September, 1922 25 Cent

RADIO

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used in –

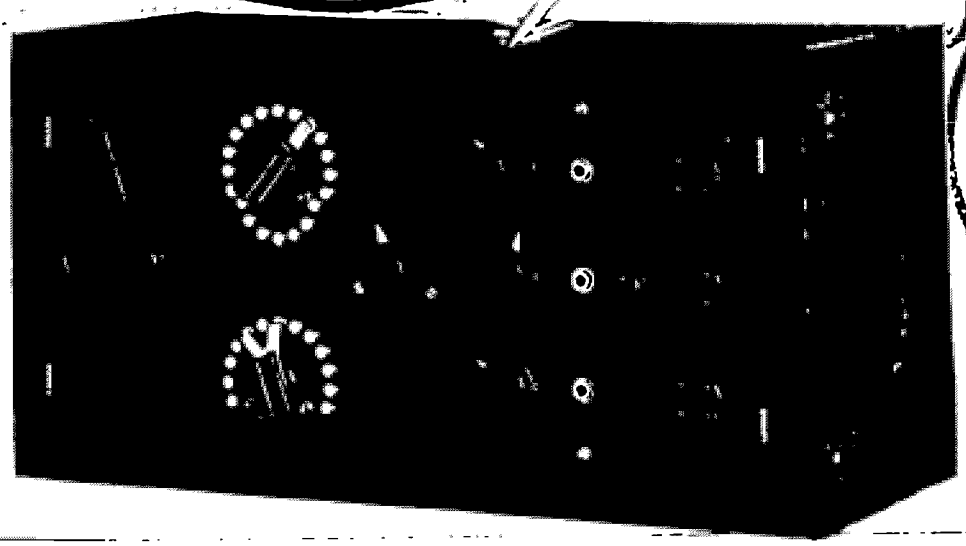
The A-P Special

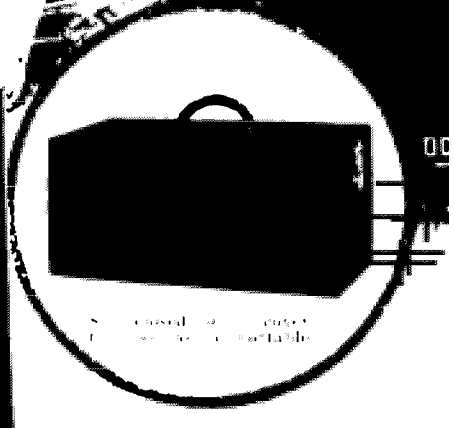
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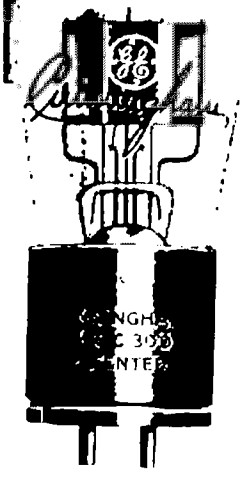
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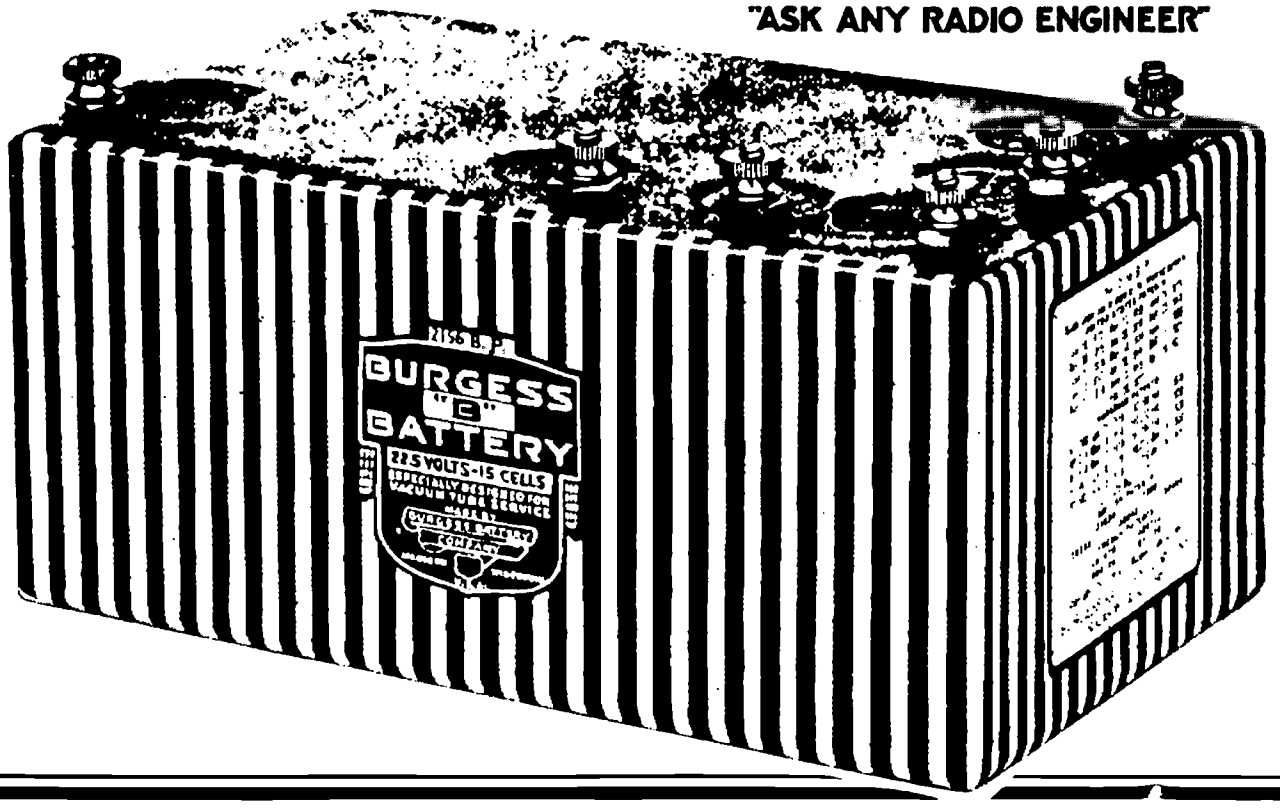
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RADIO

