent mechanics are employed, should not be run economically and pleasantly, and the spirit of tranquility and responsibility will infuse itself into each and every man in the employ of the company.

¶ The model shop, on the other hand, is an exponent of present-day efficiency. Take, for instance, the system employed in many of the great steel mills in various parts of Pennsylvania. Here the iron comes to the mills in the form of "pigs" and is converted into steel, then rolled into rails, plates, sheets or any desired shape; the various operations being arranged in succession, the finished products coming from the opposite end of the mill from where the raw material was entered.

The Editor's Desk

In this issue—by the way, the last that will be published under the name of MODERN ELECTRICS AND MECHANICS—there are many articles of timely interest. To begin with, the article on the power houses in the Sierra Nevadas that are furnishing power and light to Los Angeles should prove of interest. This gigantic hydroelectric undertaking, which has recently been finished, presented a serious task to the engineers and workmen. Owing to the present-day interest in the Panama Canal, the undertaking described in our article has been somewhat overlooked, although it is a momentous triumph of modern engineering. Another similar article is that covering a few features of the *Vaterland*—the new monster ocean liner that will shortly make her first trip.

Our mechanical readers will certainly feel that they have been well remembered in this issue. There are numerous articles of particular interest to those who read MODERN ELECTRICS AND MECHANICS for its mechanical features. There is the article on how to build a small cannon, another on the construction of a small drill press and several others in the Practical Hints columns. Then again, the excellent treatise by Mr. H. W. H. Stillwell covers at length the proper management of a machine shop. This last article will undoubtedly contain much food for thought for anyone connected with a machine shop. And even for the average reader, it will prove interesting reading, for system is necessary in every line of industry if the maximum success is to be attained.

The wireless features are headed by Mr. Alfred C. Pickells' article that was heralded in the May number. In his essay on "Do Radio Ghosts Exist?" he has brought forth many new points—not alone in radio communication but also in the study of sound waves. The other wireless features would be worthy of comment if space permitted.

There are many other articles which would certainly deserve passing comment if space permitted. Many of these are short and to the point, accompanied by one or more illustrations that aid in telling the story.

It is evident, unfortunately, that some misunderstanding exists among some readers as regards the Questions and Answers department of MODERN ELECTRICS AND MECHANICS. Let us talk it over and make it clear just what the Questions and Answers department does. To begin with, all questions sent in that are deemed of *sufficient general interest to all readers* are answered in the columns of that department at the first available opportunity. It should be borne in mind that questions cannot always be answered in the first issue after they have been sent in. If immediate answers by mail are desired, a fee of 50 cents is charged to partly defray the expenses. This fee also applies to the answering of questions that do not prove of general interest to all readers.

Our next issue will be the first one of the new consolidated magazine, POPULAR ELECTRICITY AND MODERN MECHANICS. This magazine is the result of the merging of *Popular Electricity and the World's Advance* and *Modern Electrics and Mechanics*. The combined facilities of both these well-known publications will enable a larger, broader and far more interesting magazine to be published.

The first issue of POPULAR ELECTRICITY AND MODERN MECHANICS will be replete with absorbing articles—the kind that you cannot stop reading until you have reached the last line. Readers of a popular turn of mind will find a collection of scenes depicting the latest inventions, discoveries and applications of science, both in the United States and throughout the world.

But we will not stop here. The electrical, mechanical and wireless features of both *Popular Electricity and the World's Advance* and *Modern Electrics and Mechanics* will be preserved and continued in the new consolidated magazine. Indeed, with the larger size of the publication it will be possible to furnish more of this material than in the past.

We made good our numerous promises to the readers of *Electrician and Mechanic* and *Modern Electrics*. MODERN ELECTRICS AND MECHANICS has made many new friends and has retained practically all the old readers of both publications that were merged. The new consolidation will esult in still greater success—one that will thoroughly eclipse the former one. Watch the first issue of POPULAR ELECTRICITY AND MODERN MECHANICS!

FLYING SPARKS

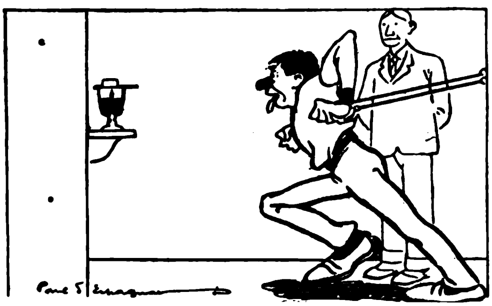
COULD YOU BLAME HIM?

First Passenger—Sir, I fancy your mother over there has a touch of seasickness; perhaps you'd better look after her.

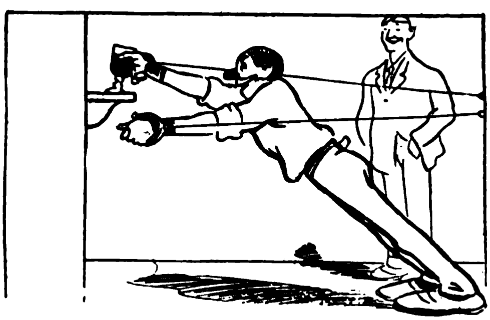
Second Passenger—The lady is my mother-in-law.

First Passenger—A thousand pardons. —*New York American.*

A TRAINING SUGGESTION



It is hard work to keep Will Getsoused in training. This pugilist is too lazy to exercise—



—unless ingenuity is employed.—*Le Pele Mele.*

HE PROBABLY DID

"I saw my boyhood chum to-day, the one that has become a millionaire."

"Did he recognize you?"

"I guess so. He turned a corner when he saw me coming."—*Houston Post.*

A CAUTIOUS GREETING

Pat—That McGinty is a fine fellow.

Mick—Is he?

Pat—He is, indeed. Great friend of mine. He wasn't satisfied wid shaking wan hand.

Mick—No!

Pat—He grabbed both my hands—fine fellow—grabbed both my hands.

Mick—Yis, I suppose he thought his watch and chain would be safer that way.—*Chicago Ledger.*

SHE FOLLOWED INSTRUCTIONS

A teacher in a large city school sent one of her scholars to buy a pound of plums from a fruit vender on the street, and as she handed the little girl a dime she said:

"Be sure, Mary, before buying the plums to pinch one or two, just to make sure that they are ripe."

In a little while the child returned with flushed cheeks and a triumphant look in her eyes.

Handing the teacher the bag of plums, she placed the dime on the desk and exclaimed:

"I pinched one or two as you told me, and when the man wasn't looking I pinched a bagful."—*National Monthly.*

A FOOL THERE WAS

Howard—A fool and his money are soon parted.

Mrs. Howard (clapping her hands)—Oh, John! How much are you going to give me?—*Life.*

HARD LUCK

First Lady—Too bad! Mrs. S. always has such abominable weather for her afternoon teas.

Second Lady—Yes; she never pours but it rains.—*Tit-Bits.*

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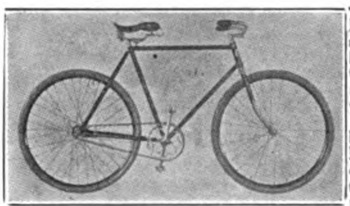

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THE NEW CABLE TELEGRAPHY

(*Continued from page* 738)

bility of the drum relay for relaying purposes is clearly evident. Where, for instance, the Picard method is used, in which the sending end of the cable is insulated from earth during the interval between the sending out of alternate impulses, the cable will remain charged positively or negatively for a considerable time after the sending key is depressed, or released, respectively. Accordingly, inasmuch as the cable is prevented from getting rid of its charge, the lever of the receiving relay will remain in contact with the marking segment of the relay a greater length of time than it would were the cable allowed to discharge immediately upon the removal of the battery at the sending end. Naturally, in due time, the charge is dissipated; but it is found in practice that the relay pointer does not return to the insulated segment of the drum within the period necessary to register the longest dash required in forming the telegraphic code. When the sending key is released, however, a minus impulse is sent into the cable which quickly terminates the marking current and returns the relay tongue to the non-marking position. With Picard transmission, obviously the drum needs but two segments: one metallic segment for marking, and one insulating segment for spacing.

Where the Gott system of transmission is used, the three section drum is necessary, for, as previously stated, each element of a letter is made by an impulse having the opposite sign to that of the element preceding it. And it is true that with this method of transmission also, holding the sending key down (as in making a dash) keeps the cable charged, thereby prolonging the excursion of the tongue of the relay to the right or to the left on the surface of the drum. In this case, releasing the key simply permits the cable to discharge to ground at the sending end, the result of which is that the relay tongue at the distant end quickly returns to the center or non-marking segment of the drum. As the next impulse transmitted is from the opposite battery pole, the relay tongue is moved into contact with the marking segment of the relay opposite to that

previously engaged; but whether this impulse is required to register a dot or a dash is, as in the former case, determined by the length of time the sending key is held down.

In view of the foregoing it is apparent that the "Cable Sounder System," as it is popularly called, is dependent upon the employment of new transmission systems and new types of receiving instruments.

It is not to be supposed that cable experts agree that no further improvement is possible. Indeed, there are at the present time many well-known electrical inventors engaged in this line of development. A list of the names of those engaged in the work would include the following gentlemen: Messrs. Taylor and Dearlove, associated with Mr. S. G. Brown; A. W. Sharman, Mr. Orling, J. E. Huertley, M. A. Turpain, and K. Gulstad.

Mr. Huertley has brought out a relay in which the moving element controlled by the suspended coil, in its movements to and fro directs an air blast upon two "hot" wires, thereby varying the electrical resistance of local circuits of which these wires form parts. Reports of the operation of this relay indicate that it is quite successful.

In the Orling receiving relay, the usual suspended coil has a bifilar semi-rigid suspension, the tension of which is adjustable, allowing a very limited movement only of the moving coil.

Attached to the coil and projecting away from it, there is a fine wire .001 inch in diameter. This fine wire, or rod, which is deflected to the right or the left in unison with like movements of the suspended coil, is called an "interceptor." A minute stream of acidulated water is projected downward from a jet situated above the interceptor. The .001 inch interceptor wire projects through the center of the stream; the slightest movement of the former being sufficient to deflect the stream from its directly downward path causing it to impinge upon two fine platinum contacts, thereby completing a local battery circuit which may include a reading sounder or a repeater transmitter. The acidulated water junction between the platinum contacts is of such small section that only a current of 8 or 10 milliamperes

may be passed through the local circuit; a strength quite sufficient to operate ordinary polarized relays.

Consideration of the foregoing undoubtedly will have made it plain to the reader that the development of satisfactory cable receiving instruments to be used in conjunction with the new methods of transmission involves a reduction of the inertia of the moving elements of such instruments, especially where the instrument is required to automatically serve as a relay or repeater. So far as the reduction or elimination of inertia is concerned, the original mirror galvanometer ideally met the requirements, as this instrument had for a scale pointer a long straight beam of light in itself devoid of mechanical inertia. Unfortunately the beam of light could not be employed to close and open local battery circuits (except by means of selenium cells, which are too slow in action for the purposes of telegraph signaling) containing sounders or repeaters.

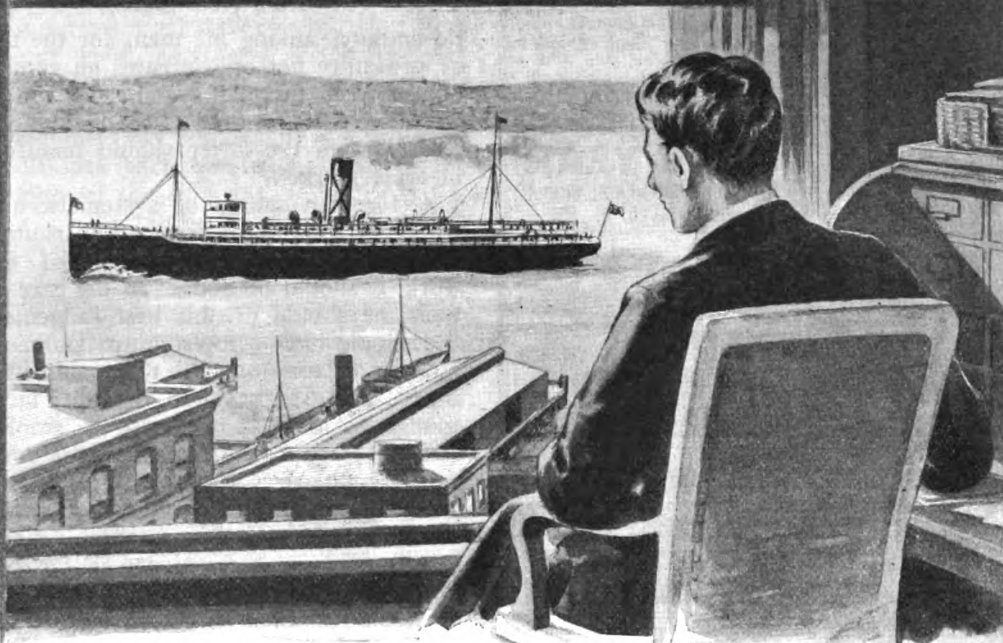
The Brown drum relay, and the Orling relay, described above, are beautiful examples of what inventors can do in the way of producing instruments which possess practically all of the advantages of the mirror galvanometer, and have the additional facility of being able to control the operation of auxiliary or local circuits connected therewith.