Established 1917 as Pacific Radio News

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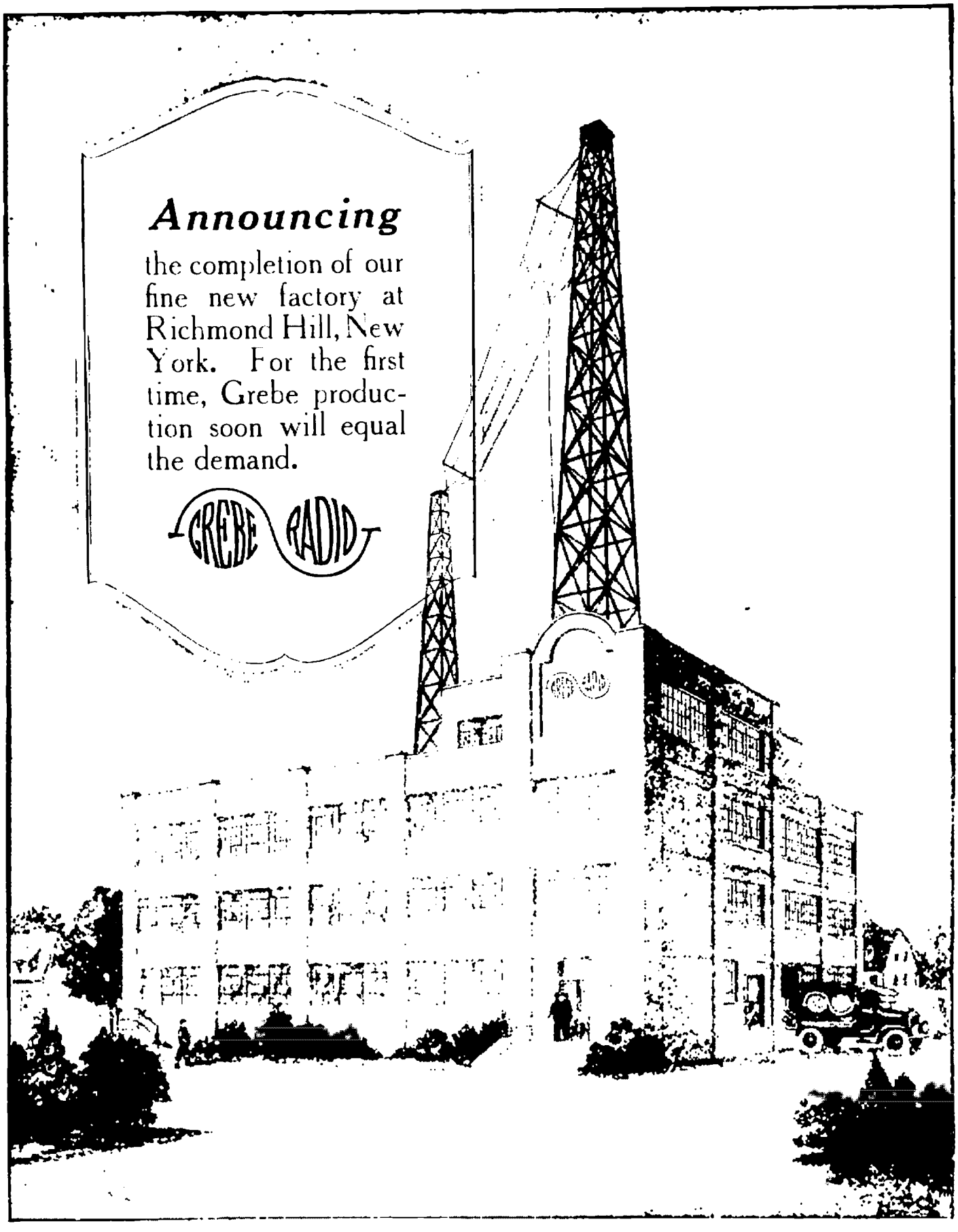
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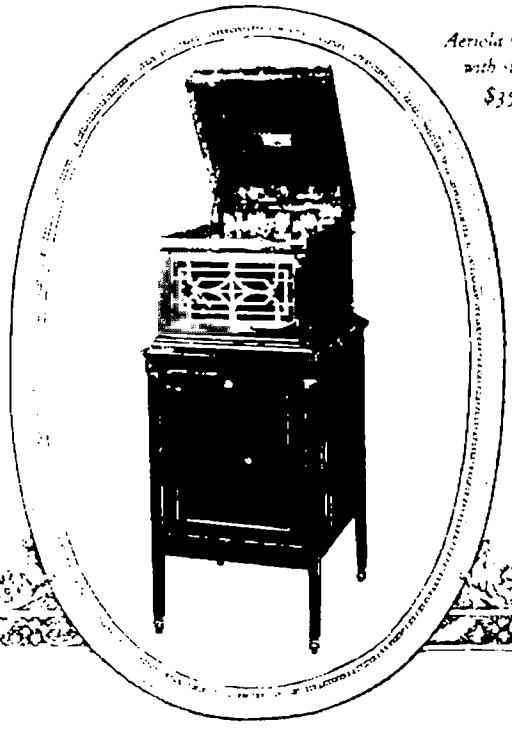
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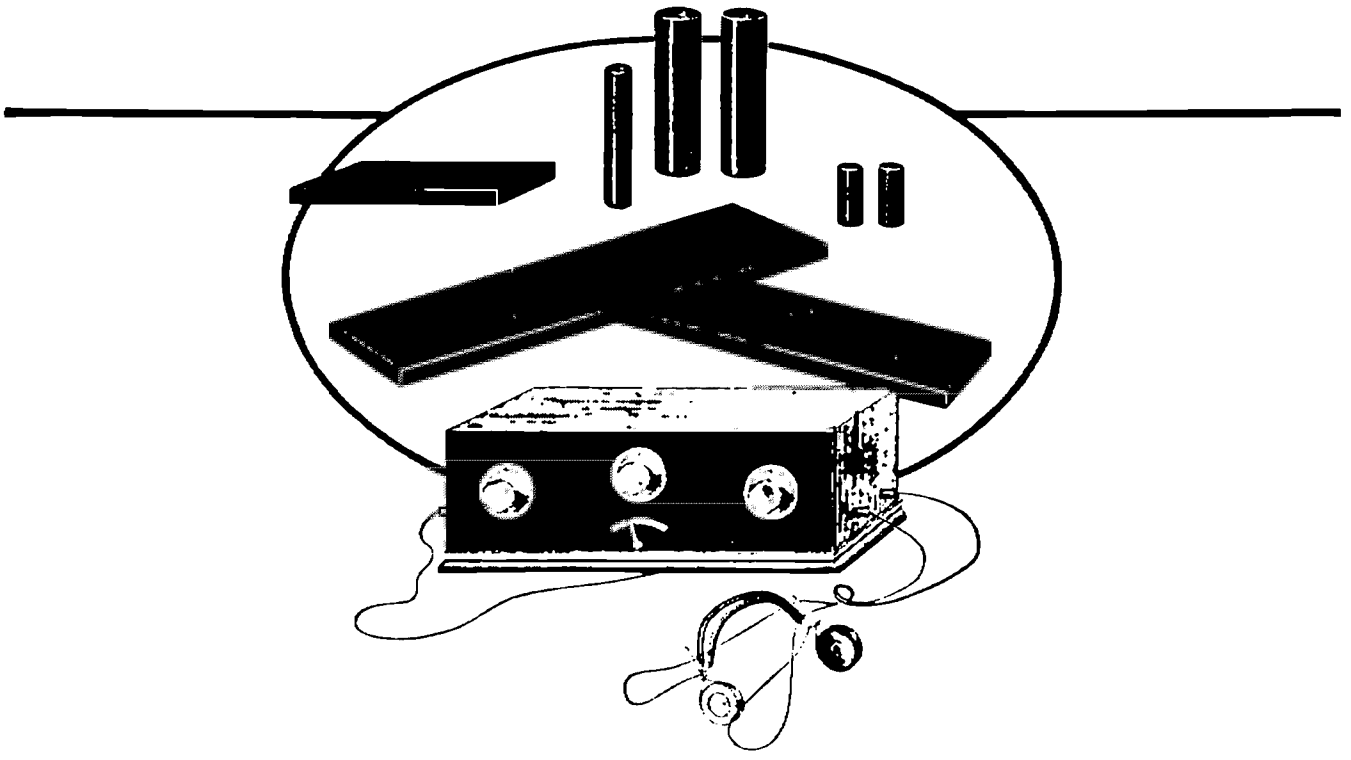
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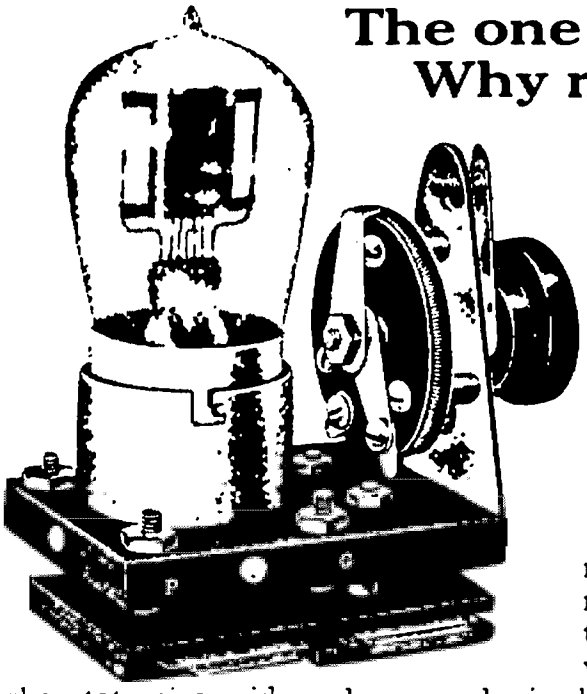
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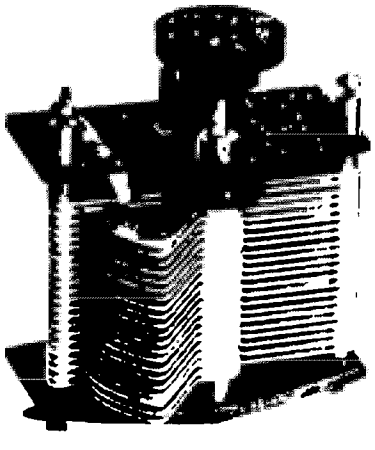
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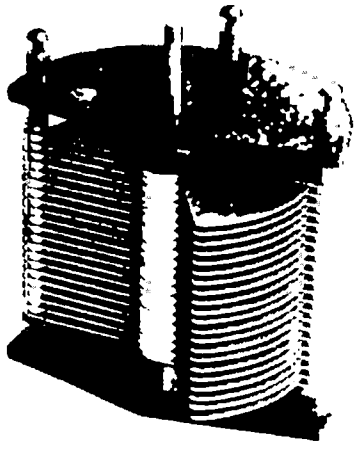
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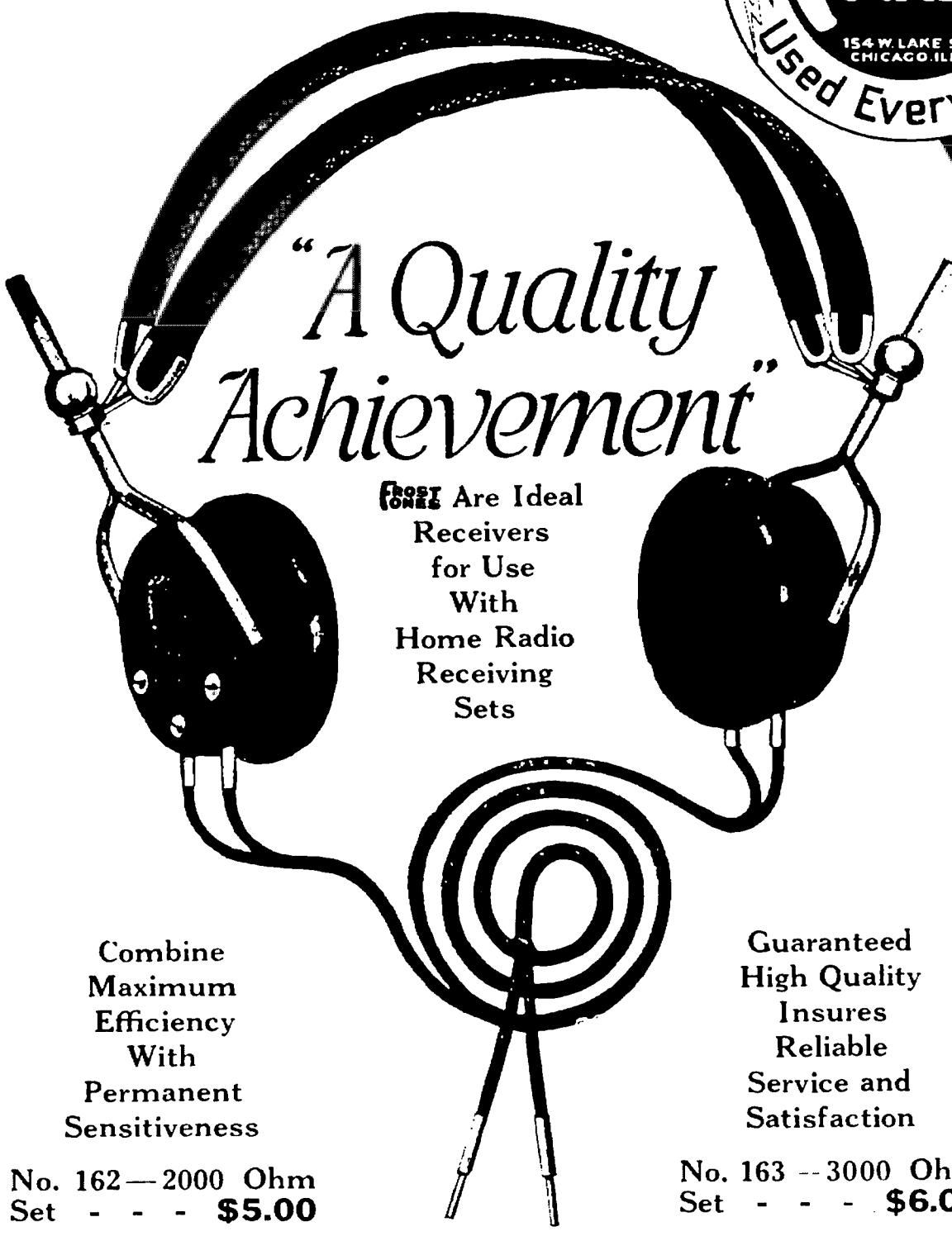
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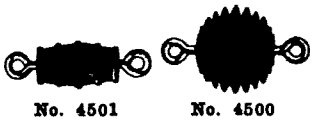
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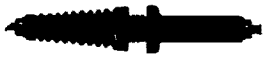
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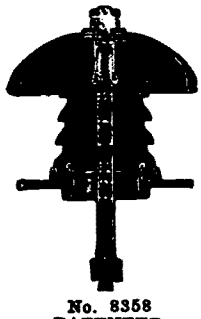
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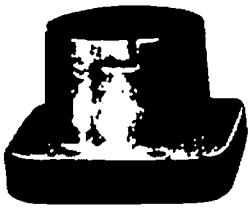
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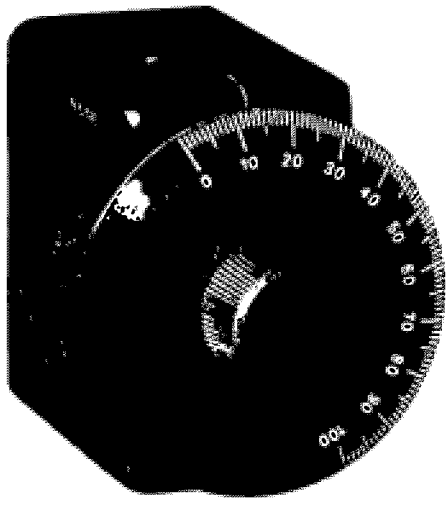
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Oct. 1½"
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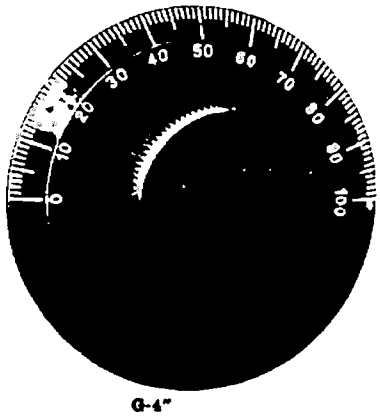
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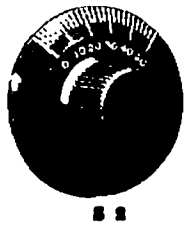
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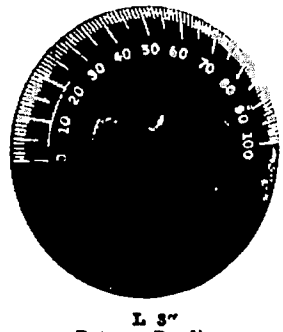
T 1⅝"



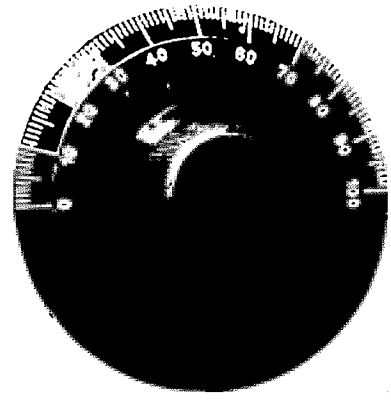
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S 2



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Sept., 1922 **RADIO** Vol. 4 No. 9

Radiotorial Comment

AS the novelty of radio telephony begins to wear off listeners-in will begin to demand a better quality of broadcasting than is now generally available. Most people are still entranced by the wonder of it, but in time the radiophone will become as commonplace as the ordinary garden variety of telephone. A radio concert is marvelous, but it does not yet satisfy a real music-lover.

This limitation does not apply to the radiophone's more utilitarian function of broadcasting news, which is becoming of increasing value and interest to isolated individuals. For the simultaneous distribution of information over large areas no better medium has been found. But radio can compete with such agencies as the phonograph as a regular means of home entertainment only when better programs are furnished and better transmitting stations erected.

Just now there are dozens of mediocre stations all over the country. The operators thereof are indulging in a wild duplication of service in order to satisfy their desire for personal publicity. Most people resent this. It will only be a matter of time before many of these stations will shut down, although some of them are in much the same position as the man who grabbed the bull's tail—it is hard to let go.

The expense of maintenance is high and poorly distributed among those who benefit from the broadcasting. A few broadminded manufacturers are holding the bag. It is likely that all branches of the trade will voluntarily assume a sales tax while business is good. But eventually the owners of receiving sets must be called upon for contributions if good service is to be continued.

In the opinion of some far-seeing men, line radio or "wired wireless" offers the logical solution to the problem. By the payment of a small monthly charge the owner of a receiving set can hook up to a telephone or power wire on which radio frequency currents, carrying speech and music, have been superimposed. But whatever the remedy, it should be applied quickly, for the business future of radio is dependent upon adequate broadcasting.

RADIO frequency amplification of short wavelengths is beautiful in theory but difficult in practice. Those who have not tried it tell the most wondrous tales of what it does, but most of those who have chased this alluring will-o'-the-wisp, following the instructions of those who have not, have been lost in the slough of despond. The successful ones are as rare as a staticless day in June.

The main difficulty is due to a lack of understanding of the limitations of present day vacuum tubes and transformers or other inter-tube connectors. These devices, while well adapted to audio frequency amplification, and even to radio frequency amplification of long wavelengths, are not suitable for increasing the strength of the high frequency currents which correspond or are identical with short wavelengths.

The reason, in a word, is capacity. The effect of capacity, as is well known, increases with the frequency of the current. A capacity whose effect is negligible at low or audio frequencies becomes bothersome at high or radio frequencies. The voltage built up by means of a transformer, high resistance, or inductive connection between tubes, is somewhat neutralized or partially short-circuited by any capacity in parallel with it in the circuit.

At high frequencies the ordinary vacuum tube offers low reactance or opposition to the flow of electric current between its grid and filament. Consequently, much of the voltage amplification that may be gained in the coupling is lost in the tube, the net gain being small. A similar loss is caused by the distributed capacity of the ordinary inductance coil or transformer winding.

So we are forced to the conclusion that until the laboratory types of low capacity tubes become commercially available, it will be difficult, if not impossible, to construct an efficient all-wave amplifier utilizing an untuned plate circuit. Furthermore, these low capacity tubes, unfortunately, have a correspondingly low amplifying power.

However, by using a tuned plate circuit, that is, a circuit in which a condenser or variometer is used to introduce a condition of resonance for the particular wavelength being received, some amateurs are getting good results with resistive coupling. These facts are brought out in detail in an article in this issue by D. K. Lippincott.

Another and more effective method for obviating these difficulties is the Armstrong super-heterodyne circuit, in which the incoming high frequency currents are first reduced by the heterodyne method to about 50,000 cycles per second, then amplified through a number of stages, and finally reduced to audio frequency. The disadvantage of this method is the expense of the large number of tubes and the large battery facilities necessary, as well as the critical adjustment required.