MAIN LINE RADIO CLUB

A recent meeting was held at the home of Mr. G. A. Pool, 143 E. Montgomery avenue, Ardmore, Pa., on March 28th, 1914, for the purpose of organizing a club on the main line of the Pennsylvania Railroad. The object of this club, known as the Main line Radio Club, is the advancement of all things pertaining to radio communication. The following officers were elected: H. Skinner, president, and G. A. Pool, secretary and treasurer.

The secretary will be pleased to hear from all who are interested in wireless telegraphy within range of Ardmore, Pa.

"Enjoy a trip to Foreign America"



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There are many surprises in the first issue of Popular Electricity and Modern Mechanics. Do not fail to secure a copy when it comes out! It will be on the news-stands June 15th.

When writing, please mention "M. E. & M."

CHAOS OR SYSTEM IN SHOP OPERATION

(*Continued from page 771*)

he employs among his men, for the use of profanity not only creates an enmity between the foreman and his workmen, but also destroys the ambition and interest which the latter should manifest in their work.

A foreman should be systematic and wherever a standard or a certain routine can be applied to any branch of the work, it should be done. In the care of tools, he should use his best judgement and should have a toolroom of sufficient capacity to accommodate the tools in his charge and if the shop is not large enough to make it necessary to employ a man to see to the toolroom, the foreman should carry the keys himself and see to it that his men return tools borrowed for their work. A checking system is of great convenience in locating tools when out on the various jobs and the tools can then be charged up to the account of the man using them. When a foreman gives a piece of work to a mechanic he should first consider whether the man in question is as well fitted for the job as some other workman, but when he once places the work, if the man is capable of doing it, he should be allowed to finish it as far as possible, as there is nothing more humiliating to the workman than to start a job and then have it taken from him and given to another.

And finally, a model foreman should endeavor to make himself so useful to his men that they cannot well get along without him. He should take a keen interest in all matters pertaining to the business and show as much interest in the management and economical operation of the business as if his own capital were invested in the business. The foreman should praise his men whenever praise is necessary and when the workman shows that he is endeavoring to do his very best. If the workman should invent some process or tool to save time and expense in manufacturing, the foreman should praise him and give it thorough trial. And if it is a success, he should do all he can to give the man the credit before his superior officers and not seek to take all the honor and glory upon himself as is the case with a great many foremen these days.

Harmony is an all-important factor in the good management of the shop. There is no reason whatever why the shop where good, intelligent mechanics are employed, should not be run economically and pleasantly, and the spirit of tranquility and responsibility will infuse itself into each and every man in the employ of the company.

CLASSIFICATION OF SHIP STATIONS

The classification of vessels as given in the "Regulations for Radio Apparatus and Operators on Steamers," edition of July 1, page 8, paragraph 7, and "Regulations Governing Radio Communication," edition of July 1, page 5, "B," "Ship Stations," have recently been amended to read:

First Class.—Vessels having a continuous service.

There shall be placed in the First Class vessels which are intended to carry 25 or more passengers—

(1) If they have an average speed in service of 15 knots or more;

(2) If they have average speed in service of more than 13 knots, but only subject to the twofold condition that they have on board 200 persons or more (passengers and crew), and that, in the course of their voyage, they go a distance of more than 500 sea miles between any two consecutive ports.

Second Class.—Vessels having a service of limited duration.

There shall be placed in the Second Class all vessels which are intended to carry 25 or more passengers, if they are not, for other reasons, placed in the First Class.

Third Class.—Vessels which have no fixed periods of service.

All vessels which are placed neither in the First nor in the Second Class shall be placed in the Third Class.

The grade of operators required on vessels of each class is prescribed in the London Convention Service Regulations, Article X. A continuous watch may be maintained by one commercial second grade operator and one cargo grade operator on cargo steamers.

When forwarding Form No. 761, "Applicant's Description of Apparatus," there should be indicated under the heading "Class of License Desired," the classification, in accordance with the above.

It is, of course, desirable to have as many vessels in the first class as possible. Vessels voluntarily equipped, and maintaining "Constant Service" will be entered in the first class.

HIGH FREQUENCY CURRENT APPARATUS

(*Continued from page 764*)

number of plates should be put in the place of each jar.

The secondary coil may comprise one layer of No. 28 B. & S., D. C. C. wire, or if heavy currents are required, use a larger wire. The drum is 32 inches long and 10 inches outside diameter, with the turns so wound that they do not touch.

The primary coil consists of 22 turns of No. 6 B. & S., hard brass wire, or stranded copper cable, wound about a cylinder 14 inches long by 20 inches outside diameter, separating the individual turns 5/8 inch apart.

In all of these coils, the primary lead connections are preferably made by means of spring clips or sliding contacts, permitting of quick variation of the number of turns in circuit.

For those desirous of making their large Tesla coil primaries of brass or copper tubing, this course is open and is just as good as a solid rod, for the reason that the high frequency current only penetrates to a depth of a few hundredths of an inch.

In building any of the transformers or high frequency coils described in this series, enameled covered wire should never be substituted for cotton or silk insulated wire, as the high inherent capacity of the enameled wire renders it unfit for such purposes. This has been learned through actual experience in building this class of apparatus by a large commercial concern.

No current-carrying part of a high frequency instrument should ever be nickel plated, for the "skin currents" will surely travel through the plating, and not the conductor under it. Since nickel is a poor electrical conductor, the logic in suppressing nickel plating for these parts is evident. Lacquered brass is just as good in appearance and twice as serviceable. Silver plate would be ideal, as silver is about the best conductor of electricity known.

All connecting leads or rods between the condensers, spark gap, or high frequency coil windings must be as direct as possible, avoiding sharp bends, and having the individual pieces of equal length; odd lengths rendering it more difficult to tune the set into resonance.

NEW THINGS

Electrical—Wireless—Mechanical

New Type Bell Ringing Transformer

In the accompanying illustration is shown a novel type of bell ringing transformer of attractive design that has recently been placed on the market by the Packard Electric Company, of Warren, Ohio.

This transformer is unique in the matter of having a porcelain covering instead of the usual iron or wood casing. It is furnished in three colors—white, brown and blue—which renders it unusually attractive for window displays or similar purposes. Furthermore, the porcelain covering is said to possess several advantages which have caused the company to adopt it.

The transformer will stand a complete short circuit continuously without damage either to itself or connections. The core is of silicon steel and the coils are form wound and vacuum treated. The entire case is filled with insulating compound.

The transformer is suitable for operating residence door bells, buzzers and all classes of light signal work. It will also be found convenient for experimental purposes. Stock models are wound to operate on alternating current voltages ranging from 100 to 130 volts, 60 to 133 cycles.

The dimensions are as follows: Length $3\frac{1}{4}$ inches, height $3\frac{1}{2}$ inches, width 3 inches. The net weight is $1\frac{3}{4}$ pounds.

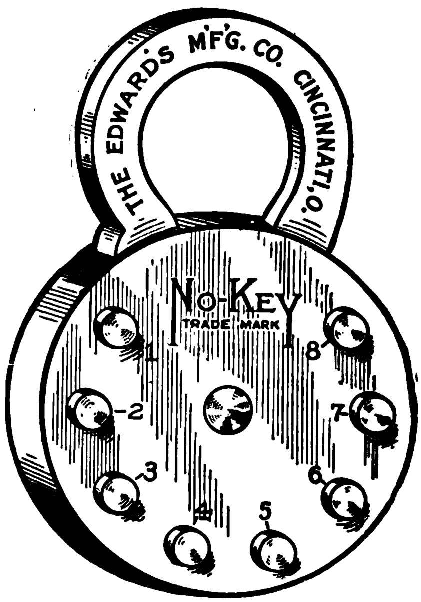
PORCELAIN COVERED BELL-RINGING TRANSFORMER

This transformer is sold at $2.50. Further particulars regarding this transformer as well as heavy duty bell ringing transformers for factories, schools, etc., may be obtained by addressing the Packard Electric Company as above.

A Keyless Padlock

Among the many recent hardware novelties is a padlock that may be opened by pressing the correct combination of buttons instead of using the conventional key.

In the accompanying illustration is shown one of these locks in which may be seen the numbered buttons that actuate the mechanism. To open the lock it is only necessary to place the fingers on the correct buttons and slightly press them, causing the lock to fly open. It is said that a person who does not know the combination cannot possibly open the lock, since it will open only when the correct buttons have been pressed.



THE NEW KEYLESS PADLOCK

These locks are furnished with eight buttons numbered from 1 to 8. Every padlock is furnished with a different combination and the manufacturers state that over 40,000 combinations are possible from these eight buttons. This insures each purchaser receiving a lock with a combination that has not been duplicated. The locks are made of solid brass and bronze, and do not contain any iron or steel that might rust and deteriorate when exposed to the weather.

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is giving such absolute satisfaction that you could not help but be pleased with it if you want a substantial, durable, convenient combination wood worker. Get our catalog telling all about it, and describing our line of band saws, saw tables, shapers, jointers, borers, planers and matchers, planers, disk-grinders, variety wood workers' band saw blades.

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Make Better Mechanics

Right and left Ratchet; and rigid.

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With six-inch shank, $1.10
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Write for "'Yankee' Tool Book" for mechanics and householders; "'Yankee' Tools in the Garage" for motorists.

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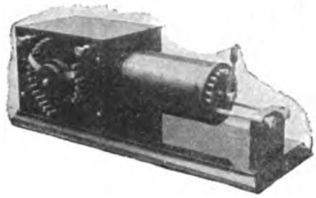
For further particulars, address the Edwards Mfg. Company, 747-797 Eggleston avenue, Cincinnati, Ohio.

New Model Loose Coupler

In the accompanying illustration is shown the latest model loose-coupler manufactured by J. F. Arnold, 243 East 118th Street, New York City, N. Y.



AN IMPROVED FORM OF LOOSE COUPLER

This loose-coupler tunes up to three thousand metres. The primary housing is of hard rubber, while the woodwork is all of hand-rubbed magohany. The secondary is wound with green silk-covered wire and has 11 taps connected to the switch. One of the good features of this loose-coupler is that the secondary slides very readily and never sticks. Any number of turns of the primary winding may be secured by means of the double-handle switch mounted at the side of the primary housing.

In designing and manufacturing this loose-coupler, every effort has been made to secure the highest efficiency. The insulation is perfect. The windings are correctly proportioned and wound on specially treated tubes that will not shrink. All connections are soldered. The primary switches do away with sliders, poor contacts and short circuits. The switches are of knife-edge pattern to insure the best possible contact. A flexible cable from the rear of the secondary is used to connect that winding to the binding posts; the slide rods serving only in their mechanical functions.

This latest loose-coupler is furnished in either nickel or lacquered brass finish. The price is $15.00.

Aside from the foregoing-mentioned instrument, Mr. J. F. Arnold manufactures other models at $7.00 and $9.00, as well as a large line of receiving and transmitting apparatus. Full particulars concerning the loose-coupler and other wireless instruments can be secured by addressing inquiries as above, enclosing a two-cent stamp to insure reply.

AN UNIQUE POWER PLANT

THE Ford Motor Company has placed contracts for a gas engine-electric power plant that will be not only one of the largest in the country but in many respects absolutely unique. The company has appropriated in the neighborhood of a million dollars for the project, which will put into effect plans that Mr. Henry Ford has long had in mind for utilizing the waste heat of the ordinary producer gas engine.

Four 6,000 h.p. Hamilton-Gray gas engines of novel design will drive the same number of Crocker-Wheeler 3,750 kw., 250 volt, 80 r. p. m. engine type, direct current generators. These will be the largest capacities on record for generators of this type. A plan view of each engine will be similar to a cross compound steam engine, with two cylinders in tandem on each side. One pair of cylinders will be operated by producer gas and the other by steam. The steam will be generated from the water used in the water jacket of the gas engine, further heated by the exhaust gases and by waste heat from the producer gas plant. This water or steam will be used as the feed water for the boiler which supplies the steam engine cylinders. A heavy flywheel will equalize the characteristics of the gas and steam driven elements of the engine. Each of the generators will have a normal rating of 3,750 kw.