A cheaper but less sensitive noise producer is the new Armstrong super-regenerative circuit, wherein, in its simplified form, a current of 15,000 cycles, or thereabouts, from an oscillating tube is made to decrease the resistance of the detector grid circuit upon which it is superimposed, so that the detector tube is able to amplify the incoming high frequency currents to a far greater extent than is possible in the ordinary regenerative circuit. This combination is easy to construct but hard to operate. It is still very much in the stage of a delicate laboratory experiment and, until further developed, should be attempted only by an experienced operator.

Design of a Low Powered Circuit for Duplex Operation

Ninth Installment of "The C. W. Manual"

By J. B. Dow, Lieutenant U. S. N.

THE present trend of radiophone construction is toward apparatus which is capable of duplex operation wherein a two way simultaneous conversation may be maintained as in wire telephony. The self contained duplex feature of such apparatus also permits of direct connection to land lines without the necessity for complete isolation of the receiver from the transmitter or the use of separate directive antennae for transmitter and receiver.

Two types of duplex apparatus are in use to a very limited extent at the present time. One of these types employs a sensitive relay which, thru the medium of microphone currents, automatically places the antenna of the talker's station on the transmitter. When the speaker breaks his conversation, the relay automatically places his receiver on the antenna again. This might more appropriately be termed a "break in" system. As might be expected, a number of mechanical and electrical difficulties limit the successful operation of such equipment at the present stage of development.

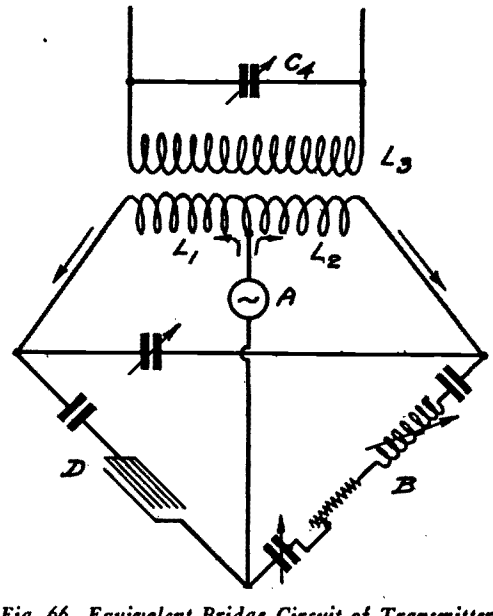


Fig. 66. Equivalent Bridge Circuit of Transmitter, Receiver and Balancer

The second type of duplex equipment balances out, insofar as the talker's receiver is concerned, any interference which might otherwise be caused by his own transmitter. At the same time, the receiver is operative, in that any received signal from an outside source will be heard.

Several types of this apparatus have been developed to a greater or lesser extent and it might be well to mention that, in principle, they are all more or less identical. Of these, the Carson system has been the most successful up to the present time.

Schematically, the Carson system consists of a balanced network (see Fig. 66) containing the source of high frequency oscillations, A; the artificial antenna, B; the real antenna or radiating member, D; and the divided inductance, L_1, L_2, which is, in effect, the primary of the receiver coupler to which is symetrically coupled the secondary, L_3.

In Fig. 66, assuming the current flow at a particular instant as indicated by the arrows, it divides thru the two equal and symetrical inductances, L_1 and L_2, part flowing to the radiating system, D, and part to the dummy circuit or balancer circuit, B. Now if the currents thru the two inductances, L_1 and L_2, are equal, no induced potential will occur across the receiver secondary, L_3, and consequently no signal will be detected by the receiver, which has originated from the source A.

If, however, a potential is induced in the branch, D, from an outside source, as for example a distant station, an unequal current will flow thru L_1 and L_2 with a result that induction will take place in L_3 and the signal will be detected.

The problem which presents itself then is that of dividing the currents in the branches L_1 and L_2 equally.

It is a well known fact that for a given frequency of

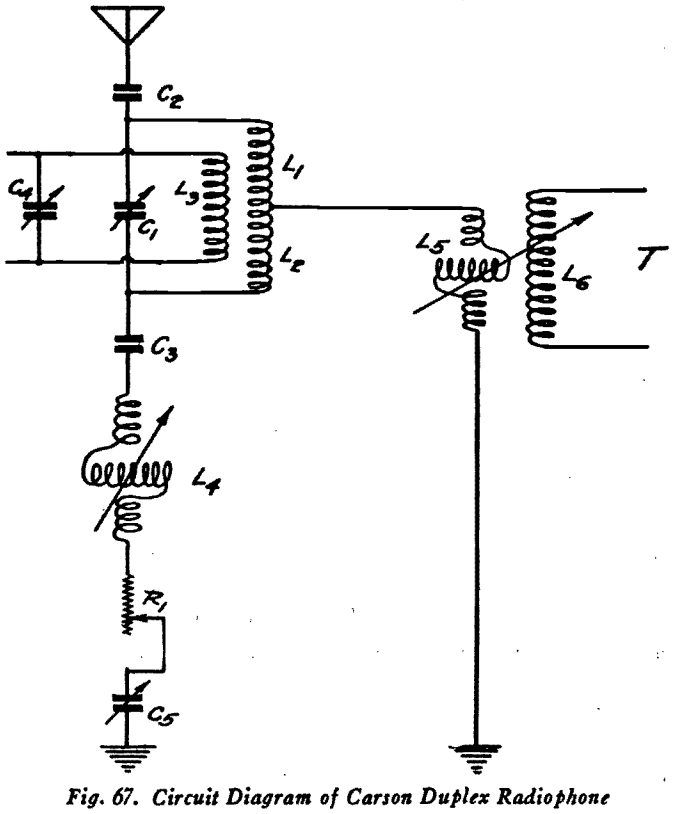


Fig. 67. Circuit Diagram of Carson Duplex Radiophone

oscillation equal currents will flow in each branch if the impedances are equal. For one definite frequency, equal impedances could be obtained with a large capacity and small inductance value in one branch and a small capacity and large inductance value in the other, but with the slightest change in frequency the impedances would change, resulting in unequal current distribution. By considering the equation for impedance it will be seen that in order to hold the same impedance in two circuits regardless of the frequency, the capacity, inductance, and resistance must have identical respective values in both circuits.

The problem then resolves itself into one of determining the proper values for capacities, inductances and resistances in the circuits.

The circuit of Fig. 67 represents a network which, in view of the capacities between component parts and the dissimilarity in the effects of lumped and distributed capacity, becomes very complex and ordinary methods of solution wherein definite circuit constants may be obtained, are not applicable. As an example, the receiver, secondary coil L_3, is coupled to the primary, L_1 and L_2, which is also a part of the transmitting circuit. Any change in the capacity rela-

tions between these three inductances, then, would influence the adjustment of the other. To minimize this effect, these three inductances, or rather the two, for L_1 and L_2 are identical, must be shielded insofar as the altering of capacity relations is concerned. This is done by enclosing L_3 in a thin copper shell, slotted so as to prevent the shell's forming a short circuited loop. Another deviation which prevents the use of ordinary principles of design is the fact that a dummy antenna or balancing circuit consisting of lumped constants is used to balance a real antenna with distributed constants.

In the circuit of Fig. 67, T is the transmitter inductively related to L_5, which is an inductance of the variometer type having a minimum inductance of 20 microhenries and a maximum of 80. These values, as well as those of future ones, are based upon the requirements of a 200 to 400 meter set. One side of this inductance is connected to earth and the other to the center tap of the shielded inductance L_1 L_2, where the circuit divides. The values of L_1 and L_2 should be 60 microhenries each.

The lower branch of the above mentioned divided circuit comprises the balancer. This contains the small series condenser, C_3, having a capacity of approximately 300 micro-microfarads; the variometer, L_4, having an inductance continuously variable from 5 to 30 microhenries, and shielded within a copper shell to eliminate variable capacity relations with adjacent apparatus; the resistance, R, which is continuously variable from 0 to 10 ohms, and the variable condenser, C_5, which has a maximum capacity of about 2000 micro-microfarads. This latter variable condenser must also be shielded for reasons previously stated.

The upper branch of the circuit contains the real antenna and the series capacity, C_2, which has the same capacity as that of C_3.

The variable capacity, C_4, across the receiver primary, L_3, facilitates tuning in for receiving, but has practically no effect upon the wavelength of the transmitter.

Assuming that such a circuit as the one illustrated in Fig. 67 is adjusted to the desired wavelength, which is dependent upon the adjustment of the variometer, L_5, and that it is desired to balance the circuits in such a manner that the transmitted signal will not be heard in the sender's receiver, the first step is to adjust L_4, R_1, and C_5, in such a manner as to approximate the constants of the real antenna. Usually, the correct values will be unknown and it will be necessary to adjust and readjust until silence is obtained in the receiver for several transmitting wavelengths. It must be understood here, that it is quite easy to obtain the necessary balance for one transmitting wavelength, but this will only suffice for that particular wavelength, and any very small adjustment in the transmitter itself would be liable to make the set noisy.

For the successful operation of a duplex circuit of the type described above it is necessary to go to extremes in shielding the apparatus, particularly the balancer and transmitter. Both cabinets, as well as the front panels where possible, should be covered inside with thin copper sheet or wire netting and all battery and generator leads should be run in lead armor. The armor of adjacent conductors should be connected together at intervals with soldered connections and grounded to maintain it at zero potential.

NOTES UPON THE SUBJECT OF OPERATION

1. The use of alternating current for filament heating often increases the life of the tubes from two to three times.

2. Protective fuses should be used in filament circuits to insure the tubes against excessive currents which are liable to destroy same. It must be borne in mind, however, that ordinary fuses do not function rapidly enough to protect the filaments against sudden increases in the current. Very fine iron wire operates as a protective device for filaments more satisfactorily than the lead-tin compositions, but when exposed to air the life of such a fuse is very short.

3. An impromptu *voltmeter* for high voltages such as are employed in the plate circuits of vacuum tubes may be made by connecting a number of 110 volt two candlepower lamps in series and estimating the voltage by the number of lamps in series and the brilliancy.

4. In smoothing out systems, little is gained by inserting a choke coil in the negative lead from the generator because this side of the circuit is usually grounded and is therefore at zero potential.

5. The circuit of Fig. 68 should be used in preference to that of Fig. 69 for the reason that if the filament battery became grounded or leaky to earth, the input inductance would not become short circuited and prevent the set from oscillating. Theoretically, however, the circuit of Fig. 69 is the better because the grid is more easily maintained at a negative potential.

6. An antenna having a natural period not greater than 70 per cent of the transmitting wavelength should be used for best results.

7. A counterpoise should always be used where practicable to reduce undesirable resistance. Frequently the radiation may be doubled in this manner.

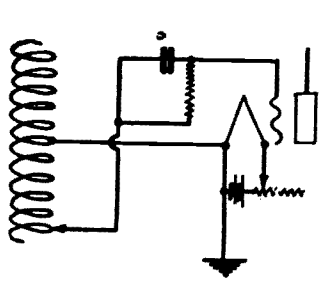


Fig. 68

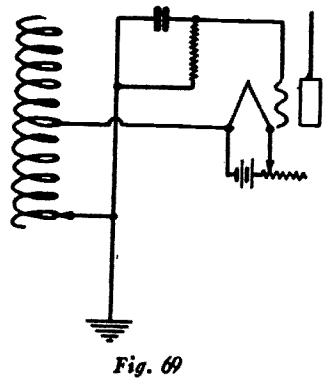


Fig. 69

8. Very often a given transmitter cannot be made to oscillate on the lower wavelengths and the cause may generally be traced to an excessive natural period of the antenna or to excessive antenna resistance which results in high impedance at the high frequencies concurrent with short wavelengths. Shortening the antenna in the first case or installing a counterpoise in the second will usually clear the difficulty.

9. A landline may be linked with a radiophone directly thru the modulation transformer for transmitting and thru a quarter inch spark coil for receiving, using the primary in the landline.

10. In adjusting a vacuum tube transmitter, use a small milliameter in the grid circuit to measure the current flow. If the grid current is excessive, the current drawn from the generator will be excessive. A large grid current results in poor modulation.

11. The actual output when using two tubes as oscillators in a transmitter will be approximately twice as great as when only one is used, but the radiation will by no means be doubled. The reason is that the current squared times the resistance determines the output.

12. Porcelain insulation in antenna systems being used with C. W. is greatly superior to other types commonly used. In this connection, glazed porcelain only must be employed.

13. When using two or more small generators in series to obtain high voltages, insulate each machine from the other in order to prevent the breaking down of insulation between the windings and the frames.

14. Do not attempt to decrease the output of a tube transmitter by dimming the filaments without first decreasing the plate voltage, or a chain of phenomena will result

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The Professional Radio Operator

By Volney G. Mathison

Photographs by the Author

WITH the radio art expanding in a tidal-wave sweep to ever widening fields of utilization, an increasing multitude of experimenter enthusiasts are looking with serious interest toward commercial wireless operating as a future means of gaining a livelihood. The crowded wireless schools attest this, and the wholesale outpour of commercial licenses to successful candidates is tangible proof. Throughout the amateurs' ranks there are regiments of novices who have small outfits installed only for learning to operate and for helping on the road to the desired government certificate; while a still greater number of others, amateurs in the real sense of the word with no immediate intention of becoming professionals, still regale themselves with the mildly exciting idea that some day they too will run the gantlet of the radio inspector's speeded-up omnigraph and have a try at sticking their fingers in the commercial pie.

Few among this great body of amateurs have any accurate conception of commercial radio operating, as it is today. Popular ideas on the professional operator's work are molded largely by wireless school advertising skillfully calculated to attract students; or again, the layman's imagination is fired through contact with some adventurous trail-blazer of his locality, who, having ventured on a summer trip across a placid lake or pike-poled along a little stretch of sunny sea-coast, has returned to his native haunts to be forever afterward the hero of the home circle of radio bugs.

Such sources of information obviously can not well be trusted to give any comprehensive insight into the commercial wireless game as it really is, with its shortcomings and its tremendous possibilities, nor should such one-sided and haphazard views be made the basis of a decision to become a commercial operator. Radio is still so new and is now passing through such a peculiar transitory stage that only a large actual experience in the commercial field itself can enable any one competently to judge its present position and to predict with any degree of accuracy what the future will bring.to it.

Based upon eight years of such experience, the present article has been prepared to assist the prospective operator, be he already a determined learner or merely one of the joyous bugs with the desire lurking like a latent disease in his system, to decide whether in his own particular case the game is worth his while; and, if so, to help him with practical information and advice on the road into the professional domain.

The Radio Operator an Ultra-Modern

AMONG the many highly specialized professions which the far-reaching applications of electricity have brought into existence almost over night, there are hardly any so new as commercial wireless operating. In 1906 there were not fifty wireless operators in the United States. In Germany, the pioneer nation in the commercialization of the researches of Hertz and the applications of Marconi, there may have been a few more; for the Germans built and installed radio equipment for the Mexican government as early as 1901.

These first radio operators, in our own country, were virtually all old Western Union men. Many of them knew only the Morse, that is, the land-wire code, which indeed was mostly used on the air; and their knowledge of radio was fully as imperfect as their apparatus —straight-gap transmitter, a couple of single-slide tuning coils, and a chunk of carborundum.

Our pioneer brasspounders, happily unhampered by radio inspectors and legislated restrictions upon wavelengths and decrement, generally crashed forth with their bursting-shell gaps on any old wave the outfit happened to radiate. Not a few of the early operators, it is a fact, were wholly ignorant of even the elementary principles of resonance and tuning. In those days the call signals were miscellaneous two-letter combinations—which shows how few there were—selected by each station or operating company for itself; and before the international adoption of the present familiar SOS, the recognized distress signal was CQD, imported probably from land-wire practice.

Though the United States Government issued a number of so-called "Certificates of Skill" to wireless men as early as 1910, full official recognition of the radio operator dates back no farther than 1912, when coincident with the passage of our first general radio legislation, formal operators' licenses were created and legally required in all commercial wireless stations, both on shipboard and ashore.

By the latter part of 1914, more than three thousand commercial operator licenses had been issued, although many of these were only of second grade. During 1921, the number of issued licenses passed the 20,000 mark. From this it should not be inferred, however, that there are 20,000 licensed radio operators among us today. Since an operator's license has a life of but two years, it will be seen that only those certificates issued within the last twenty-four months are valid. It is estimated that the number of actually usable commercial operator licenses in existence at present is about



Commercial radio station at Unga, Unga Island, Alaska (KVI), constructed by the author. In this picturesque village of the "Samuel Jones" stories, something of the untamed spirit of earlier Alaskan days is still discoverable.

seven thousand. During these ten years —1912 to 1922—there were issued about 125 extra first grade licenses, which require a thirty-word-a-minute Continental and a twenty-five word land-wire code test. Owing to expirations, as just explained, there are now perhaps thirty operators in the country holding extra first class licenses.

THE RADIO OPERATOR'S SALARY

IN NO other kind of work have the current wages fluctuated to such an extreme extent as have those of the wireless operator. The early shipboard radio men of 1906 received from eighty to one hundred dollars a month. Considering the price levels of those days, and compared with the land-wire wages generally prevailing at that time, this was a fairly satisfactory salary; for it must be kept in mind when comparing wages that the radio operator, that is to say, the shipboard operator, is rated as an officer, and receives an officer's accommodations and maintenance.

The commercial wireless operators' pay stayed around the hundred dollar mark but a short time. In 1910, interest in amateur radio began to sweep over the country like a scandal through a small town. Stations of all powers and radiating all wavelengths began to spring up everywhere. Incidentally, there was one high-power fanatic on the east coast possessed of a ten-kilowatt transmitter and five acres of ground plates, who nightly tortured the ether with a weird nasal note which stuck with you all over the Atlantic like a bad dream, and which if perpetrated upon the air today would probably wreck the radio inspector's decremeter and put the criminally-inclined amateur on the rock-pile in a striped suit for life.

The wireless companies, quick to see a new and better field from which to recruit employees, fostered interest in amateur radio through the establishment of wireless magazines and associations; and opened schools where radio instruction was offered at a very nominal cost —in some cases as low as five dollars a month. Popular interest in radio steadily augmenting, in a remarkably short time we operators of the pie-tin condenser and hay-wire helix type were become as numerous as mosquitoes in New Jersey; the old wire men were gradually frozen out; and a great decrease in salaries began.

In 1912, beginners were paid $45 a month. At this time assignments were very easy to get, because the operators' ranks were made up largely of tourists and college vacationers who seldom stayed more than a trip or two. In 1913 a strike was attempted, which was unsuccessful—due perhaps to the increasing influx of the travel-hungry, who came down to the piers in five thousand dollar cars to go to sea for $40 a month.

The lowest point was reached in 1914, in which year the standard salary in the commercial service was thirty dollars a month on the Pacific coast and twenty-five dollars on the Atlantic. This munificent wage was paid to the operator by the wireless company; and the company in turn received from the shipowner—I have been informed by a shipowner—the sum of $125 a month and up for each operator and antiquated outfit they furnished. If the operator behaved well, his monthly pay was raised two dollars and fifty cents every six months, or five dollars a year. Those of the older men who were operating before the wages went down like a torpedoed coal-barge and who still stayed, generally received from $45 to $55; and a very limited number, perhaps six or seven, of the moss-backed Morse men got their old rate of eighty dollars.

The shore-station operators at this time were paid from eighty to ninety dollars a month; but since no maintenance was furnished to them, their position was hardly preferable to that of the shipboard men.

In 1915, the monopoly of commercial radio which had existed from the beginning was shattered, on the Pacific coast at least, by the development of a Poulsen arc set suitable for installation on shipboard. Irked by the arbitrary leasing policies of the older concerns, a great many ship-owners promptly had arc equipment installed on their ships. This encouraged the formation of other radio companies; and, after weathering many heavy gales of patent litigation—which, indeed, wrecked more than one of them—these also began to build commercial wireless apparatus and to install it upon many vessels.

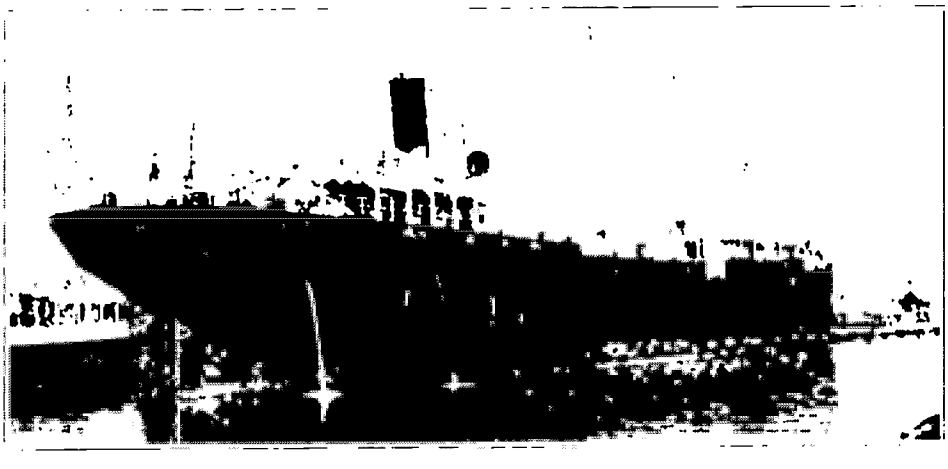
The steamship companies that leased or bought outright the equipments of these newer concerns were privileged to pay their own operators. Since the wireless companies therefore had nothing to do with the men, further than to assign them to vacant positions, they often helped the operators to get a little better than the average wages. In 1915 the pay on the arc ships was $45 for freighters and oil-tankers, and $60 for the first operators on the passenger steamers. Operators sailing on ships with privately owned equipment at this time received from $55 to $65.

But while wages were slowly improving through the breaking down of the monopoly of the leasing companies, this was a mere preliminary to the sudden salvaging of the operators' submarined salaries which was wrought by the world war. With wages in every line of work ashore fattening like a steer on spring clover, radio operators became extremely scarce; and the mushroom growth of the American merchant marine created a still acuter situation. The thirty-dollar beginner of 1914, in 1918 was getting eighty dollars; in 1919, $110; and in 1920, $125. In addition to this, a good many were sailing as combination operators and supercargoes at salaries ranging from $150 to $225 a month.

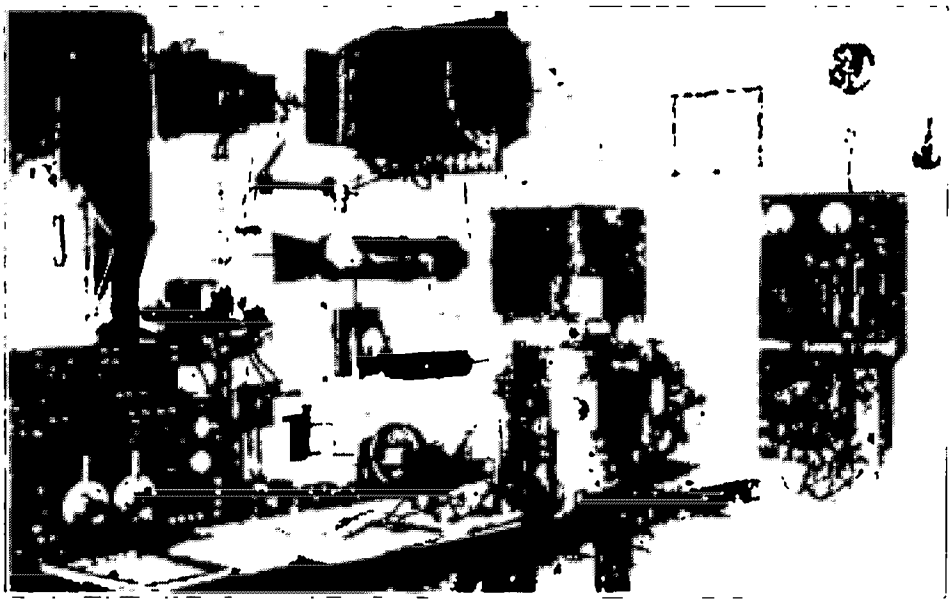
This peak was but short-lived—hardly twelve months. In 1921, a cut to $107 was resisted, unsuccessfully. In the present year another cut to $90 was put into effect on governmentally-owned vessels. The use of combination operators and supercargoes or pursers has been generally discontinued. The prevailing salary, therefore, in the American merchant marine today is $75 for the second operator on passenger ships and $90 for the first operator, or for the single operator on vessels where only one man is carried. On some of the largest Shipping Board passenger liners, the chief operator still receives $107. At this writing, a few of the private steamship companies have not yet followed the government in making the latest general cut from $107 to $90; but they probably will.

SHORE-STATION SALARIES

IT WILL be remarked that throughout this article I am dealing mainly with the vicissitudes of the shipboard radio man. The prospective operator's



Arc-equipped tank steamer "Dilworth" lying at Honolulu. While the rest of the bunch have to fuss around getting the cargo ashore, the wireless operator is away disporting himself on a surf-board at Waikiki.



A modern shipboard arc set. With this set, which has an antenna less than thirty feet above the transmitter, communication recently was maintained with KFS (San Francisco) while off the Japan coast, or a distance of 4611 miles. (SS "Stockton")

interest must primarily be directed toward the sea; for here is virtually the only kind of operator employment immediately open to the beginner. Not only do the ship operators outnumber those employed ashore thirty to one, but the land radio stations require expert and experienced men; and while it is certainly true that there are scores of amateurs with operating ability far superior to that of some commercial men, yet they will not be likely to find any opportunity to take up radio operating ashore for the reason that there is keen competition among the very best ship operators for these shore berths, and very justly the radio companies would not think of rejecting their old men in favor of newly-fledged and unknown operators, however remarkable their qualifications.

Such is the situation at present; and although there is no doubt that the future is destined to bring an almost inconceivable utilization of radio in fields other than the marine, nevertheless it seems to me that the conditions just outlined will largely continue to obtain. The shipboard radio station, with its comparatively light traffic, is the obvious place to gain preliminary commercial experience. For the encouragement of those to whom the idea of earning their daily bread only to hang in jack-knife fashion over a ship's rail and feed it to the finny tribe does not greatly appeal, it may be said that the time is undoubtedly coming when the beginner will not, as now, have to cavort very long upon the briny deep to become eligible for a berth ashore.

The salaries of operators in all branches of land radio work are controlled to a considerable extent by ship-operator wages—although the prevailing pay of the Morse or land-wire men may also have something to do with it. Increases in marine operator pay during the last eight years have forced the establishment of higher wage scales ashore, though not in proportion. Likewise, the cutting of shipboard wages will tend to the reduction of land operator salaries. This will not take place to any appreciable extent, however, because on the other hand with traffic steadily becoming heavier, better men are required to handle it.

While there are not at present many commercial coastal radio stations handling ship traffic, the number of them will increase. The salaries paid to the old-time operators with whom these stations are manned average about $145 a month. In high-power or trans-oceanic stations, about the same or somewhat higher salaries prevail. Living quarters are often furnished, but usually no maintenance.