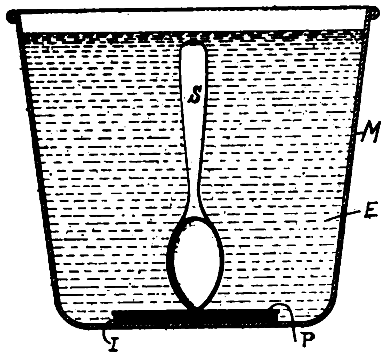
These generators are designed for much higher efficiency than ordinarily found in commercial practice. Full load efficiencies will be not less than 94½ per cent. By these means and by the utilization of energy usually lost in waste heat, it is proposed to make the new Ford power plant the most economical in the country in respect to cost of production per kilowatt hour.

The armatures will be of split construction which is necessitated by clearance requirements through tunnels and bridges in shipment from Ampere to Detroit, and the generators will be finally assembled at the Ford plant.

In trying to find uses for blight-killed chestnut it has been found that it cannot be utilized for crating stone; quarry owners say that chestnut wood leaves an indelible stain on the marble or granite.

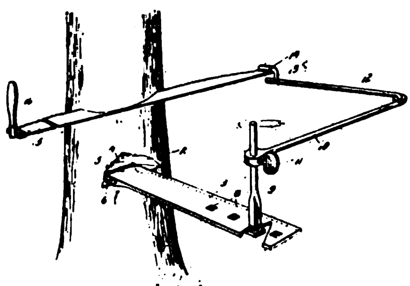
RECENT NOVEL PATENTS

1,093,236. ELECTROLYTIC - CLEANING ELECTRODE. THOMAS APPLEBY, Philadelphia, Pa. Filed June 24, 1913. Serial No. 775,465. (Cl. 204—7.)



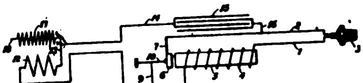
1. As an article of manufacture, a unit consisting of an electro-positive electrolytic cleaning element and insulating material attached thereto for supporting said element in and electrically separating the same from a metallic container of electrolytic solution.

1,093,458. SAW-GUIDE. GEORGE WASHINGTON MOORE, Florence Logging Camp, Snohomish county, Wash. Filed Oct. 3, 1911. Serial No. 652,617. (Cl. 143—168.)



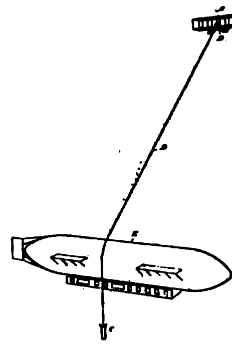
1. A supporting bar for saw guides having an upturned knife edge at one end and depending knife edges at opposite sides and on the lower surface thereof and adjacent to the first knife edge.

1,092,398. HIGH-TENSION DISCHARGE APPARATUS. GEORGE D. ROGERS, Cleveland, Ohio. Filed May 31, 1913. Serial No. 770,903. (Cl. 250—36.)



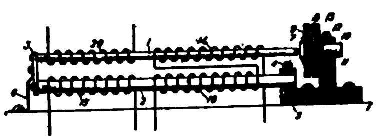
In a high tension discharge apparatus, the combination with a main circuit provided with means for connection to a supply current and including an induction coil and a circuit controller, of a condenser connected to the main circuit at one side of said circuit controller, the primary winding of a high frequency coil connected to the main circuit at the other side of said circuit controller and to the condenser, and the secondary winding of the high frequency coil having one end connected to the primary winding thereof and terminating in a single end for connection to a therapeutical instrument, substantially as described.

1,092,760. MEANS FOR DESTROYING AIR-CRAFT. JOSEPH A. STEINMETZ, Philadelphia, Pa. Filed May 19, 1913. Serial No. 768,515. (Cl. 244—1.)



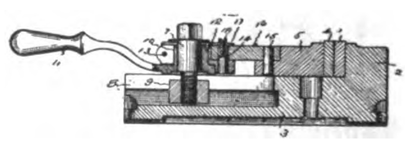
1. For destroying air-craft when the destroyer is in free flight, the combination with a flying machine, of a bomb far below said machine, suspended freely therefrom by a readily flexed connection, and provided with a contact device in position to cause explosion of the bomb when the latter is drawn vertically upward against the said air-craft which deflects that portion of the connection between said machine and bomb by relative lateral movement of the connection and air-craft.

1,092,453. DEVICE FOR AMPLIFYING VARIATIONS IN ELECTRICAL CURRENTS. PAUL M. RAINEY, West Hoboken, N. J., assignor to Western Electric Company, New York, N. Y., a Corporation of Illinois. Filed Oct. 14, 1913. Serial No. 795,124. (Cl. 179—171.)



1. In a telephone repeater, a plurality of pieces of magnetic material; means for normally subjecting certain of said pieces to steady magnetizing forces of low intensity, and others of said pieces to steady magnetizing forces of relatively high intensity, means for impressing magnetizing forces of variable intensities on said pieces and causing by such variable forces an increase in length of certain of said pieces and a decrease in length of other of said pieces, and means for connecting said pieces to each other, to a support and to a variable resistance element, whereby variations in the intensity of magnetizing force cause a variation in said variable resistance element.

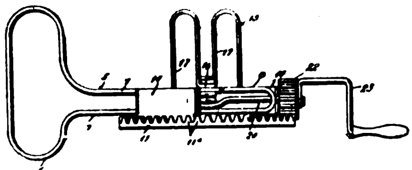
1,092,145. LEVER-VISE. CURTIS HAKES, Winsted, Conn., assignor to The Carter & Hakes Machine Company, Winchester, Conn., a Corporation of Connecticut. Filed Apr. 21, 1913. Serial No. 762,498. (Cl. 81—26.)



1. A lever vise having a fixed jaw, a jaw movable toward and from the fixed jaw, an eccentric, a handle for turning the eccentric, and a pair of jointed toggle levers the outer end of one toggle lever being connected with the movable jaw and the outer end of the other toggle lever being connected with the eccentric.

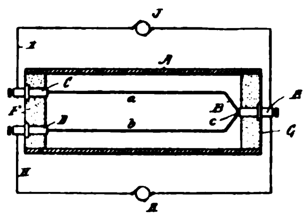
RECENT NOVEL PATENTS

1,094,318. VEGETABLE-SLICER. John Embl, Sr., Silverdale, Wash. Filed June 27, 1912. Serial No. 706,236. (Cl. 146—11.)



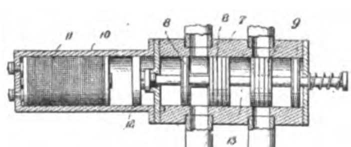
The combination with a handle, of spaced frame members extending from said handle, a pivot pin projecting through said frame members, a shaft carried by said pivot pin between said frame members and extending laterally from the pin, a cutter carrying wheel pivotally mounted on said pivot pin, driving means for said wheel mounted on said shaft, and a follower supporting arm carried by said pin, whereby said pin connects the frame, the wheel, the shaft and the follower arm.

1,094,030. ELECTRIC FUSE. Severn D. Sprong and Walter E. McCoy, New York, N. Y., assignors of one-third to Frank W. Smith, New York, N. Y. Filed Sept. 6, 1912. Serial No. 718,826. (Cl. 175—27.)



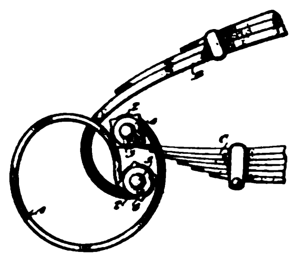
1. An electric fuse, comprising a tube, a closure of insulating material at each end of said tube, one of said closures having two inwardly converging passages, two circuit terminals disposed in said passages, a single circuit terminal entering said tube through the other closure, and a U-shaped fuse strip having its loop connected to said single terminal and its ends connected respectively to said two terminals.

1,092,718. TRAIN-STOPPING APPARATUS. Arnold O. Johnson, Elnora, Ind. Filed Apr. 4, 1913. Serial No. 758,871. (Cl. 137—4.)



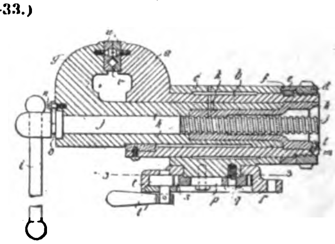
1. In train stopping apparatus, the combination with a locomotive steam main and fluid brake pipe, of a cylinder common to both of said pipes and in communication therewith, a valve slidably disposed within said cylinder and comprising a pair of disks one of which normally obstructs the flow of fluid through the brake pipe, while the other is adapted to act as a balancing disk, and a second pair of disks, the members of said second pair being normally disposed at opposite sides of the path of steam through the cylinder and acting to balance the valve, a stem interconnecting said disks for simultaneous movement, an armature on said stem, a cylindrical casing connected to said cylinder at one end thereof and surrounding said armature, a magnet in said casing and controlling said armature, an electric circuit including said magnet and designed when closed to energize the magnet whereby the disks will be moved out of normal position to shut off the flow of steam through the steam main and permit the flow of fluid through the brake pipe.

1,094,305. AUXILIARY SPRING FOR USE ON AUTOMOBILES. Robert P. Clark and William H. Clark, Fresno, Cal. Filed July 22, 1913. Serial No. 780,576. (Cl. 21—50.)



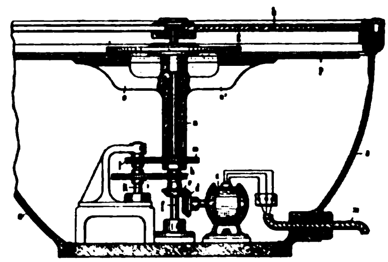
1. The combination with two springs, of a spring ring having overlapping ends, one terminal of the ring connected to an end of one of the springs, and the other terminal of the ring connected to the end of another spring, so that when any vibration or shock is transmitted to the springs, the spring ring will be caused to be convoluted, thereby decreasing the diameter of the ring.

1,094,359. BENCH-VISE. John George Barker, Lincoln, England. Filed Nov. 12, 1913. Serial No. 800,450. (Cl. 81—33.)



A bench vise comprising a base having a horizontally disposed tubular body portion, a sleeve rotatably mounted therein and provided at one end with a jaw portion abutting one end of said body and at the other end with a threaded extension projecting beyond the said body, a collar slidably keyed to said extension, the adjacent faces of said collar and said body being formed with interlocking clutch faces, a nut threaded upon said extension and adapted to control said collar, a second jaw, provided with a stem slidably keyed within the said sleeve, and a screw for adjusting the last mentioned jaw, substantially as described.

1,092,816. GYROSCOPE-COMPASS. Hermann Anschütz-Kaempfe, Neumühlen, near Kiel, Germany. Filed Sept. 9, 1910. Serial No. 581,202. (Cl. 33—204.)



1. The combination, with a gyroscope compass, of a subcompass comprising a principal card and a secondary card geared thereto to move at a greater speed, and means comprising a synchronizing device controlled by the gyroscope compass for driving the principal card of the subcompass in a definite relation to the movement of the gyroscope compass.

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THE ADVANTAGES OF TRADE-MARK REGISTRATION

(Continued from page 756)

Corporations, as well as individuals, have the right of registration under the Statute; and the right is not restricted to citizens or residents provided the foreign individual or corporation owning the trade mark has a business establishment situated in the jurisdiction of the United States, or is a resident or corporation of any foreign country which affords, by treaty, similar rights to those enjoyed by citizens of the United States.

The coveted certificate of United States registration, when granted, remains in force for twenty years, and may be renewed before expiration for like periods of twenty years, so that there is practically no limit to its perpetuity—and the older it is the better as a rule.

But a condition precedent to registration is *use* by the owner "in lawful trade," either in commerce among the several United States, in commerce with foreign nations, or in commerce with the Indian Tribes—the latter being thus distinguished as neither alien nor domestic, but of sufficient importance to merit special recognition in a commercial sense. Obviously, also, the mere intent to use is not sufficient, and neither person nor corporation can enact the dog in the manger by pre-empting without use a desirable mark to the exclusion of others in the same line of trade—although as a matter of fact a merely nominal use is sufficient to sustain ownership.

MARVELOUS ESCAPE FROM ELECTROCUTION

What is probably an unprecedented occurrence is presented by the recent escape from death of Clarence W. White, of Niagara Falls, N. Y., through whose body a current of 12,000 volts passed accidentally.

White is 23 years old and is employed at the National Carbon Company Works in the foregoing-mentioned city. It was while dusting off a switchboard at the plant that he accidently came in contact with the current and was instantly knocked to a sitting position on the floor. His most serious injury was a badly burned hand.

WIRELESS TELEGRAPHY

(*Continued from page 746*)

prove a formidable rival to existing methods.*

In the sending antenna we have powerful high frequency currents in the base and high potentials at the upper free end. Even in small stations the current at the base or earthed end of the antenna may be 5 or 10 amperes, and in large stations may reach a value of 50 or 100 amperes, and is sufficient to raise to incandescence quite large rods of arc-light carbon.