On the Pacific coast, the progressive Federal Telegraph Company, perfecters of the Poulsen arc, are operating an extensive overland triplex radio system handling traffic between the larger coastal cities in direct competition with the land-wire concerns; and this company pays its operators $150 a month for forty-eight hours weekly work and eighty cents an hour for over-time. These operators are all regularly licensed radio men, though the transmitters and receivers to which their head telephones and their sending keys are connected are many miles away from the city offices where they work. All they have to do is telegraph; and this they do at a speed of from thirty-five to forty-five words a minute, turning out perfect typewritten copy. The receiving apparatus, as well as the arc transmitters, on this marvelous circuit is all out in the city suburbs, the several pairs of phone leads being extended over leased wires to the operating desks in the down-town offices. As one of the company's division heads remarked to me the other day, the operators at their tables, with nothing in sight but phones, keys, and typewriters, find that for them the romance in radio has been pretty thoroughly removed. The expert apparatus tenders who are constantly on watch out in the transmitting and receiving stations proper of this ultra-modern system, receive about the same pay as the operators.

Another very new employment for a limited number of experienced arc operators has been created through the development of the aerial mail service, in conjunction with which is maintained a chain of two and five kilowatt arc stations between San Francisco and Chicago. The present operator's salary in these stations is $165 a month, without maintenance.

A considerable number of radio operators are shipped at Seattle and San

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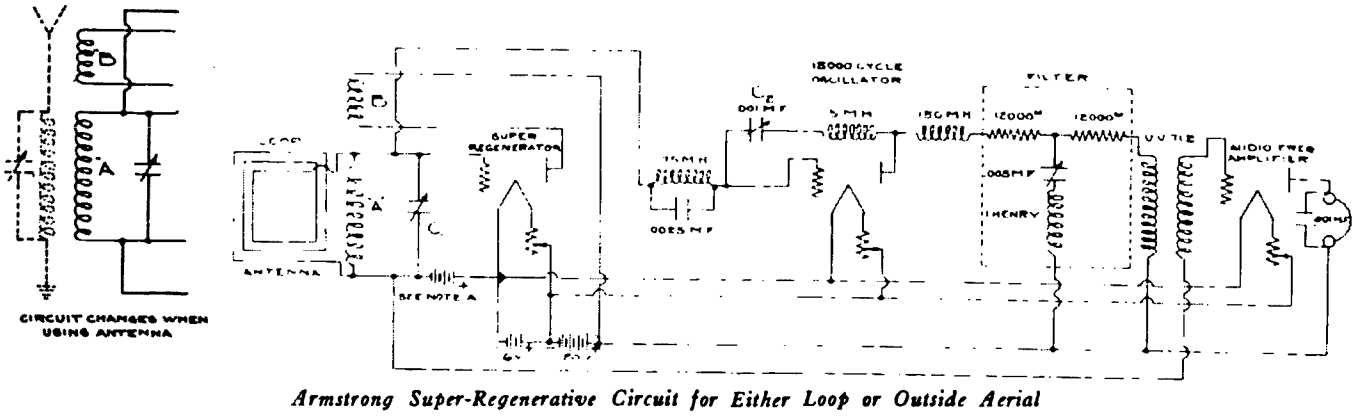


Raising wireless masts in Alaska is a cold job. Here the rigging gang are hard at it, sending up a topmast.

Getting Results with Super-Regeneration

By G. M. Best

A GREAT amount of information has been published recently about the new Armstrong circuit, or "super-regenerative" circuit, as it is called by its originator, and it is to be regretted that no two published circuits are alike in detail, or in some cases, even in principle, thus causing a large amount of confusion. Hence it seems in order to describe here the results of experimental work performed by the writer, with the idea of determining which of the published circuits were correct, and what types of apparatus were most suitable for the use of the average experimenter, who is not always equipped with the best of everything, or a large bank account, either. As a detailed theoretical treatise of this new circuit will appear in a later issue of RADIO, only a brief reference will be made here to fundamental principles.



Armstrong Super-Regenerative Circuit for Either Loop or Outside Aerial

NOTE A—For W. E. Co. "E"; 205-B, or VT—2 tubes, Cunningham C-302 and Radiotron UV-302, on 120 volts plate, use 9 volts. Two No. 703 or No. 751 Eveready batteries will do. For Cunningham C-301 or Radiotron UV-301, use 4.5 volts, one No. 703 or No. 751 Eveready battery.

In the ordinary regenerative receiver, consisting of a feedback from the plate circuit into the grid circuit of the detector, some of the energy in the plate circuit is superimposed on the energy of the grid circuit, increasing the grid current and therefore causing an increase in the plate current, due to the amplification factor of the tube. This is called regeneration, and can be carried up to the point where the resistance of the circuit becomes zero and the tube commences to oscillate, without distortion of signals. When the tube oscillates, further amplification is impossible, and the limit of the present regenerative circuit is reached.

Super-regeneration is a method by which the regenerative principle can be carried much farther than the present limitations, due to the fact that it prevents oscillations and allows regeneration to be carried on to its fullest extent. This is accomplished by introducing into the ordinary regenerative receiver some source of alternating current that will periodically vary the grid voltage of the detector tube to such an extent that the resistance of the circuit can be made equal to zero or nearly so, and yet prevent the circuit from oscillating at the period dependent upon the constants in the circuit. If the external generator is made to produce a frequency sufficiently high to be out of the range of the human ear, say between 10,000 and 20,000 cycles, the voltage in the grid circuit of the detector will be alternately increased and decreased, according to the frequency of the external generator. While the voltage is increased, the resistance of the detector circuit will be greatly decreased, and the current will build up to large values; when the voltage is reversed the current will be practically zero. It is during the period that the resistance of the circuit is small that the super-regeneration is accomplished, and Armstrong has developed a simple means within the reach of anyone who has a fair working knowledge of vacuum tubes and their associated apparatus.

The circuit diagram shown herewith is one which has given excellent results, and presents no difficulties that cannot be surmounted by a little patience and attention to details. The best way to mount the apparatus is to lay it out on a board, placing the various pieces of equipment so that the leads will not be too long, and yet providing sufficient separation so that unnecessary coupling will be avoided.

Three tubes are required, one being the super-regenerative amplifier and detector, the second the external generator or oscillator, and the third the audio frequency amplifier. While five watt power tubes will give considerably greater energy output than the ordinary receiving tubes, it is not absolutely necessary that power tubes be used, as good results have been obtained using Radiotron or Cunningham amplifier tubes, on 80 volts plate. Most of the circuits already published show one audio frequency amplifier working with 200 volts, or even more, on the plate, to produce signals of sufficient strength to operate a loud speaker. A two stage audio frequency amplifier working with 80 to 100 volts on the plate, and with the proper grid potentials, will accomplish the same results, and will thereby avoid the expensive battery and large filament current consumed by the power tubes. In the diagram shown here only one amplifier is shown and the voltage of all three tubes is assumed to be 120 volts. Use hard tubes, the soft variety being unsuitable for this sort of work. A common "C" or grid biasing battery can be used, the correct values being given under Note "A," in the diagram, for 120 volts on the plate, using the various makes of tubes.

The loop may be constructed of 20 turns of No. 16 or No. 18 insulated wire wound on a frame 3 ft. square, when 360 meter reception is desired. Taps should be provided for the shorter wavelengths.

For 360 meters inductance *A* should be a 50 turn honeycomb coil, and the tickler-inductance *B* should be either 75 or 100 turns, depending upon the constants of the tube. The external oscillator has the following inductances, which may be either Giblin-Remler or any of the other compact types of coils; 75 millihenries (1250 turns), 5 millihenries (400 turns), and 150 millihenries (1500 turns). These are placed in the positions shown in the diagram and are not inductively coupled to each other, the generator employing capacitive coupling to produce the desired frequency.

With the proper capacities indicated in the diagram the generator will oscillate at some frequency around 15,000 cycles. The .0025 mf. condenser can be made by placing several small grid

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Radio Frequency Amplification

By Donald Lippincott

THE topic of the day for the radio chapter of the Ananias Club seems to be radio frequency amplification. Several causes probably contribute to this state of affairs. The fact that the Armstrong patent is being more vigorously enforced is probably the foremost one, for radio frequency amplification is often spoken of as a substitute for regeneration. But whatever the reason, interested and disinterested parties have scattered such a mass of conflicting statements that the ordinary amateur is reduced to a state of hopeless bewilderment. Add to this the further fact that the most outspoken opponents of this method of increasing the range of reception are those who have tried it, and one sees why it is coming to be considered a jinx.

When such a pass is reached the simplest thing to do is to discard 99 per cent of what you hear and figure it out. If you haven't sufficient mathematics, common sense will do instead. Let's start at the beginning. It may seem like repeating a lot of obvious facts, but we will run the risk of that because perhaps we may have overlooked one of them just because it was obvious.

First and foremost, we are dealing with quantities that are exceedingly small even as radio quantities go. If we weren't we wouldn't have to amplify before we detect. The fact means that terms which are ordinarily dismissed as negligible may be as great or greater than the quantities we wish to use. As this statement stands, it merely points out an unavoidable limitation, but it also suggests a precaution: leaky insulation, sloppy connections, slipshod work and waste power should be avoided. Moreover, they induce noises, and you can't expect to hear distance if a dab of soldering paste is holding a Chinese New Year celebration of its own where you left it between the input binding posts.

Next, the audion tube is operated by fluctuations in voltage impressed on the grid. If we can make these fluctuations produce ones of greater amplitude on the grid of a second tube we have amplification. But the effect of these voltage fluctuations is simply to produce variations in the impedance of the plate circuit. Since this circuit includes a source of constant voltage, the final effect on this tube is a fluctuation in plate current.

To utilize these current fluctuations to produce voltage changes to be impressed on the grid of the second tube, we pass the current through an impedance. The variations in the potential drop across the impedance are the voltage changes we seek. This always holds true, whether we use inductive, reactive or resistive coupling.

Now, to produce large variations in voltage by this method, an impedance must be high. This condition is fulfilled in most of the transformers and couplers on the market. But a high impedance shunted by another impedance gives an impedance not so high. A condenser is an impedance and the filament and grid of a tube form a condenser which is shunted across the coupler. At audio frequencies this has an impedance so great that it may be neglected. The current by-passed is practically zero. But at radio frequency—360 meters for example—the current by-passed by this condenser is about 1000 times as great, and while 1000 times zero is zero, 1000 times "practically zero" is something else again.

It is this capacity effect that is responsible for most of the difficulties encountered with radio frequency amplification. It is not equally pronounced with all tubes. Inter-electrode capacity is affected by the same factors that determine the capacity of any condenser. Other things being equal, the tube with the smallest electrodes and the greatest separation will give the best results.

Even more disastrous than inter-electrode capacity is high distributed capacity in the inter-tube transformer or reactor. A coil wound with enameled wire and impregnated with paraffin will have sufficient capacity effectually to sap off any voltage it may be able to build up. Yet radio frequency transformers of exactly this construction have been sold in considerable quantities and are no doubt responsible in large measure for much of the ill repute from which radio frequency amplification now suffers.

Another fruitful source of trouble is the desire to conserve tubes and at the same time get maximum effect on both strong and weak signals by using the same tube for either radio or audio frequency at will. A telephone key switch seems the handiest way to make the change, but a telephone key, with its parallel strip spring, is a most excellent condenser, and when it is included in the circuit one might just as well connect the grid to ground directly—it wouldn't kill the set any deader.

If it does seem best to hook up in some way which will allow the use of the same tube for either audio or radio frequency, there are two possible methods. Either a special type of anti-capacity switch must be used, the set being so designed as to give the shortest possible leads and simplest connections for the radio frequency hook-up, or else an inter-tube coupler must be used, which will function on either frequency. In this case the shift is made by simply interchanging the tubes, or if a hard detector tube is used, all that is necessary is to change the filament current to the sensitive point for the desired tube. It seems probable that with this type of coupler each tube does a part of the detecting and that some amplification takes place at both frequencies for all adjustments.

The remarks in the foregoing paragraphs on the effects of capacity are all based on the assumption of forced oscillations. If the inter-tube circuits are tuned an entirely different state of affairs exists. Under these circumstances the circuit is in effect an inductance shunted by capacity, *i. e.*, a parallel resonant circuit. Such a circuit has an infinite impedance for the tuned frequency and an extremely low impedance for practically all others. Our oscillating voltage can be impressed on the grid with a minimum of loss and the results are startling.

Some of the manufacturers of inter-tube coupling devices are now showing circuits whereby they can be tuned. The diagram of the manufacturer should always be followed for this purpose, for the method of tuning depends on the inherent characteristics of the coupler. Other manufacturers tune their transformers to the desired frequency when used with some definite make of tube, the idea being to get maximum results on 360 meters and some results throughout the entire band. It is very difficult to get exact duplication in manufacture, however, and thus far the writer has never been able to get dependable results with this type of construction. The resonant range has always been found to be very narrow and the discrepancies between different transformers and tubes of the same make sufficient to make one sample, perhaps, perfectly satisfactory, while the next one tested would prove completely dead.

Still another factor enters into this question of the tuned circuit. The plate of the first tube is effectively in parallel with the grid of the second. A tuned plate circuit is one of the recognized methods for getting regeneration. If you believe that regeneration always involves distortion, or if you hold no license under the Armstrong patent, that path is closed to you. But if what you want to hear is code, or if you are after distance, and distortion means nothing in your young life, a single stage of tuned radio frequency with a good coupler and careful construction and operation will bring in stations you didn't know existed.

Continued on page 54

The New Super-Regenerative Receiver

By Kenneth Harkness, Chief Engineer Radio Guild, New York

MAJOR ARMSTRONG'S super-regenerative circuit is merely a new arrangement of well-known apparatus. This invention is particularly interesting to amateurs because it is essentially a means for amplifying the short wavelengths to which amateurs are restricted for transmission.

In fact, in the reception of 200 meter waves the amplification is four times as great as in the reception of 400 meter waves.