There is, therefore, a considerable expenditure of power on the antenna. Part of this goes into heating the antenna conductors, but a large proportion is radiated. Nevertheless, the overall efficiency, generator to aerial, of the ordinary spark set is at present probably not more than 20 or 25 per cent., though the Telefunken company, using a quenched spark instrument, claims to have attained efficiencies of 75 per cent. This high figure is not reached by rotating quenched gaps, like that invented by Marconi.

Of the energy radiated only a very small proportion reaches a given receiving antenna. The received current is usually reckoned in micro-amperes, or at best, in fractions of milliamperes. If the receiving antenna is properly tuned to a closed condenser circuit inductively coupled to it, the energy absorbed by the antenna is transferred and accumulated in the condenser circuit.

In this last we now have feeble currents circulating which imitate in mode of variation the currents in the radiating or sending antenna. To detect them it is now most usual to employ a sensitive telephone receiver in connection with some form of current rectifier, or else a current operated detector like the Marconi magnetic detector, which is placed in the condenser circuit.

If we merely connect a telephone receiver across the condenser circuit there will be no audible response, because the frequency of the current oscillations is too great to affect a telephone receiver.

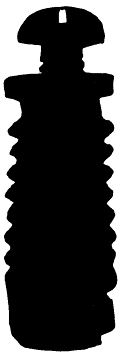
*The ingenious methods of Goldschmidt of utilizing the properties of the polyphase induction motor to increase frequency have been developed recently by a German company and promise success in the matter of obtaining undamped waves.

If, however, we insert some device which will act like a valve, the oscillations in each group will be rectified and add to one another so that intermittent gushes of current corresponding to the group frequency of the transmitter will pass through the telephone and produce a shrill note. If the groups are interrupted at the sending station by a Morse key the receiving operator hears long or short musical sounds which he interprets into the letters of the telegraphic alphabet.

Among the rectifiers in general use are the valve or glow lamp detector, invented by Fleming, and its modifications; the electrolytic detector and the crystal detectors, the first of which, carborundum, was discovered by Dunwoody, and others by Pickard and Pierce. Thus, for instance, a copper point pressed against a flat surface of molybdenite is a good rectifier. Another detector is the galena-graphite detector. Also a gold point pressing against an artificial surface of ferric disulphide (iron pyrites) is very sensitive. Other crystals are copper pyrites, zincite, bornite, etc.

In spite of much valuable work done by Pierce, Pickard, and others, the action of these so-called crystal rectifiers is not fully understood. It appears not to be thermoelectric, since the rectified current is opposite in direction to that obtained by heating the junction.

One of the practical difficulties yet to be overcome is the invention of a suitable calling instrument which is free from the effects of atmospheric strays. At present the operators have to sit with the telephones on their heads waiting for the arrival of a call, and this is special and skilled work which cannot be deputed to any one else. Lately both the Marconi and Telefunken companies have introduced call instruments in which a signal equivalent to a prolonged dash in the Morse code deflects a galvanometer, which in turn closes a battery bell circuit. We believe the Telefunken instrument which is normally adjusted to respond to a prolonged signal enduring 10 seconds and causing a total galvanometer deflection of 3 millimeters, to be quite free from the effects of atmospheric static. Another desirable apparatus is a relay which is simple and yet sensitive to print the messages on a paper tape.



The Einthoven galvanometer is effective but seems to be more elaborate than necessary.

Dr. Kapp and Mr. Von Kramer have invented an alternating current resonance relay which is sensitive, and can be operated on a current of about 1/5 milliampere at a frequency of about 100; but this does not quite satisfy the demands of general use. What is desired is a relay sensitive to currents of frequency 50 to 500 or 1,000 and of strength about 1/10 microampere.

(*To be continued in the July issue of* POPULAR ELECTRICITY AND MODERN MECHANICS.)

A GOOD RECEIVING SET

(*Continued from page* 736)

the full current from the audion battery through it.

Three binding posts are provided for telephones. The center binding post is connected as per Fig. 1.

The author strongly advises even longer sliding rods for the secondary of the loose coupler than the drawing shows, as on using the audion even very faint distant stations tune best with the secondary as remote from the primary as possible. When using the crystal, tighter coupling is required and the further away the secondary is moved from the primary, the more accurate is the condenser reading on the No. 2 condenser. When employing the crystal detector, place the telephones in the left and middle binding posts, for best results, but for the audion connect the telephones on the two outside binding posts. Otherwise the audion battery is not in series with the receivers.

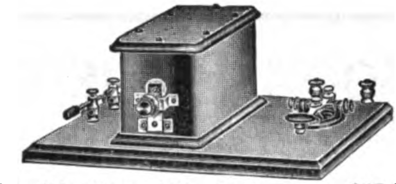
DIRECTIONS FOR USING THE AUDION

After the set is completed as per diagrams, connect to the aerial; if same is of the loop type, connect to A A, or if a single straightaway aerial, to top binding post marked A, and of course the ground to G. Place a jumper from binding posts 1 to 3. To operate, begin by placing circuit selector on 1-1 and selector detector switch on A A. The telephones are connected to T T. The 6 volt audion (storage) battery is

connected through a rheostat, preferably the well-known circular type. It is necessary to make sure that all the resistance is cut in when starting. The pole changer is thrown to the left. The audion battery switch is placed on about 4 or 5. Now gradually bring one of the audion filaments up to normal incandescence or about the same heat or color as a carbon lamp would glow on full current. The operator should then hear a loud hissing sound in the receivers. If this sound is missing, start over again, this time reversing the storage battery wires (both filaments cannot be used on the same polarity) and gradually bring filament up to normal heat again. A somewhat purple or blue glow around the heated filament and a hissing noise in the receivers will then be experienced. If these indications are not present, increase or decrease the audion battery until these characteristics appear. They are absolutely essential to the best working of the audion. Reverse the pole changer if necessary, but if the set is wired right, the position to the left is correct. Now by just bringing the filament up to the heat where the audion battery works at the minimum number of cells, the best results are obtained—*i. e.,* so the hissing is just audible. Next, if a normal large aerial is being used, place the primary switch marked 1 on button 12 and switch No. 2 on button 30. Secondary switch is all cut in or on button 15. Pull the secondary all out or leave about ½ inch between primary and secondary. Adjust variable condenser No. 3 on maximum, secondary condenser No. 2 on the first quarter and the set is then receptive for about 600 meter wave lengths; by manipulating the primary switches the maximum results can be obtained. If the operator is close to a large commercial station, he should watch out for trouble. The audion is liable to instantly fade or rather "polarize." If this happens, it must be de-polarized before it can be again rendered sensitive. This is best done by moistening the tips of the fingers and touching the two small binding posts that wires marked D and E are connected to leading into the box

(*Continued on page* 816)

No. 484. Transmitting Tuning Coil..........$5.10



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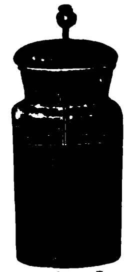

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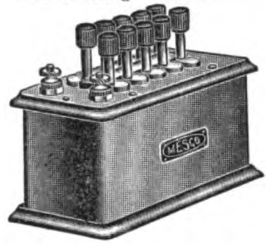

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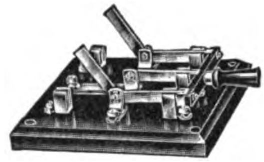

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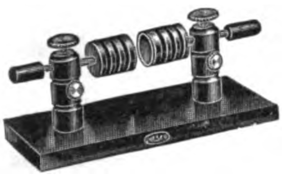

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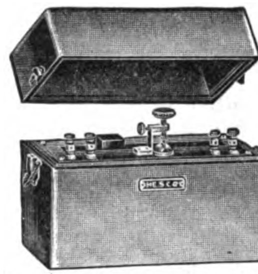

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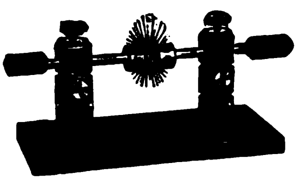

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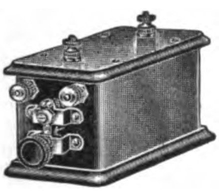
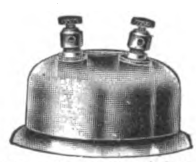


No. 462. Wireless Spark Coil, 1 in.............$5.40



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BOOK REVIEWS

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Kites and Model Aeroplanes

There has just been published an instructive work entitled "Kitecraft and Kite Tournaments" * which should find an important place among the practical, how-to-make literature of the younger generation.

This work treats in a comprehensible and reliable manner on the making and flying of kites of all kinds. Plain surface kites, box kites, combination plain surface and box kites and others are described. An entire chapter is devoted to the decoration of kites, while several chapters are given over to messengers, moving devices, suspended figures and appliances, balloons and parachutes, reels and other kite-flying accessories.

The rear portion of the book covers the making and flying of model aeroplanes and gliders. The general design of model aeroplanes, propellers, rubber band motors, reduction gearing and other topics are included.

The last two chapters of the work cover tournaments — discussing how such competitions may be organized and conducted for kites and model aeroplanes.

"Kitecraft and Kite Tournaments" * will be found most interesting by all boys desirous of making and flying kites and model aeroplanes. It will also prove a valuable addition to the library of school teachers and instructors.

**Kitecraft and Kite Tournaments*, by Charles M. Miller. Published by The Manual Arts Press, Peoria, Ill. Contains 144 pages and over 267 illustrations. Handsomely bound in an attractive cloth cover. Price, $1.00.

A Handbook on Electric Vehicles

With the already large and constantly increasing number of electric vehicles now in use for both pleasure and commercial purposes, the recent work entitled "The Electric Vehicle Handbook" * is indeed opportune.

This handy reference work contains useful and practical information for anyone having to do with electric vehicles, be he driver, owner, repairman, or employee in a garage where such machines are stored and their batteries recharged.

A good portion of the book is devoted to the care of storage batteries, covering in detail the various makes employed in electric vehicles, how they are charged, repaired and other information of importance in this connection. Quite a few pages are devoted to the various arrangements for charging storage cells, such as mercury rectifiers, motor-generator sets, etc. Then follow descriptions on the different parts of the vehicles—tires, motors, controllers, axles, countershafts, differential gearing, steering gear, brakes, bearings, and the usual accessories. Each subject is gone into thoroughly and such information given as may enable the reader to effect repairs. The remainder of the book is devoted to a list of associations and publications identified with the development of the electric vehicle, as well as important data on the costs of operating such machines of different capacities.

This work can be recommended without hesitation to anyone interested in electric vehicles. Especially is this true with those coming in daily contact with machines of this kind, since the work is a practical one and intended primarily for them.

**The Electric Vehicle Handbook*, by H. C. Cushing, Jr., and Frank W. Smith. Published by H. C. Cushing, Jr., 53 Park Row, New York City. Contains 356 pages and 161 illustrations. Pocket size, bound in leather. Price, $2.00.

Motion Pictures

In a work entitled "Motion Picture Making and Exhibiting,"* another valuable volume has been added to cinematograph literature.

This book opens with the principles and history of motion picture photography. The remaining first half of the work covers the making of motion picture films, describing the cameras, manufacturing of the film stock, the development of the negative, printing the positive, tinting films and waterproof and fireproof films. In a chapter that follows the actual taking of a motion picture is discussed. Among the subjects mentioned are: The classification of films, illumination of the studios, the producer, the players, taking studio pictures, yard pictures, taking topical films, pictures in the field and trick pictures. Another entire chapter is devoted to the scenario —how it is written, the correct form, and how it may be sold.

The second portion of the work covers the motion picture theatre. Among the topics discussed are: Starting a theatre, the airdome, the program, advertising the show, the ticket office and profitable side lines. An entire chapter is devoted to describing the projecting machine and its operation, as well as the care of film. The wiring of the operating booth and theatre is also discussed. Valuable information, regarding specifications and ordinances governing motion picture theatres and ventilation requirements, is given in another chapter. The final pages deal with colored pictures, talking pictures, stereoscopic pictures and the principal methods of coloring.

Not only will anyone intimately connected with the motion picture industry find this work of great interest, but even the layman desirous of securing a general knowledge of the subject will find it entertaining reading.

** Motion Picture Making and Exhibiting*, by John B. Rathbun. Published by Charles C. Thompson Company, Chicago, Ill. Contains 236 pages and is profusely illustrated. Cloth bound. Price, $1.00.