It is possible for any amateur to build one of these receivers, as the assembly is simple. The difficult matter is the tuning. Probably many have failed to obtain any response or at least only mediocre results, from the receivers they have built and have been disappointed. To these we can only recommend that they try again, and persevere until they are successful. We have now constructed four super-regenerative receivers for test purposes, each of which employs a different combination as given by Mr. Armstrong. With the first it took us a day to even obtain a signal of any kind. It took us two days more to tune it in such a way that the signals came in loud. The subsequent receivers did not take quite so long to tune because we had become more familiar with the method. It will be understood, therefore, that a great deal of patience and perseverance is required to tune, but once the combination has been found it is not difficult to maintain. The results obtainable are well worth the time and energy expended.

There are several different circuits which can be used. Undoubtedly the most popular will be that which was given by Major Armstrong in his address to the Radio Club of America. This circuit is comparatively stable. The necessary parts required to construct a receiver of this type are as follows:

2 Open Circuit Jacks
1 Variocoupler
1 Variometer
1 D. L. 1500
1 D. L. 1250
1 5 Milhenry Air-Core Choke
1 Iron Core Choke Coil (about .1 henry)
2 Non-inductive Resistances of 12,000 ohms each
1 Potentiometer
1 .0005 Mf. Variable Condenser
2 .001 Mf. Variable Condensers
2 Fixed Condensers, .001 Mf. each
2 Fixed Condensers, .005 each
3 Tube Sockets
3 Rheostats
1 Audio-Frequency Amplifying Transformer
Filament, Plate and Grid Batteries.

In this list a variometer is indicated. This is placed in the plate circuit of the first tube. This variometer can be omitted if the secondary of the variocoupler is especially wound with 100 turns of wire. Variocouplers especially designed for super-regenerative receivers are now obtainable on the market.

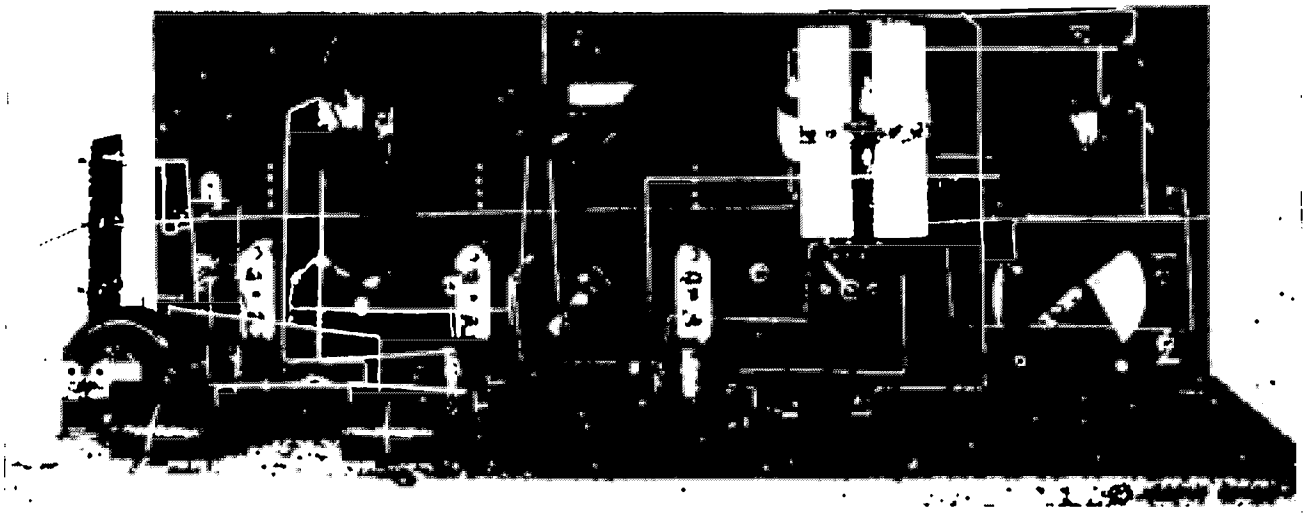
The only other special apparatus in this list, which may not be very familiar are the choke coils and resistances. These are required for the filter circuit which prevents the strong intermediate frequency produced by the second tube from paralyzing the third tube. As a matter of fact, there are several different types of filter circuits which can be used. One type is shown in the circuit. This was used by us and excellent results obtained. It consists of two non-inductive resistances of 12,000 ohms each, one .005 mfd. fixed condenser and one iron-core choke coil of about .1 henry inductance. (See Fig. 2.) This filter combination is now on the market and may be purchased as a single unit.

Another piece of apparatus which has caused a good deal of inquiry amongst amateurs is the 5 milhenry choke. This choke, with a variable condenser, is placed between the plate and grid of the second tube. A D. L. 300 honeycomb coil may be used for this choke. The value of a D. L. 300 is over 5 milhenries, but it will serve the purpose and give excellent results.

All the rest of the apparatus is quite familiar. The loop may consist of 12 turns of No. 20 wire spaced ½ in. apart wound on a form 3 ft. square. It may be in the form of a spiral or a solenoid. A clip should be provided to tap any required number of turns on this loop.

The usual instructions for assembling any receiver apply to this one. To expect good results the wiring must be carefully made and all points soldered. Use stiff wire and make all turns at right angles.

The best type of tubes to use in this circuit are Western Electric E tubes. The results obtained are well worth the higher price. These tubes can now be purchased. With these tubes we have found the best values of plate batteries to be about 100 volts for the first two tubes and 200 volts for the third tube. Biasing batteries are absolutely essential in the grid circuits of each tube. For the first two tubes the values of the grid batteries may be anywhere from 6 to 20 volts. It is best to commence with 6 volts and gradually increase the



Back view of a three-tube super-regenerative receiver constructed by Mr. Harkness. The wiring diagram for this receiver is given in Fig. 1

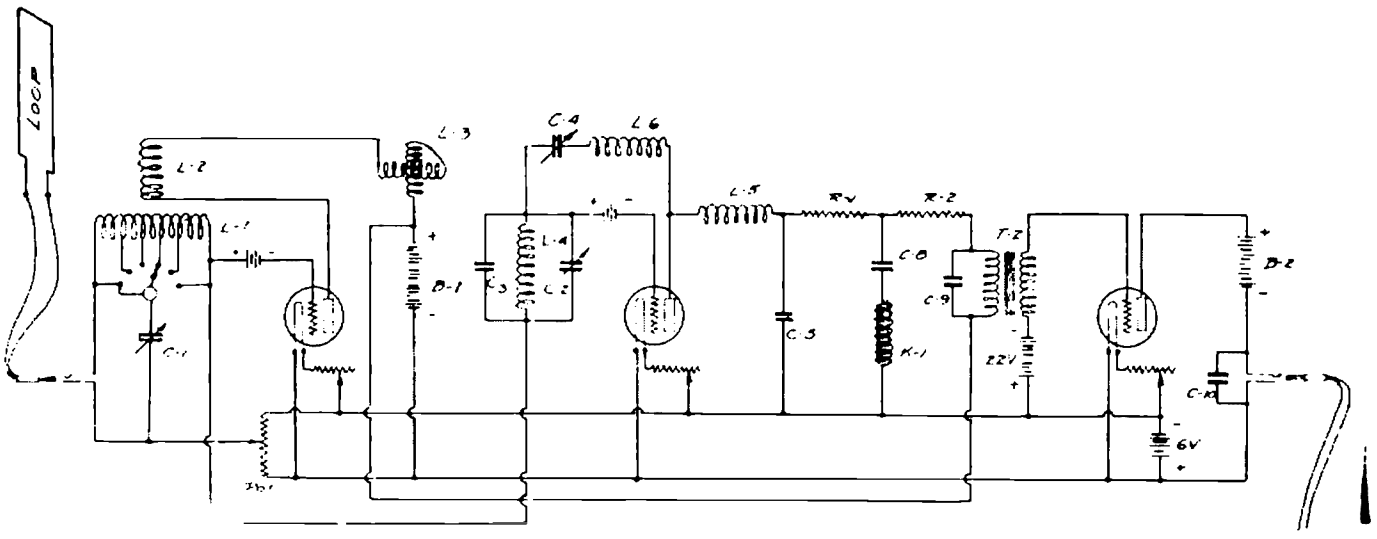


Fig. 1.—Wiring diagram of the three-tube super-regenerative receiver.

value until the best results are obtained. A 22-volt battery may be used for the grid bias of the third tube.

It is rather difficult to give directions for tuning a super-regenerative receiver. In the first place, it must be realized that it is an entirely new method of reception and the conditions which apply to other methods of reception do not necessarily apply to the super-regenerative receiver. As with everything else, the individual will learn more by practice than by information and advice from others. Those who have regenerative receivers have learned to tune them by actual practice and they must similarly learn to tune the super-regenerative receiver. However, we can give a few hints which will be found useful.

The constructor should first look for certain effects to determine if his circuit is functioning properly. When the filaments of the tube are lit a penetrative high-pitched whistle should be heard in the phones. If this is not heard, vary the condenser (C_4) which couples the grid and plate coils of the second tube. If there is no response, vary the plate and grid batteries of the second tube. If there is still no response there is either a break in the circuit or it has not been properly wired. When the fault has been found, the whistle indicates the second tube is oscillating. The first tube must then be made to oscillate. To obtain this adjust the condenser across the loop and adjust the feed back coil. The feed back coil may be the especially wound secondary of the variocoupler or the ordinary secondary and a variometer in series with it. Adjust also the voltage of the grid battery of this tube. When the first tube oscillates it will easily be recognized by a loud roar in the phones.

With both tubes oscillating a movement of any of the variable elements in the circuit should produce a series of heterodynes of harmonics in the phones.

The following are the constants:

C1—.0005 M. F.; L1 and L2—Vario-coupler.
L3—Variometer; L4—D. L. 1500.
L5—D. L. 1250; L6—D. L. 800.
C2—.001 M. F.; C3—.0015 M. F.
C4—.001 M. F.; C5—.005 M. F.
R1, 2—12000 ohm resistances.
C8—.00ɔ M. F.; K1—.1 Henry Iron Core Choke.
Tr—Audio Frequency Amplifying Transformer.
C9—.002 M. F.; C10—.002 M. F.
Pot.—200-400 ohms Potentiometer.
B1—100 V.; B2—200 Volts (with 5 watt tubes)

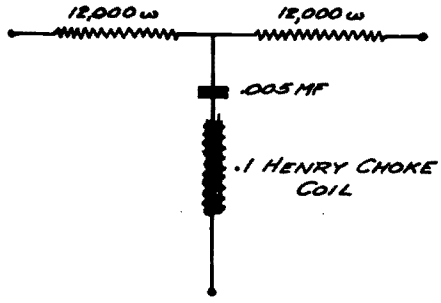


Fig. 2.—Filter System

If any condenser is moved a series of loud whistles running up and down the scale should be heard. No progress can be made until this condition is arrived at. Those who have built super-regenerative receivers and have not obtained this effect may as well realize that their circuit is not functioning properly. They must make the adjustments just outlined and obtain this effect.

When the proper state has been obtained the circuit should then be tuned. First of all the loop or grid circuit of the first tube is tuned roughly to the wavelength it is desired to receive. For 360 meters about 6 turns on a 3 ft. loop and about 20 turns of the primary of the variocoupler will be the correct value. Final adjustment is obtained by the condenser across the loop. Voice or music from a transmitting station may be audible, but whistling and roaring noises may accompany it. Then vary the condenser C_2 across the grid coil of the second tube and the condenser C_4 coupling the grid and plate coils until the signals are heard much louder. The feed back coil of the first tube may again be varied. Terrific roars and whistles will be heard but continue to tune until the critical point is found where these disappear. The grid voltages of the first and second tubes should be gradually increased and new adjustments made all around. When the proper values of C_2 and C_4, which provide marked amplification, have been obtained these condensers may be left in these positions and final adjustments made with the feed back coil of the first tube, and the potentiometer. One point will be found where the whistling and roaring ceases and the incoming signals are enormously amplified. It will take a long while to find the correct adjustments and, other than this general outline, there is no fixed rule in the matter. The potentiometer across the filament battery is of considerable assistance in finding the critical point. The grid voltages are particularly critical. The best results are obtained with fairly high voltages, but, to tune the circuit, commence with a lower voltage.

Make sure that the proper values and tubes are used and then persevere and patiently experiment until the results are obtained.

The main thing to remember is that the super-regenerative receiver works wonderfully well. If you are unable to make it work, don't blame the circuit, but blame yourself. Continue to try until you are successful. When you have found the combination it is no longer difficult.

STATION 3BV, WEST CHESTER, PA.

By PAUL G. WATSON

All the apparatus used in 3BV is home-made with the exception of the Magnavox. The receiving set is wired for both long and short waves, two tuners being employed for this purpose. The audion panel is wired on the "Ultr-audion" plan and contains all necessary audion controls. A pre-war "Auditron" is used in this detector, and gives much better results than any of the more modern tubes.

The amplifier is a 2-step audio frequency type, in outward appearance similar to a "Deforest," but radically different inside. The circuit of the Federal Tel. & Tel. Co. of Buffalo, N. Y., is used in connection with Acme "A-2" transformers.

The short wave tuner is composed of a "Simplex" variocoupler, two "Simplex" variometers, and a "Cotoco" .001 mfd. variable short wave condenser. A switch is arranged on the short wave condenser, so that it is automatically short-circuited when the dial is turned to a position just beyond 180. The primary switch of the tuner is a back mounted affair and gives much better results than the old type of switch.

The long wave tuner is composed of a coil mount, two .001 mfd. "Cotoco" condensers and a series-parallel switch. The tickler or feed back circuit is employed. All the connections in this tuner and in fact all the other pieces are made with No. 14 hard drawn wire, giving the best possible results. Connections between the various pieces are made with No. 10 wire, reducing resistance to a minimum.