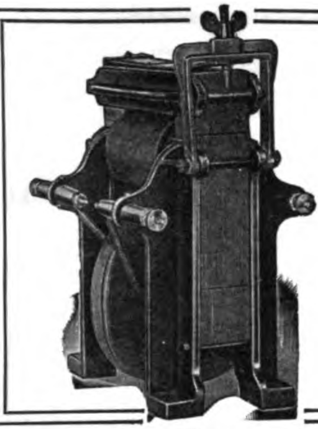
THE ENERGY OF THE FUTURE

(*Continued from page 727*)

able mirrors which reflect the rays in such a manner that they always fall vertically upon the glass covers.

Many attempts have been made to utilize the energy of the tides. So many and so signal have been the failures that many prognosticate that these are beyond the powers of man. So far these attempts made have been to use the power in a direct manner and although the energy stored there by nature is far in excess of any demand man will ever make upon it, it is as yet questionable whether it will ever be put into direct use. It is some years since a plan to compress air by tidal action was patented in Boston, Mass. It is not as yet generally known whether the invention has been put into practical use. It appears probable, however, that such a system or a modification of it will take a large place in future economy of energy.

The principle of this system involves the compression of air using the tides to obtain a practically constant head of water and a continuous supply which suffers no interference by change of the seasons. Fig. 3 shows a transverse sectional view of the necessary construction in the tidal hydraulic air compressor. Two shafts are driven down preferably through a dam or other concrete work so that the direction of the tunnel *R* is transverse with the direction of the ebb and flow of the tides. At the top of one of these shafts is an iron or concrete structure fitted with strong gates. As shown in fig. 4, these gates are opened and shut automatically by the water itself: When the tide is flowing in the direction indicated by the arrow the gate *a* is opened whilst gate *b* is shut tight. The head tank contains the compressor head, which consists of heavy wood and iron work carrying a number of intake or suction pipes. This is constructed in such a manner that the head adjusts itself to the varying depths of water and the pipes are maintained at a constant depth below the surface. The intake pipes are situated vertically above the compressor shaft which may be constructed of steel surrounded with concrete, as shown in fig. 3. In this way the chamber *R* is rendered air-tight when the system is in operation.



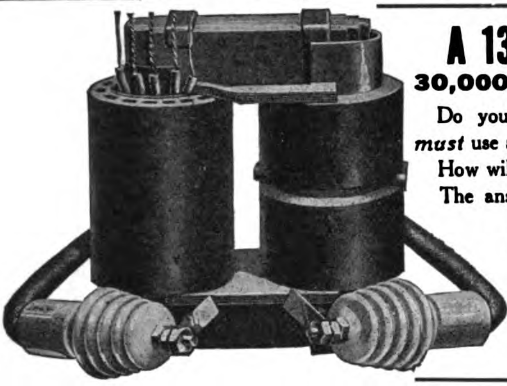
Memphis, Tenn., to Superior, Wis.

825 miles with a 1 kw., 20,000 volt Transformer—a Thordarson, of course. Good instruments mean better wireless. The Thordarson Wireless Transformer is built in 3 standard types, 5,000, 10,000 and 20,000 volts—special windings to order. Connects direct to A. C. mains—equipped with flexible impedance.

Write for Details

Thordarson Electric Mfg. Co.

509 So. Jefferson St., Chicago



A 13200 Volt Transformer for $9.

30,000 TURNS OF WIRE ON THIS TRANSFORMER

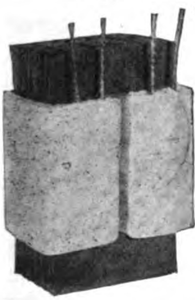
Do you realize that to meet the government requirements you *must* use a small condenser?

How will you get full power out of a small condenser?

The answer is: "Use **high-voltage** transformers." In other words, **Packard transformers.** The above transformer is almost a ½ kw., for it can be used with 4 ampers primary. Order to-day.

The Packard Electric Co.

540 Dana Ave., WARREN, OHIO



TRANSFORMERS

FOR REAL WORK

Just the thing for your laboratory to provide low-voltage current for small motors, lamps, experiments, etc. Not affected by short-circuit. No parts to wear out requiring renewal—Will last for ever.

FRAASA TYPE SC.

Transformers are built in capacities of 30, 50 and 100 watts. Secondary voltages 15 and 25 with 2½ or 5 volt taps. Illustration shows transformer removed from steel case.

WRITE FOR BULLETIN SC 141.

Fraasa Engineering Company, NORWOOD, OHIO Suburb of Cincinnati.

Campbell

$2.00 SAMPLE $2.00

COUPON

CAMPBELL ELECTRIC CO.

LYNN, MASS.

Enclosed find $2.00 for which send "SAMPLE" BELL TRANSFORMER, to ring one or two bells at a time, operate door openers, etc., from the alternating electric light circuit of—Volts—Cycles.

NAME_______________

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Low Voltage Transformers

Highest efficiency and durability

For operating electrical and mechanical toys.

Work successfully on 110 to 125 volts.

Special Bell Types for ringing door bells, annunciators, indicators, etc. Better than batteries at lower operating expense.

Write today for free descriptive circular. Dealers wanted.

O. J. GOETTMANN, *Manufacturer*

126 East Ohio St., N. S., Pittsburg, Pa.

As the tide ebbs and flows the water enters the head tank and thence travels round and down the intake pipes and compressor shaft into the chamber *R* and up the tail race shaft *U* into the open sea. It tends to produce a vacuum in falling through the intake pipes and in order to prevent this, outside air is drawn in with the water and carried down the shaft. It is set free only when the descending water is shattered on the disperser or abutment *D*. The liberated air accumulates in the pocket of the chamber *R* from which it is drawn off through the pipe *P*. The pressure at which the air leaves the chamber equals the back pressure or weight of water in the uptake shaft. In this way the plant may be constructed to deliver air at a specified pressure. A shaft of 230 feet will deliver air at 100 lbs. gauge pressure; 460 feet deep will give 200 lbs. pressure. With regard to the head of water—height of tide—from which the developed horsepower is calculated, there are certain localities more favorable than others; the physical features of land and sea unite to produce great differences. If one assumes an average tide of 10 feet with a volume of water of 1,000 cubic feet per second, one compressor alone will develop 1,140 horsepower. The quantity of compressed air delivered will depend upon the pressure of the air. There is much in favor of this scheme not only as a prospective source of energy, but as one which may well be put into present operation. The following points are worthy of notice: 1—The scheme is not confined to the installation of one compressor, but is equally well adaptable to the employment of a battery of compressors. In this way a saving on first cost per horsepower is gained. 2—By making the chamber *R* sufficiently large, enough air can be stored to maintain the supply during the time when the tides are at their lowest. 3—The production of compressed air proceeds alternately in increasing and diminishing quantities but always is continuous. 4—The first cost, in some instances excessive due to provision of breakwaters where locations are in exposed spots, is soon repaid since the system calls for no machinery and practically no supervision by a staff of operatives.

Thus may be harnessed to the use of humanity the enormous energy of the tides. There is nothing more regular than their ebb and flow. Neither cloudy days nor prolonged drought affects them and whilst the energy thus obtained is in the form of compressed air, the immediate adoption of the system would ease the demand of industry upon the present fuel resources. None can doubt that success will reward the wit and ingenuity of man in this direction. In closing, let us quote F. R. Soddy, in his work "Matter and Energy": "The world is great enough and rich enough to supply human aspirations and ambitions beyond all present dreams. But the human intellect must keep pace in its development with the expanding vision of natural abundance."

THE WIRELESS STATION ABOARD S. S. IMPERATOR

By Maurice E. Pelgrims

PROGRESS is the watchword of the 20th Century. After the *Republic* and *Titanic* disasters, wireless telegraphy proved to be a very important part of the modern ocean steamer's equipment. More recently, when the Uranium liner *Volturno* was afire in mid-Atlantic and sent out the distress signals, ten great liners answered her plea for help, thus saving the lives of a great number of the passengers.

The Hamburg-American Line when putting the latest of the Atlantic greyhounds into service did not forget the wireless part in the least. As are all other things on board the gigantic ship, the radio outfit is also of the latest design. It is not the usual ship station but a station as powerful as any of our coastal stations that has been installed on the *Imperator*. It has three different outfits, each having its individual aerial. The power equipment consists of a motor-generator furnishing 500 cycle current at 1,500 r. p. m., the direct current being supplied by the ship's generator. The important parts of the set lead to a marble base switchboard from which they can be regulated at the operator's will. There is also a special arrangement of switches permitting of the adjustment of the set to any wavelength desired. An air-cooled spark gap and an ammeter are also mounted on the board. The transformer, condensers, oscillation transformer and aerial inductance coil are placed inside of the operating desk leaving the upper part of the desk free for the two smaller sets. The antenna used by the larger set is of the "T" type, 670 feet long and supported by the two masts at a height of 240 feet. This set insures constant communication with either of the continents, *i. e.*, Europe or America. During one trip it has worked with the Norddeich station in Germany up to a distance of more than 2,000 nautical miles, and at the same time its signals were being received at the Sayville (Long Island) Telefunken station.

The receiving apparatus can work on a wavelength varying from 300 to 5,000 meters and has a device to protect it from static.

The second station, intended for shorter distance work, operates about 350 miles in daytime and about 700 miles by night. It has a motor-generator for furnishing alternating current to a 1½ kw. transformer and is connected up similar to the stations used on other liners. The receiving apparatus is the same as that used with the larger set, but has no static preventer.

The third outfit is the so-called auxiliary set and is only used when the two other sets are out of order or when working with a nearby high powered station. It consists of an induction coil using storage cells for the source of power. The accumulators are able to work the induction coil for about six hours. The two last sets have individual aerials consisting of a single wire going from the wireless cabin to one of the masts. A wavemeter, which permits the operators to adjust either of the sets to any wavelength desired, is included as a part of the wireless equipment of the *Imperator*.

Wireless Telegraph Contest

The Wireless Station and Laboratory contest is a regular monthly feature. The best photograph submitted each month is awarded a first prize of Three Dollars; second best, Two Dollars; third best, One Dollar.

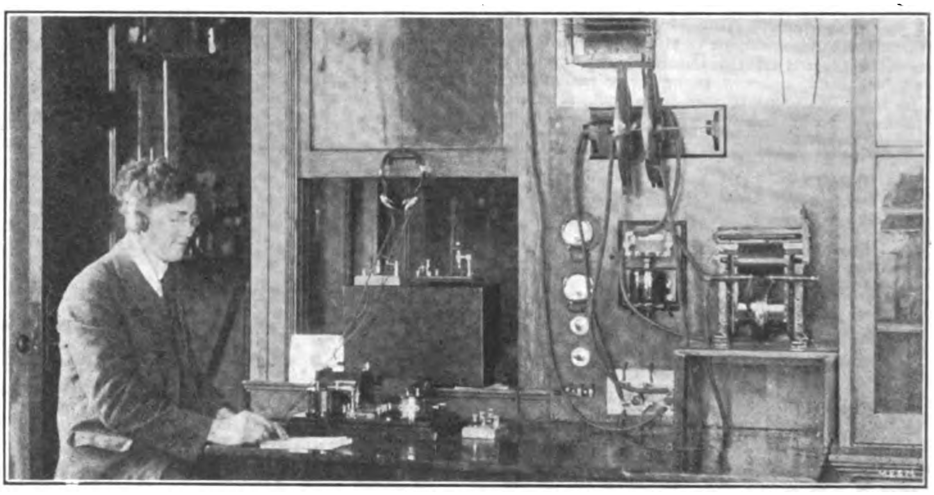
The description of a station should not exceed 250 words. Write on one side of the paper only, using as many separate sheets as are necessary. Descriptions should be written in ink—not pencil. Typewritten descriptions using double spacing are preferable to any. It is advisable to send two prints of the photograph whenever possible—one toned dark and the other light—in order to permit of choosing the one best adapted for reproduction. Prints should be sharp and distinct.

This competition is open to all, irrespective of whether they are subscribers or not.

FIRST PRIZE

In the accompanying illustration may be seen the wireless station recently installed in the West Des Moines High School.

The sending set consists of a ½ kw. transformer, a Murdock rotary gap, a 1 kw. oscillation transformer, "Boston" key, Murdock moulded condenser and Clapp-Eastham antenna switch.



WIRELESS STATION RECENTLY INSTALLED IN THE WEST DES MOINES HIGH SCHOOL, CONSISTING OF A ONE-HALF KILOWATT TRANSMITTING SET AND EFFICIENT RECEIVING APPARATUS

The receiving set is entirely of Murdock make with three extra detectors.

The aerial consists of six wires 200 feet long and 102 feet high. The wires are No. 10 copper.

We have been heard about 350 miles and have received from Arlington, Key West, Bar Harbor, Mich., Ames, Ia., and many other stations.

In connection with this wireless set we have our own motor generator equipment for furnishing 3 kw. of alternating current.

In conjunction with this wireless station, a wireless association has been organized with a membership of 58.—*Geo. Le Vine, Des Moines, Ia.*

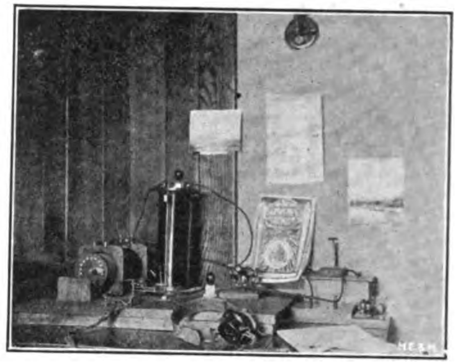
SECOND PRIZE

Herewith is a photograph of my wireless station.

The aerial is of the inverted L type, 90 feet long, 50 feet high, and consists

of four wires spaced evenly on 10-foot spreaders.

The sending apparatus consists of:



THE WIRELESS STATION OF RAYMOND S. BAKER, OF GLOVERSVILLE, N. Y.

One-half inch spark coil, glass-plate condenser, zinc spark gap, and wireless key. The coil is used with an electrolytic interrupter on 110 V., A. C.

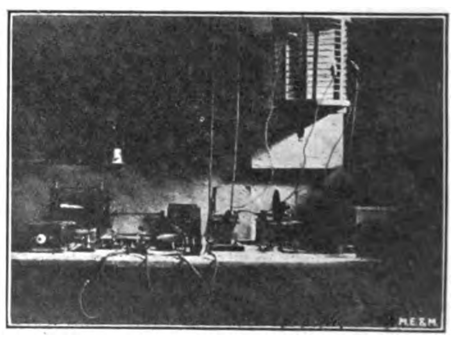
The receiving set is mounted on a cypress cabinet and consists of: Loose coupler, loading coil, fixed condenser, galena detector, pair of 2,000-ohm phones, and a buzzer test.

The aerial switch may be seen on the right hand side of the cabinet.

With this set I have had very good results, receiving as far south as NAW, Cuba, 1,700 miles; and north as far as Maine. All apparatus is home-made with the exception of the coil, phones and key. —*Raymond S. Baker, Gloversville, N. Y.*

THIRD PRIZE

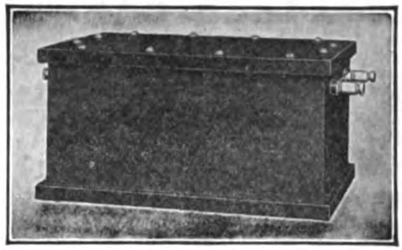
In the accompanying illustration may be seen my wireless apparatus which has



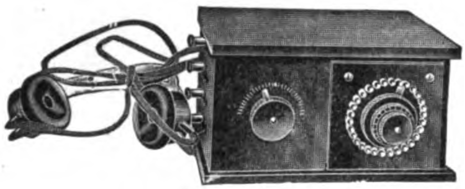
TRANSMITTING AND RECEIVING APPARATUS OF LEONARD BOHAC, OF CEDAR RAPIDS, IOWA

all been home-made, with the exception of the telephone receivers and the two keys.

Transmitting Sets
Receiving Sets
Transformers
Condensors
Spark Gaps
Oscillation Transformers
Wave Meters
Tuners Keys



THE BLITZEN TRANSFORMER
¼ K.W. $15.00 ½ K.W. $22.00 1 K.W. $36.00



Blitzen Receiving Set, Price, $33.00

If its wireless, we manufacture it in the CLAPP-EASTHAM shops, the CLAPP-EASTHAM way; a little better than the best.

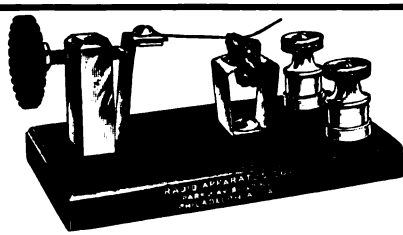
The most complete wireless catalog in America, also a catalog of parts and materials for the construction of apparatus, sent for 4c. stamps.

CLAPP-EASTHAM CO.

143 Main Street, CAMBRIDGE, MASS.

Aylsworth Agencies Co.
149 New Montgomery St., San Francisco, Cal.
Western Sales Agents

J. J. Duck Co.
432-434 St. Clair Street, Toledo, Ohio
Central States Agents

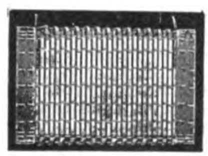


SOMETHING NEW

This High Efficiency Detector has the finest possible adjustment, especially good with Galena, price only $1.75.
Our latest catalog tells how to erect and maintain wireless telegraph stations, also diagrams and code. Send 5c. in stamps.

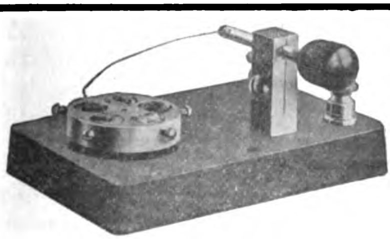
RADIO APPARATUS COMPANY
Parkway Building, Philadelphia, Pa.

RESISTANCES
FOR WIRELESS TELEGRAPH AND TELEPHONE



And for all other purposes. Connect your induction coil or transformer on any lighting or power circuit. Cheapest and best made units for 110 volts, ½ amps 56 cents. Send for catalogue.

DUBILIER ELEC. CO., Inc.
80 Fifth Ave., New York, N. Y.
Have You Seen the Dubilier Electric Radiator for Heating? Sells for $5.00



New Halcun Detector

Holds five separate crystals, Cat Whisker Type, molded composition rubber base, nickel plated.

PRICES

With receiving condenser in base - - - - - - - - - - - $2.50
Without receiving condenser in base - - - - - - - - - - $2.00

HALLER CUNNINGHAM ELECTRIC CO.
428 MARKET STREET, San Francisco, California.

The sending set comprises a 2-inch coil, a ½-inch coil—the latter being used for short distance work—plate glass variable sending condenser, rotary gap, helix and key. I also have a hot wire ammeter which may be seen above the loose coupler but is not in the circuit.

The receiving set consists of a 2,000-meter loose coupler with fixed condenser in its base; variable condenser, loading coil, 2,000-ohm phones, and electrolytic, carborundum and silicon detectors. My aerial consists of four wires on 8-foot spreaders. It is 60 feet high and 65 feet long, and of the inverted L type.

Many of my instruments were made from directions given in MODERN ELECTRICS AND MECHANICS.—*Leonard Bohac, Cedar Rapids, Ia.*

A GOOD RECEIVING SET

(Continued from page 802)

A loud click will then be heard in the receivers and the audion is again in proper condition. When the audion is working properly, there should be a faint bluish or pinkish glow around the plate or D, especially near that part of the plate that is close to the hot filament. A new or "raw" audion will not be as sensitive as a seasoned or old one. Just before the filament burns out, the audion is at its best. Using a standard perikon detector, the author has found by actual test that in this condition an audion is ten times as sensitive as the perikon. It will normally average from five to seven times as sensitive as the very best of crystals, perikon and galena included. Always shut off the audion while transmitting because it prolongs the life of the filaments. In switching from one filament to the other, reverse the storage heating battery. It is not necessary to reverse the audion battery. Of course, never leave the audion battery switch on 2 buttons at once, as the cells under these buttons are short-circuited. Always, when through, bring battery switches to zero and pole changer to 0-0.

SECONDARY OF LOOSE COUPLER WAVE METER

The secondary is the most important part of this piece of apparatus. If it is

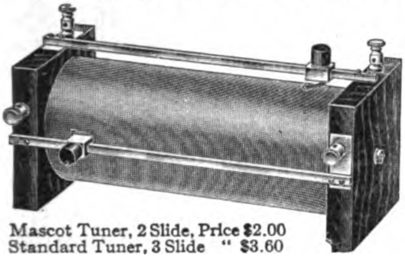
not made according to directions, it is more than probable that all of the good work has been done for nothing. The author has tried every conceivable winding and the one here described works by far the best. The ends are of hard rubber as per drawing. The tube is built up according to previous directions and the winding is rather peculiar. It consists of 15 taps and each tap contains 6 turns. The wire is No. 30 with two wires in parallel and a strong white linen thread wound between each turn. This method of winding reduces capacity between turns to a minimum and allows the required capacity to be placed where it belongs, namely, in condenser No. 2. If a reliable variable plate condenser is used for No. 2 and No. 3, with 15 taps and these condensers a very high efficiency loose coupler will be obtained for wave lengths up to 1,000 meters. If higher than this is required, it is strongly advised to build an extra secondary containing four times this number of turns and using the same capacity. This brings the set up to the wave lengths employed by the big transcontinental stations.

Very strong reasons have previously been stated for using an air dielectric variable condenser for the stopping condenser No. 3 and this certainly proves its merits.

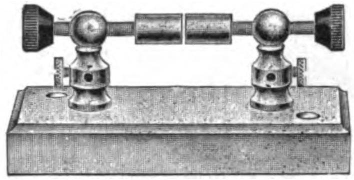
In a recent trip across the Pacific Ocean, the author tried out some extreme long distance receiving with a set identical with the one here described, and was in constant touch with the Marconi San Francisco station for over 4,000 miles. On one occasion San Francisco was picked up very faintly but loud enough to make positive identification just two and one-half hours out after leaving Yokohama, Japan. This was at night in the month of September. On a very recent trip down on the Pacific Coast to the Panama Canal, "press" was copied from the Marconi San Francisco station, a distance of over 2,000 miles through heavy static. Different secondaries were tried and the one here described proved the best. It allowed looser coupling and in fact, with the audion, most of the time the loosest coupling possible with the set was used.

USE THE BEST

Wireless Keys, Tuners, Helices, Condensers, Spark Gaps, Leyden Jars, Receivers, Head Bands, Anchor Gaps, Antenna Switches, Spark Coils, Rotary Variable Condensers, Potentiometers, Transformers, Buzzoplex, (for learning Wireless Signals), etc.



Mascot Tuner, 2 Slide, Price $2.00
Standard Tuner, 3 Slide " $3.60



Mascot Spark Gap, Price $1.20

Made by J. H. BUNNELL & CO., Electrical Mfgrs.

32 PARK PLACE (**Broadway Block**) **NEW YORK**

Sold By All Live Dealers

Send for our New Manual of **Instruction and Wireless Catalog No. 34-W.**

Patented

Can You Tune Out Unwanted Stations?

If you have trouble in tuning out unwanted stations you should get this new receiving transformer. One wireless operator who has had several years' experience writes in part: "Your tuning transformer gives excellent results. It beats anything that I ever worked." It's yours for only $10.00. Send 2c stamp for circular.

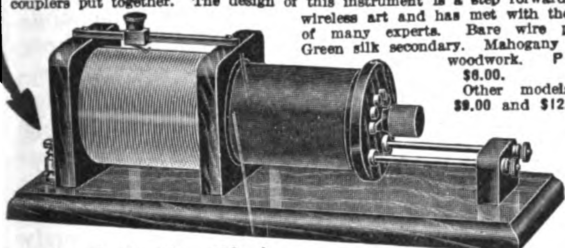
COLBY'S TELEGRAPH SCHOOL, Auburn, N. Y.

The Experimenters' Supply House

The best advertisement for the Amco Loose Coupler are the hundreds of well satisfied customers who have declared it is

THE MOST SERVICEABLE AND EFFICIENT LOOSE COUPLER ON THE MARKET

There are more of these instruments in service today than all other loose couplers put together. The design of this instrument is a step forward in the wireless art and has met with the praise of many experts. Bare wire primary. Green silk secondary. Mahogany finished woodwork. PRICE $6.00. Other models $4.00 $9.00 and $12.00.



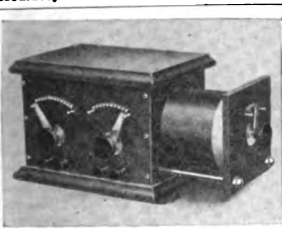
Complete set of parts, ready to assemble, with blue print.....$3.50

With primary and secondary wound, $4.25.

SEND 4c. IN STAMPS FOR THE NEW AMCO CATALOG

We manufacture the largest line of reliable wireless apparatus in the country. Over 100 Wireless Instruments and 200 Parts, with which you can build your own instruments at small cost, are shown in our catalog. Also, Storage Cells, Rectifiers, Transformers, Motors, Dynamos, Steam Engines, Books, Tools, Model Aeroplanes, Electric Bicycle Lamps, Flashlights and Supplies.

ADAMS-MORGAN CO.
Box 72d
Upper Montclair, N. J.



WE WISH TO ANNOUNCE THE NEW

SAUNDERS NAVY TYPE TUNER

$18.00 FINISHED IN GENUINE MAHOGANY AND POLISHED HARD RUBBER

Send for free descriptive circular

GEO. S. SAUNDERS AND CO.
168 Washington St. BOSTON, MASS. 11 Devonshire St.