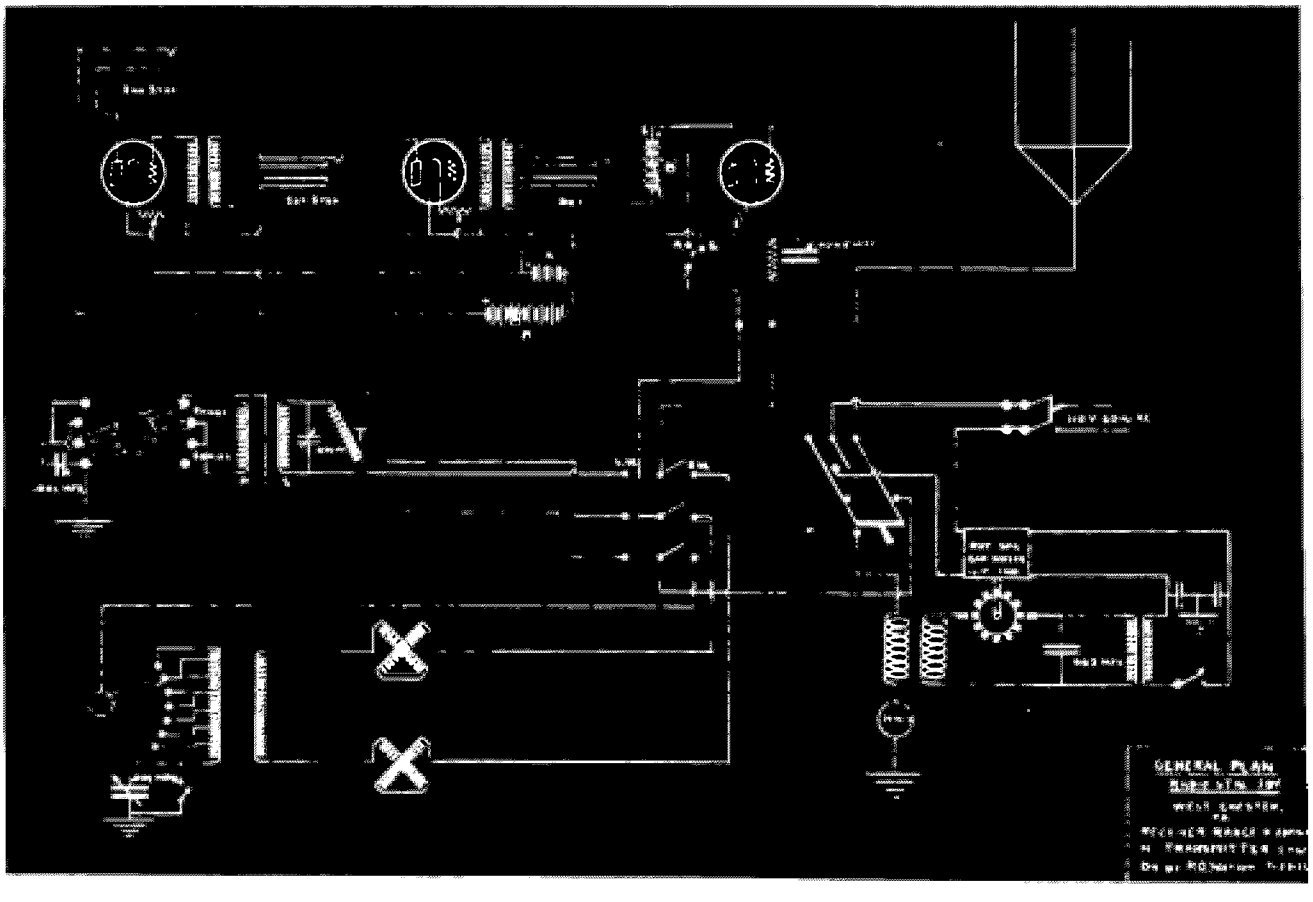
3BV, West Chester, Pa. Layout of 3BV

A three pole double throw switch changes the two audion leads and the antenna from one tuner to the other. By using this system of transfer no dead end losses occur.

Unfortunately I am unable to get a. c. for a respectable transmitter, so I am forced to use a spark coil, but have worked 44 miles, to 3CC with this coil, after tuning it closely.

The antenna is a 6-wire affair, 90 ft. long, with 16-ft. spreaders. A 25-ft. vertical section tapering to a 4-ft. spreader serves as a portion of the

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General Plan of Station 3BV

Scratchi Discusses the Business Lookout

By David P. Gibbons

To Editor RADIO (Magazine which make new crop of such to resemble 30 cents Russian).

Hon. Sir:

Since grasping present-time position as newspaper radio expert my Cousin Scratchi have rapidly develop himself into really brainless wonder. I desire therefore, Mr. Editor, to demand some sniggestings from you how he can improve this defect, because I think, mightbe, you are quite good at advice dispensing, since peppy books all tell student that everyone have something which we are very good at it, and I do not know what else you can be good at.

My cousin are fast losing fine opinion of high intelligents among the generally public and are also losing, in additional, small amount of conscients which he formally possess, if any. Each a. m. and p. m. his letter box are fully charged with jammed mail from all sectors of this glorious land where liberty still wave a little. Each envelope contain 11 or 8 knotted problems which display how highly ignorant the trodden-down proletariats have recently became.

"How have you succeed to obtain such great mastery of radio to answer all these deep questionings?" I quirk at him, night before this one. "Did you uptake loud-praised corresponding course for this while key tapping on old scow maru?"

"Most silly question of all!" he rap me back, "Key tapper on all marus become daily more vacant in top story and have too slight cash balance for foolishnesses after he pay for sufficiently passionate sox and neckties every trip. To learn radio through mail carrying gent are muchly similar to learning box-fighting or brick-lying professions in that style—possible mightbe, but not very so."

"But have not many thousands," I demur, "given full-page testimony of grand results from those coursings? Do not one gent rush homeward to snappy real estate and say loudly for neighbors, 'Holloa, dearie! Just got other thousand dollar weekly raise?' And do not other bimbo explanate freely how he grow fresh set of brains in single eventide by making sign on dotty coupon and forwarding three cash dollars every Saturday hence fourth?"

"They do indeed," Scratchi sneak over, "and also many thousand elsewise honest people inform simple stranger that climates of San Francisco are very finest in universe!"

I get snarled up by this, Mr. Editor, and cannot upthink suited back-kick until too lately.

I switch to higher wave then, and require from him if Hon. Ad. Manager do not still endeavour to grab off some of his valued space on radio page.

"Not so muchly these passed few weeks ago," he respond, "since ecstatic season which are now drawing towards glad finish have drove many possible radio bugs to sea and mountain trippings, and camperouts who are busy writing on postal views, 'Having splendor time, wish you were here,' have not sufficient time space to examine newest unregenerate style receptors. Also, again, quite several of the sprung-up, night-flying companies which make smartly



Johnny used the clothesline for a counterpoise

aleck living off poor fish have discover that fish do not desire to be stung twice in same place. Not matter how dumb, novice who have just paid 12 iron bucks for 40-cent sea shell amplifier will make notable pause before donating 5 additional green ones for peanut size bottle of liquor which make crystal work like two stepper and extract all static from ether."

"Since one are born every minute, all are not yet dead!" I reflex in heavy brisbrainy manner.

"You inform them, monkey wrench," he make slangy crackle, "you are always amongst nuts."

"But do not many vacationers desire to buy classy receiving sets to take along and get home town news and musical programs while seeing how grand nature are?" I pose with stump him idea.

"Desire to do so, truly," he circulate, "but most of such who leave home fires for a change and a rest, return themselves back with quite small change while gracious hotel keeper have the rest."

"Do you, then, observe that radio boom are popping up distress signals," I rogate, "and are on road to join other passed crazies like jazz and bobby hair?"

"By no means at all," he flare at me, "soon as all bathing togs are back again on usual nail in closet, greatest indoor sport will bloom again into magnitude which shall make movie and auto businesses look like umbrella mending industry. When new Armstrong circuit are placed on counters and midget-wave transmitters shoot forth really music and song, bird who cannot speak the language will become rare as the goof who still wears derby hat and white vestcoat. I shall then have to install several new letter boxes for daily stream of edisonaires and 4 or 5 new waste baskets to remove such as require too much heady work."

"Would not this grand volume of information fill greatest part of radio dept. space?" I interrog.

"I shall have sufficient of it when I throw away all press-agency photos of sweet young things listening to radio in shrunk-up bath suits, which make most radio depts. look like copy of Barber Shop Gazette. I shall gain further space by rejecting free ads. in broadcastors programs of the Dambigo or the Knobby Reducing Pianos, and shall insert some relied-upon knowledge about wireless in places now occupied by pipe-addick writers of Sunday Magazine Sector."

"Where shall you obtain this vast increase of knowledge to sail abeam of all those startled developings which make old timers dizzier than ever?" I deploy.

"That are dark-color newspaper secret," my Cousin modulate in low note, as he shut down for customer regulated period.

I do same thing, Mr. Editor, and hoping your input continues to amplify on steepest part of curve,

I am please to indict myself,

Your interesting reader,

HILOLI NOGO.

THE CQ HOUND

Listen, old-timers, and your fones will resound
With the terrible squeal of the CQ hound,
Whose sending won't stop for fire or flood,
Though every old-timer thirsts for his blood.
It's always "Hello, and how am I now?" and
"QSU now, for it's time to chow."
He is always on deck, though "QTC NIL,"
His messages read, "Is this you or Bill?"
Oh! For his presence and a huge rettysnitch,
A double-barreled shotgun, a barrel of hot pitch.
That never again could we hear that sound,
The eternal squeal of the CQ hound.

NAVY ELIMINATES MUSH

Recent experiments conducted at the Mare Island Naval Radio Station are reported to have eliminated "mush" and harmonic interference by means of a current transformer. Tests conducted with the co-operation of commercial stations in the vicinity show that these companies experienced no interference while the high power arcs at the naval stations were in operation.

The Conscience Shop

By Earl Ennis

THE Papyrus Club is one of the loitering-places of the overly-wealthy. Over its billiard tables and in its stuccoed grill, are pulled many of the strings that effect the "big business" transactions of the outer world. Among the sterling figures whose names and connections were of inestimable value to the already firmly entrenched reputation of the Papyrus Club, were Homer Madsen, president of the Citizens Trust Company, and Marcus Waterford, president and general manager of the Development Oil Company. Madsen had been a director in the club for ten years, and Waterford, while never having attained that distinction, occupied the equally enviable position of being Madsen's proxy on such occasions as the latter was unable to attend the board meetings.

Waterford lived at the club. Madsen, while occupying a palatial home in Cloyn Court, nevertheless passed the greater part of his time at the club also. Both were familiar figures in the lounging room, where evening after evening, they could be found at cards or chess.

One week before the occurrence of the mysterious events now to be discussed, the stock of the Development Oil Co. had been manipulated by Madsen and Waterford so as to drop sharply in price and carry to ruin the savings of thousands of small investors. Among these unfortunates was the "clientele" of a boarding house where lived Walter Rivers, contractor and engineer, and also Miss Katie Ferguson, whom Walter had admired for months. All but Walter had lost their all in the "drop" from which the manipulators had reaped a rich harvest.

Because of his pity for his fellow boarders, and especially because of his admiration for Katie Ferguson, Walter Rivers had assumed the task of compelling the rascals to return their ill-gotten gains. He soon reached the conclusion that they could not be touched by law, and in a flash of inspiration he determined to try to touch the conscience of Madsen, whom he divined to be the power behind the deal.

By diligent search he had secured the architect's plans of the Madsen home and armed with this information was able to lower a radio receiving set down the chimney leading to an open fire place in Madsen's private apartments. He did this by posing as a telephone lineman shooting trouble.

Meantime Miss Ferguson had quietly learned of Madsen's habits and especially that he was accustomed to read before his fire place just before retiring each evening.

ON the night following the day of Walter's excursion to the Madsen home and the installation of the odd-looking apparatus in the chimney there-



"Madsen jumped from his chair with a startled exclamation."

of, Madsen and Waterford passed the evening as usual—this time at billiards. At about 10:30 o'clock, Madsen tired of the game and decided to go home. As he left the club in his machine, the engine of an automobile directly across the street purred suddenly into life, and edged along until it was directly behind the limousine. Only when Madsen's driver turned his machine into the gravelled drive, did the second car drop the trail and turning abruptly about, return downtown.

A few moments later the second car halted before an all-night drug store. Katie Ferguson alighted and paid and dismissed the driver. Then she made her way to the telephone booth in the store and called Rivers at his office.

"He has just gone home," said Katie, cryptically.

"All right," Walter replied. "That is fine. Grab a surface car and come up. Everything is set."

With nerves that tingled with anticipation Katie hurried out of the drug store and boarded a car. Fifteen minutes later she was in Walter's office. The young engineer had extinguished all the lights save the drop-light over his desk; the room was shrouded in mysterious shadows. Katie began to tremble, but Walter's quiet voice and unconcerned manner steadied her.

"Now tell me about it," she said, her inner excitement revealing itself in her voice. "What are you going to do?"

Walter smiled.

"Well, for one thing," he explained, "I'm going to give Madsen the scare of his life. For another, I'm going to make him a present of a conscience. I told you this was a conscience shop. Behold the conscience!" He pointed to the mysterious instrument on the laboratory table, and the odd spiral above it.

Katie shook her head.

"You will have to be more explicit, I don't understand at all."

"The idea is this—" Walter explained. "This instrument is a wireless telephone of the very latest type. It works without any overhead wires, except for this small spiral. The instrument we installed in the chimney yesterday is the receiving end of the same instrument with a loud speaking attachment. Whatever we say in this instrument is picked up and repeated by the one in Madsen's chimney."

Katie's eyes began to glow.

"You mean——?"

"I mean that at 11:30 we are going to hold a conversation with our friend Madsen. That is, I am going to hold the conversation. He is going to listen. He will have to listen, because we have figured that he will be sitting in front of his fancy fire place. As far as Madsen is concerned, my voice, which will in reality come out of the fire place, will seem to come out of space. Unless I miss my guess, it is going to give Mr. Madsen the shock of his life!"