WIRELESS RECEIVERS

Double German Silver Headband

2000 Ohms, by mail, this month only, **$5.90**

HOT WIRE AMMETERS

"CONTINENTAL"

Best make all over the world

0-3 to 0-5 amp., by mail, this month only, **$4.95**

All literature sent free with order, otherwise 5c. stamps requested and credited on first order.

COSMOS ELECTRIC CO., 136 N. LIBERTY ST., NEW YORK CITY

To lead the current from the secondary into the circuit selector switch, use some flexible cord. Do not use sliders on the brass rods. Make the secondary slide very loose and free, because it will be found that the degree of coupling is very essential to fine tuning and if the secondary sticks or works hard, it is rather difficult to properly adjust. By building a slider wire bridge across the telephone circuit as shown in one of the illustrations, the set becomes a very accurate decremeter and distance measurer.

A thin hard rubber plate ¼ by 1 inch is screwed across the front of the box and over this is mounted a slider, such as is sold by any wireless supply house, on ¼ by ¼ inch brass rod which reaches the whole length of the case. The slider contact rests on a very fine resistance wire and is hooked up to the telephones the same as a potentiometer. This variable shunt is placed across the phones and is calibrated by means of a Wheatstone bridge. Now, by placing the condenser at the maximum position where a signal comes in loudest, then adjusting the bridge until the signal fades out completely, and afterwards noting this on cross-section paper, very accurate resonance curves can be plotted and from them the log. decrement can be very easily figured by previously published formulae.

If the experimenter has access to an electrical laboratory where the sensitiveness of his receivers can be measured, then it becomes quite an easy matter to measure the incoming energy of a distant station in watts, volts or amperes.

In conclusion, the author wishes to state that if instructions are minutely followed, a receiving set, wave meter and decremeter can very easily be made whose accuracy is fine enough for ordinary laboratory work, providing a good wave meter and accurate Wheatstone bridge are used to calibrate the set. It is very nearly impossible to state what the inductance and capacity of the different windings are going to be before they are finished, and then each receiving set must be calibrated with a standard. The values in this article have been those of the writer's set and may not be duplicated.

Something New in Transmitting Sets

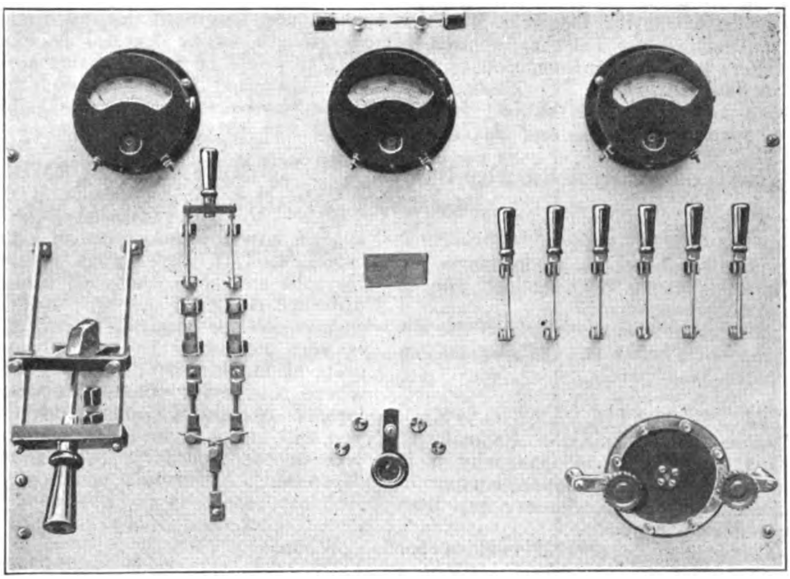
A NEW PANEL TYPE COMPACT SET OF HIGH

EFFICIENCY

EFFICIENCY IS WHAT COUNTS IN WIRELESS APPARATUS AND WE HAVE DESIGNED AND BUILT EACH SEPARATE INSTRUMENT WITH THIS PARTICULAR POINT IN VIEW.

TAKE ADVANTAGE OF OUR EXPERIENCE AND GET THE BEST. OUR STRONG POINT IS NOT PRICE, BUT IT IS QUALITY. WE SELL YOU THE BEST THAT CAN BE HAD AND AT A FAIR PRICE.

This new panel transmitting set comprises a complete and up-to-date combination of instruments, properly mounted and arranged on a polished marble panel, and connected up, ready for use. In this type of set, the efficiency is much higher, as the apparatus is mounted close together, and all leads are very short and heavy.



The apparatus included, consists of the following:—Closed core type H transformer, transmitting condenser, oscillation helix, rotary spark gap, anchor gap, aerial switch, key, ammeter, voltmeter, and hot-wire milli-ammeter for aerial circuit. The transformer is variable in power, and the condenser capacity may also be varied, direct from the front of the panel. The speed of the rotary gap may be varied, allowing different spark frequencies to be used. Together with our new panel receiving set, this makes an ideal outfit. Our new catalog has been delayed, but will be ready for absolute delivery on April 15. Send 10c in stamps for one now.

IMPORTANT Owing to our rapidly growing business, we are fitting up an entirely new and very modern plant directly across the street from our present location, where we will make a specialty of filling your orders direct from stock the same day we receive them. Note change of address, and send all correspondence to our new place at No. 124 North Sheridan Ave., Pittsburgh, Pa.

EDGCOMB-PYLE WIRELESS MFG. CO.

124 No. SHERIDAN AVE. PITTSBURGH, PA.

Questions and Answers

Questions and queries pertaining to electrical and mechanical subjects and of general interest to all readers, will be answered in this department. Name and full address of the sender should accompany all inquiries. Questions that are not deemed by the editor to be of general interest, will not be published and no answers will be given by mail.

DEBEG SYSTEM.

(78) A. G. A., Buckingham, Quebec, Can., asks:

Q. 1.—Is the name Debeg used by the Sayville station in addressing the press dispatches the name of a wireless company or system?

A. 1.—It is the name given to the German Marconi Co. known as the Deutsche Betriebs Gesellschaft für Drahtlose Telegraphie, m. b. h.

Q. 2.—Where can I get information on the "Logarithmic Decrement"?

A. 2.—See article on this subject in the September, 1912, *Electrician and Mechanic,* by H. B. Richmond.

Q. 3.—What is the power of Brooklyn Navy Yard?

A. 3.—5 KW.

GUNNERY.

(79) F. F., Brooklyn, N. Y., asks:

Q. 1.—What is meant by a 12-inch gun, a .38 or .50 "caliber" firearm?

A. 1.—The measurement pertains to the diameter of the bore, being 12", .38", or .50", in the three cases, respectively.

ROTARY VS. STATIONARY GAPS.

(80) Walter Baird, Meadville, Pa., asks:

Q. 1.—Will you please tell me why it is that I can get a greater radiation current in my aerial when I use a stationary gap than when I use a rotary gap?

A. 1.—There may be several reasons for this. When you were using the stationary gap the energy may have been going out over a broad range of wavelengths, but on the rotary gap the set was probably better tuned, which is one of the advantages secured by using a rotary gap; the energy emitted being only a single wavelength. Thus, while the energy in the antenna may appear to be less with the rotary gap, it is more efficiently radiated than with the stationary gap, giving you a longer range although the antenna current is reduced. There is also the additional feature that the rotary gap may be running at too high a speed so that the condenser cannot properly charge, but it is probably the former reason that causes the lower reading.

Q. 2.—Why is it that the transformer takes more current with the stationary gap than with the rotary gap?

A. 2.—The answer to this question is similar to Q. 1. The effective radiation is greater with the rotary gap so that while the set is requiring less input the effective output is increased. The over-all efficiency being increased the primary input is decreased.

Q. 3.—Is it true that the wavelength of a T aerial is one-half of what it would be if the aerial were connected in L?

A. 3.—As a general proposition this is far from being true. It depends on the relation of the top length to the lead-in length. The wavelength of a T aerial is somewhat less than it would be for the same aerial connected in inverted L. Just how much less depends on the particular aerial. The T aerial is the less directive of the two.

INDUCTANCE FORMULAE

(81) F. C. B., Saylesville, R. I., asks:

Q. 1.—Will you please have the kindness to explain how the inductance of a helix may be calculated? I have tried several different formulæ and come out each time with vastly different results.

A. 1.—When empirical formulæ are used it is very necessary to carefully consider the units of measurement used. This is probably where your error comes. It would take too long to explain the many formulæ used, but you will find a seven-page article on this subject in the February, 1913, *Electrician and Mechanic.* A formula which gives very satisfactory results is as follows:

$$L = l \times (3.1416\ D\ n)^2$$

Where

L = inductance in centimeters
l = length of helix in centimeters
D = diameter of helix in centimeters.
n = number of turns per centimeter.

Q. 2.—Another thing I have not been able to understand is the formula for wavelength. When I use a stationary gap I need a different value of capacity than when I use a rotary gap. Yet the wavelength does not appear to decrease when the capacity is cut down for the rotary gap.

A. 2.—You are perfectly correct in your assumptions, but you probably introduce an error in the inductance which you have not considered. When you changed from the stationary gap you probably changed the length of your leads, or the distance on the gap over which the current has to pass before discharging was increased. This would increase the inductance and the net result is probably that the wavelength has remained the same. It takes but a very small change in the length of a lead to effect a wide change when oper-

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Conduit Wiring, How to Install, what the requirements and restrictions are, etc.
Armored Conductor Wiring, How to Install.
How to ground conduit, why grounding is necessary.
What the commonly used electrical fittings are and how they are used.
How to install fixtures.
How to plan wiring installations.
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Generator and alternator installations.
Switchboard Connections.
Starting a direct current generator.
Starting an alternating current generator.
Connections for ground detector lamps.
Motors and their installation.
Motor starters and complete wiring connections.
Motor speed regulators and complete wiring connections.
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WHAT OTHERS SAY:

"Electric Light and Motor Wiring" contains many items of great interest to me. Congratulate you upon your successful publication.
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M. F. Flynn.

The book covers the subject well and is in my opinion a great deal superior to the higher priced books covering the same subject for use by the electrical trade worker who does not understand the meaning of many of the technical terms used.
CHAS. W. MITCHELL,
Electrical Inspector, Board of Fire Prevention, New York.

"Electric Light and Motor Wiring" is a valuable collection of information, telling just what one wants to know. Allow me to congratulate the author.
PROF. W. P. GRAHAM,
Electrical Engineering Dept.,
Syracuse University.

Your very excellent little book entitled "Electric Light and Motor Wiring" has just been received
I want to congratulate you, as from what little I have examined it, it surely meets the wants of a great many men.
E. B. STRONG, President.
Journal of Electricity, Power & Gas
San Francisco, Cal.

Enclosed find check for $1.00. I find the book very interesting and worth the cash.
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ating on such short wavelengths as are required for amateurs. Your wavelength is the same whether the gap is running or standing still.

HIGH VOLTAGE

(82) P. W. R., Scranton, Pa., writes:

Q. 1.—He has been proposing to make a 50,000-volt transformer, but has been told by a presumably reliable authority that a better method is to employ an inductance in series with two condensers; that the difficulty of insulating the latter is much less than with the transformer. Could we give some directions?

A. 1.—It is true that very high voltages can be produced by properly connecting an inductance with a capacity, but for any particular voltage the adjustment is close, and to know just what the voltage becomes is difficult. When you alter any one item of the whole equipment, the "resonant" condition may entirely disappear. What has been suggested to you is described in Tesla's small book entitled, "Experiments with High Frequency Alternating Currents." This is certainly worth your reading, but we feel sure you will decide that the apparatus and adaptations do not fit your requirements.

RADIO APPARATUS

(83) Doan Washburne, Plainfield, N. J., asks:

Q. 1.—Where can I get a description of the construction and operation of a tikker detector?

A. 1.—The December, 1913, *Electrician and Mechanic* contained an article on this subject by Mr. P. J. O'Gara.

Q. 2.—What back number contains a description of how to make a loose-coupled receiving set?

A. 2.—The February, 1910, *Electrician and Mechanic* contains an article on the construction of an entire receiving set, including a loose-coupled receiving transformer.

HE COULDN'T

The Artist—I want you to pose for my picture, "The Prodigal Son."

The Tramp—Can't do it.

The Artist—Why not?

The Tramp—Veal doesn't agree with me.—*London Illustrated Bits.*

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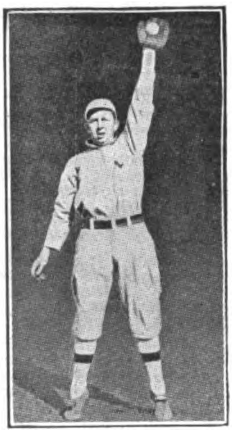
MODERN PUBLISHING COMPANY.
(Signed) ORLAND J. RIDENOUR,
Business Manager.

Sworn to and subscribed before me this 13th day of March, 1914.
[SEAL] HARRY S. WALLENSTEIN,
Notary Public, N. Y. County, No. 4011.
(My commission expires March 30th, 1915.)



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FIFTY CENTS (IN QUANTITIES) BUYS A full size compressed air clothes washer; patented Jan. 30, 1914. Women grab it at $1.50. Weighs two pounds. Thoroughly cleans tub of clothes in three minutes. Washday now a pleasure. Mr. Marrick earned $90 first three weeks. A Kansas boy earned $55.40 outside school hours in one month. Send for catalog to-day and get your county right. No charge for territory. Wendell Co., 306 Oak St., Leipsic, O. ★

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SELL HERBS BY MAIL. NEW IDEA INstruction book worth dollars, only 10c. Indiana Herb Gardens, Box M, Hammond, Ind. (1)

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MODERN ELECTRICS AND MECHANICS

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Advertisements should be addresed to "Apparatus Exchange Department," care *Modern Electrics and Mechanics*, 33 Union Square, New York.

Advertisements for the July number should reach us on or before May 31st.

HAVE A DRAWING SET, A "T" SQUARE, miniature lights and sockets, all of which are in good condition, which I would like to exchange for anything in wireless or what have you? Chas. W. Davis, 98 Sumner Pl., Buffalo, N. Y.

WHAT HAVE YOU TO EXCHANGE FOR A 100 to 400 watt laboratory step-down transformer; primary for a ½ k.w. step-up transformer ready wound but never used; 1 inch spark coil; small glass plate condenser; one 1000 ohm receiver and one 1000 ohm receiver with a headband? Would like a simple wireless receiving outfit of reliable make with a pair of 2000 ohm head phones or what have you in the wireless or electrical line? Everett W. Davis, 2232 Fairfax Ave., Morgan Park, Illinois.

WANT ABOUT 6 POUNDS NO. 30 MAGNET wire, 50 feet No. 14 magnet wire, and buzzer for a six inch coil? Have wireless goods, motors, dynamos, 2 keys for telegraph, 1 wireless key, 1 4 ohm sounder, and other things. Write and state wants. Laudie Rose, Box 361, Hoisington, Kansas.

WILL EXCHANGE AN AUTOMATIC TELEgraph transmitter for a pair of two or three thousand ohm phones and headband. Also have mechanical magazines from 1907 to date to trade for phones or other wireless instruments including aerial supplies. Leslie Jones, Charlestown, Indiana.

WANTED—BLITZEN, PACKARD OR EDGEcomb-Pyle 1 K.W. transformer and rotary gap or same make ½ K.W. transformer, condenser and rotary gap or Holtzer-Cabot 3000 ohm phones and Blitzen commercial tuner for tenor sexaphone, cost $85, in good condition. What have you to exchange? Henry Michel, 318 N. Black Ave., Bozeman, Montana.

WILL EXCHANGE COMPLETE PARTS FOR a 6-in. spark coil, consisting of 9 lbs. No. 32 C.C. magnet wire, complete inductor with insulation tube, 2 lbs. tinfoil, 1 lb. sheet mica 5 x 5½", binding posts, worth $38; also independent interrupter, $8; one 1¼ x 1½ inch armature; also other wireless raw material, for Blitzen receiving transformer, variable condenser, etc. Chas. Rohbock, 115 East Fourth, North, Salt Lake City, Utah.

WANTED: 4 x 5 PLATE DEVELOPING TANK or Simplex plate holders; will exchange double slide tuner and detector; have also fire alarm attachment; will exchange it for Little Hustler battery motor. Henry Kienzle, 450 East 85th St., New York City.

FOR EXCHANGE: ONE 6-60 "VESTA" STORage battery, which is but one week old and still retains its first charge, cost $15, for loose coupler of equal value, one using primary switch contacts preferred. Reason for trading, home has just been wired for city current. Also open core transformer, about ⅓ k.w., in polished oak case, for one 31-plate rotary condenser and a couple of small fixed condensers, or will trade for other receiving goods. Make offer. George Le Vine, 801 W. Seventh St., Des Moines, Ia.

HAVE 4 x 5 FOCUSING CAMERA OR 110-VOLT d.c. ¼ h.p. motor, to trade for Audion or Wallace detector, also a 22 long Stevens rifle for Boston or other key, suitable for 1 kw. or variable condenser of Clapp-Eastham or Murdock make. Roy Shively, 553 South 25th Ave., Omaha, Nebr.

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HAVE FOR EXCHANGE: ONE 110-V., A.C., 60-cycle motor, which makes 3800 r.p.m. with a rotary wheel on; one 110-v.., d.c. motor, which makes 3000 r.p.m. Both motors are practically new. One $2.50 Perikon detector with crystals, complete, crystals licensed for amateur use, and a mandolin harp which is new. Also have a double slide tuning coil (Mfg.) 1500 meters, and an audion detector, complete. Will exchange any of the above for any of the following, according to value: Variable condensers, electrical books or omnigraph instruments. Address Harold C. Mulford, Oyster Bay, Long Island, N. Y.

WILL EXCHANGE AUDION DETECTOR, 60-volt battery, 6-volt battery, loose coupler, tuning coil, transformer, loose coupler, receivers 2000 ohms, eight switches, telegraph set 5 ohms, two wireless keys, variable plate condenser, two Junior condensers, one large condenser, volt meter, 30 volts. What have you? Chas. Fucci, 179 16th St., Jersey City, N. J.

I HAVE A 1000-OHM PHONE WITH LEATHER-covered head band and cord, $3; 1 loose coupler, $4.50; 1 type S dynamo, $3.70; one Junior dynamo, $2.95; 1 one potentiometer, $1.50; 1 electrolytic detector, $1.25; and 1 ½-kw. aerial switch, to trade for Blitzen receiving transformer. I also have a fine helix worth $3.50, to trade for Murdock or other good loading inductance. Geo. Storer, 2249 Glenwood Ave., Toledo, Ohio.

FOUR SPLITDORF AUTO COILS, 1 IN.; PRImary and secondary of 1-inch Bulldog coil, peroxide of lead detector, Junior condenser. Want a 22 calibre revolver or motorcycle supplies. Write what you have. F. Grey Daly, Anamosa, Ia.

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HAVE TO EXCHANGE A BICYCLE WORTH $9 and baseball bat worth 75c and burning outfit worth $2, in exchange for a 3-in. spark coil. The bicycle has a new head lamp and new tires and new bell. Arthur Rogers, 119 Florence St., East Everett, Mass.

AN ELECTRICAL TESTING OUTFIT, ALMOST new, comprising D'Arsonval galvanometer, worth $8; slide-wire bridge, $2.50; wet battery, bar and horse-shoe magnets, compass ½ lb. copper wire, Nos. 18 and 24; two resistance coils of 1 and 10 ohms, and iron filings; total value, $13.50. Would like to exchange for good leather suit case worth about $10, or what have you? Lawrence Mason, 159 Shawmut ave., New Bedford, Mass.

WILL EXCHANGE TWO 13,200 VOLT, CLOSED core transformers, sending condenser, about .045 mf.; large marble-base gap; Morse recorder, double circuit; Stanley H. W. ammeter; 3400 ohm receivers; two a.c. fan motors; small d.c. motor, and small gasoline stationary engine, about ½ h.p. Want prism binoculars, steel duck boat, modern high-grade firearms, or what have yon? F. Schiller, 220 Elm St., Utica, N. Y.

LEARN TO FLY—BIG TWO-FOOT BLERIOT Monoplane. Latest model, knocked down, packed, ready for mailing, with blue print and complete drawings for assembling, with wheels and propeller. This model is usually sold by dealers for $2.00. Boys all over the country are having barrels of fun with them. For good, wholesome amusement, there is probably no flying device more entertaining and that will afford more fun for the boys and grown-ups than this pleasing toy. Guaranteed to fly or money refunded. Sent prepaid on receipt of price, $1.00. Model Flying Machine Company, 820 Reliance Bldg., New York City.

WISH TO EXCHANGE "SPAULDING" 13-INCH pear shaped single end punching bag, a ladies' size tennis racket of standard make and one racket, "Spaulding" make, men's size, and a good double court tennis net (new), for a good pair of field glasses of standard make. G. H. Clemons, Storm Lake, Ia.

WHAT WILL YOU OFFER FOR THE FOLlowing, in good condition: ½ kw. transformer coil, leyden jar stand, small rotary gap, oscillation transformer, Tesla coil, loose coupler, two rotary variable condensers, three detectors, tuning coil and a pair of 2000 ohm phones. Also have a 35 ohm relay, Geissler tube and a wireless book. First offer takes them. Arthur Haake, Closter, Bergen County, N. J.

WANTED—2000 OR 2500 OHM PHONES, COMplete; two-inch spark coil; detectors; audion; hot wire meter; rotary variable condenser; or ½ kw. transformer and audions or detectors in exchange for one Premo No. 4 camera with tripod, roller, acid tester, case, plate holders, developer disks, etc., for 4 x 5 plates. Cost over $30. W. W. Stacey, Box 44, Preston, Canada.

BOOKS, AS A RULE, ARE FILLED UP WITH technicalities and are of very little use to the experimenter, but here is a book which is simple, plain and understandable. Send your order at once for your copy of "Electricity Made Simple," Clarke Caryl Haskins, 233 pages, 108 illustrations, 12mo., cloth binding. Price $1.00 postpaid. Modern Publishing Co., 32 Union Sq., East, New York.

HAVE A 22 CAL. STEVENS TAKE-DOWN rifle, 32 cal. pistol, five-shot, and galena detector. Will give galena and silicon crystals with detector. Want loose coupler or sending and receiving condenser. A. Rust, 309 Quay St., Pittsburg, Pa.

HAVE GOOD AMATEUR LOOSE COUPLER; half-inch spark coil; large complete receiving set; half-inch complete transmitter set with step-down transformer; receiving condenser. Want head sets or any first-class goods. E. R. Hough, Johnstown, N. Y.

HAVE A 500-WATT TRANSFORMER TO WORK on 110 to 10 volts; a drawing table with adjustable iron base, and a lot of electric lighting fittings. Want a good typewriter. Have electric desk lamp and also a lot of 10 volt, 16 c.p. small tungsten lamps. Want 8 x 10 photo lens. H. Gosner, 2561 N. 11th St., Philadelphia, Pa.

ANY ONE HAVING A SAIL FOR CANOE, spars for same, and suitable side boards, and who wishes to exchange them for wireless or electrical goods, will do well by writing to Jas. F. Lupton, Jr., Greenport, Suffolk Co., Long Island, N. Y.

WANTED—A PAIR OF BRANDES SUPERIOR type 2000 ohm phones. Sylvan Turner, 2316 Crockett St., Greenville, Texas.

THE PROCESS OF TRANSMITTING WIRELESS messages through the air over long distances by the aid of electricity is to countless thousands of people only a mysterious fairy tale, but here is a book for you, Mr. Operator, which states nothing but cold facts. "Operators' Wireless Telegraph and Telephone Hand Book," by Victor H. Laughter. 12mo., 210 pages, fully illustrated, giving the operator all the information he desires. Price $1.00 postpaid. Modern Publishing Co., 32 Union Sq., East, New York.

WILL TRADE 32 CALIBER, 5 SHOT HAMMERless revolver for good $5 rotary variable condenser. Also have set of boxing gloves, loose coupler, 22 caliber rifle, stamp collection, Locke adding machine, 7 ft. Bristol rod (jointed), and 30 boys' books. Need battery motor, detector, fixed condenser, coherer and decoherer. Whatever you have, write to J. Eugene Ayer, No. Franklin, Conn.

WANTED—AN OFFER FOR A MODEL 8 REMington typewriter and an 8 h.p. gasoline marine engine. State what you have in the wireless line and I will send full particulars. Standard wireless receiving and sending apparatus preferred; also 8-15 pounds antenium aerial wire and electrose aerial insulators. Ben T. Elkins, St. Cloud, Fla.

WILL EXCHANGE NEW 6 VOLT, 100 A.H. storage battery, 75 watt, 15 volt d.c. charging dynamo, small switchboard voltmeter and ammeter, ¼ h.p. water motor, gas lighting jump spark coil, telegraph relay and modern telephone transmitters for first-class high power binoculars with case, 3A Eastman kodak with high grade anastigmat lens and fast shutter, 6 in. to 10 in. vibrating spark coil, ¼ to 1 h.p. water-cooled gas engine. J. A. Gordon, 508 North St., La Fayette, Ind.

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