He looked at the clock. There remained but a few moments of the hour he had set for the test. Walter tested the various parts of his instrument. Then he touched the switch and a generator beneath the table began to purr.

"That is where I get the current that transmits the waves from this spiral antenna through the air to the similar spiral antenna in the chimney," he said.

Continued on page 56

A Radio Primer

By H. A. Eveleth

THE RADIO TELEPHONE TRANSMITTER

TO transmit the complex vibrations of the voice and music there must be available a source of high frequency alternating current of constant amplitude to act as a carrier of the speech or music and a means to alter or modulate the wave form of the high frequency current to correspond to the vibrations of the sounds being transmitted. The high frequency or undamped oscillations are inaudible at the receiving station, but when these oscillations are modulated at the sending station similar variations occur in the wave form of the current received at the listening station and speech or music is reproduced.

Undamped oscillations may be generated by a suitable arc, by a high frequency generator or by the three-electrode vacuum tube. The tube method is the most practical and 5-watt, 50-watt and even 250-watt power tubes are available for generating undamped oscillations.

There are several ways by which the C. W. radiation of the antenna may be modulated. The method of absorbing power from the aerial may be easily understood. One tube, called the generator tube, is so connected that it generates undamped oscillations which set up by induction similar currents in the antenna ground circuit. A second tube, called the modulator, is connected in parallel or shunt with the generator tube, but in series with the grid of the modulator is connected the secondary winding of a transformer, the primary winding of which is in series with a battery and a microphone or telephone transmitter into which a person speaks.

Referring to the modulator tube, the resistance between the plate and filament depends on the potential of the grid and the potential will vary according to current variations in the microphone. More or less current will, therefore, be absorbed from the output of the generator tube. This will cause similar absorption of energy from the aerial-ground circuit and the changes in wave form will be detected at the receiving station.

In actual practice, motor-generators are usually used to furnish the filament current and the high voltage plate current. Condensers and choke coils are used as a filter to eliminate audible sounds caused by the commutator segments. In addition there must be variable condensers and inductances for tuning the different circuits and the whole system must be carefully tested to secure good modulation so that the speech or music will be clear and natural at the receiving station.

When concerts are broadcasted microphones with horn attachments are placed in proper locations in the broadcasting room and the walls and ceiling of the room are usually draped with cloth to prevent echoes and eliminate the distortion that would occur were this precaution not taken. Phonograph records are played by substituting a special microphone for the usual phonograph reproducer, the vibrations of the needle varying the resistance of the microphone.



Dr. Chas. P. Steinmetz and Senator Guglielmo Marconi during the latter's visit to Schenectady, N. Y.

WIRELESS STATION ABANDONED

Podhu, probably the most famous wireless station in the world, has sent its last message. "MBD," its famous sign call for which ships' operators have listened eagerly for the last nineteen years, is now replaced by "MFT," the sign of Clifden, the Irish station of the Marconi Company, which has taken up the duty of talking to people who go down to sea in ships, telling them at midnight what has been happening throughout the world during the preceding twenty-four hours.

Perched on the rockbound coast of Cornwall, Podhu has made history. It was the first high power wireless station to be built and from here the first wireless message was sent across the Atlantic with 2000-meter wavelength on December 12, 1901, to St. Johns, Newfoundland.

It was from Podhu, in 1920, that the first wireless telephony test between England and a liner at sea was carried out.

ANOTHER PRIZE CIRCUIT CONTEST

The publishers of RADIO have been authorized by the Winkler-Reichman Co. of Chicago, manufacturers of the "Thorophone," to offer a prize of $50 for a new or an improved circuit, giving the clearest and strongest reception of radio signals. As they stipulate that the winning circuit give as good a reception on a loop as does their A-10 circuit with an outside aerial, the prize winner will probably have to provide for radio frequency amplification, and thus may come within the provisions for the $100 Radio Frequency Amplification Contest now being conducted by the publishers of RADIO. On this account the closing date for both contests is extended to October 15, 1922. In the event that a circuit wins both first prizes the designer thereof will receive $100, with prizes of $25, $15 and $10 for the second, third and fourth contestants.

All apparatus used — tubes, variometers, variocouplers, condensers, etc.—should be of a type readily obtainable on the market. Each contestant should give a bill of material with his circuit, showing the make, catalog number and the manufacturer's address of all apparatus used in his receiving set. When possible, alternative equipment should also be named.

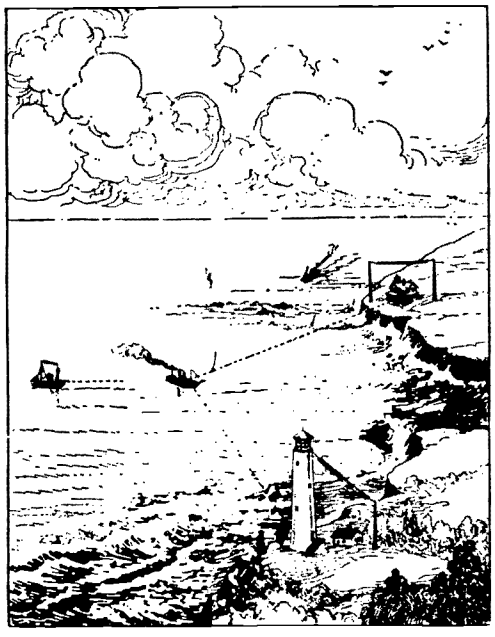
Contestants are required to submit manuscript written on one side of the sheet with all sketches and diagrams legibly drawn in ink on separate sheets. Photographs of completed equipment should accompany the manuscript. No consideration can be given to circuits that have been previously published, or to any one circuit that has not been successfully tried out in practice.

The publisher reserves the right to print all worthy ideas, not prize winners, at the usual space rates. No manuscript entered in this contest can be returned. The contest is open to any one, radio clubs included, except the manufacturers of radio equipment. Prizes will be paid upon publication. Address all communications to the Editor, care of this publication.

SUCCESSFUL TEST OF KOLSTER RADIO COMPASS

An official test and demonstration of the Kolster radio compass and position finder as an aid to navigating a fog-bound vessel was made Aug. 2 on board the lighthouse tender Sequoia around San Francisco Bay and outside the heads. H. W. Rhodes, superintendent of lighthouses, was host to a large party of Navy and Government officials as well as a score of steamship men.

Leaving the dock at 10 a. m., the Sequoia proceeded into the bay, where visual bearings and radio bearings were taken simultaneously. After charting these observations, and while the Madrona was still obscured by the morning fog, the Sequoia set her course and maintained it the entire distance to the Madrona, using the radio compass only to guide her to the anchorage.



Sketch Showing How Ship's Position Is Determined with Radio Compass

Again leaving the dock at 1:30 p. m., the Sequoia proceeded outside the heads, where the Madrona had preceded her, and carried out further tests successfully.

Later in the afternoon cross bearings were take on the San Francisco lightship and the Madrona, which had proceeded to a point off Duxbury Reef. During these runs Dr. Kolster was blindfolded and brought the ship back to her original course.

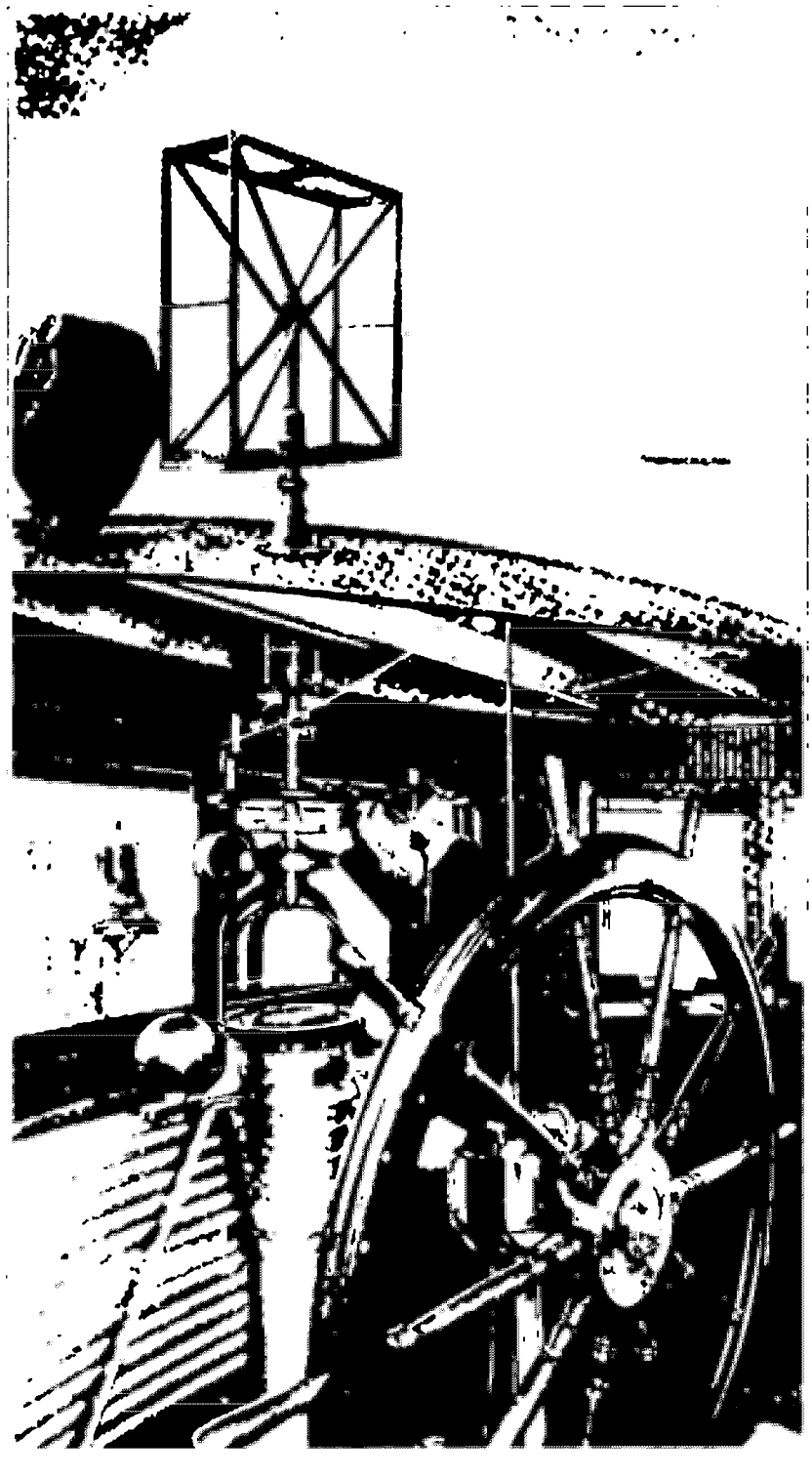
Members from the Ship Masters' Association were given an opportunity to use the compass, and, although inexperienced, were able to obtain accurate bearings.

The Bureau of Lighthouses has adopted the Kolster system of radio beacons on shore with the direction finder on board the ship in the hands of the navigator in preference to the system of placing the direction finders on shore. The San Francisco lightship is now permanently operating as a radio beacon station and additional Pacific Coast radio beacon stations have already been authorized for Cape Flattery, Columbia River, Blunt's Reef and Los Angeles. It is intended to make additional installations of the radio beacon stations along the coast as soon as practicable.

Dr. F. A. Kolster, inventor of the system, and representatives of the Federal Telegraph Company, manufacturers of the apparatus, were on board the Sequoia to explain to shipping men the operation of the system.

By means of the Kolster radio compass mariners can make their way into port in a fog without sending wireless messages to the stations on shore. The instrument is operated by the captain in the pilot house of the ship and the course is set for the lightship in spite of the fog.

A radio telephone circuit between Copenhagen and Bornholm was recently opened to the public. The arc system is used for transmission and the rates charged are lower than for similar service by telegraph.



Kolster Radio Compass Installation on the "Sequoia"

"And It Came To Pass ---"

Wherein Radio Liars Cometh Up for Discussion

By S. P. W.

AND it came to pass that a certain ham was appointed a statistician in the city of the government; even one of those who hath at his tongue's tip data of great interest, like unto the fact that if all the spaghetti manufactured in the United States in three weeks were placed end to end it would reach from New York City to Oshkosh, Wis., should anyone wish to follow it that far. And the combination of a radio man and a statistician in one was fearful and wonderful.

He setteth himself to determine the number of tubes burned out in a year, and the results maketh him wish that he were De Forest. He maketh notes on the number of times that "O M" is heard in the air in seventeen evenings, and lo, the number runneth off the right side of the paper. He noteth the number of hams who asketh "How is my tone?" and gives thanks that C. W. maketh this query unpopular. He maketh many and divers compilations, and learneth much.

One day the Chief, even he who was in charge, cometh unto him and saith, "The word hath gone around that the followers of Radio are liars, every one, and it is desired that this blight upon the moral life of our country be investigated." And speaking further, he delegateth our friend to look into the matter. The report followeth:

The belief that all radio men are liars is found to be indeed well founded, for the writer hath traveled the length and the breadth of the land, and lo, they all telleth tall stories. And the nature of these radio liars (for each class falleth into a group by itself), is various, in this wise:

The radio liar whom we all knoweth is he who maketh up wonderful tales of distant parts wherein his call hath been picked up. He enlargeth upon his DX operation at all times; he disregardeth the report post-cards he receiveth, for he careth not for facts. He talketh boastingly before beginners, and speaks knowingly of "reaching out." In club meetings he addresseth the chair and all and sundry on the rights of "us DX men." He carryeth around cards from stations that reporteth him from distances of two or three hundred miles, and claimeth to have many more at home, which haveth a way of becoming mislaid. And of all radio liars he is the most numerous and the most harmless, for lo, all wise operators knoweth him, and heedeth not his empty words.

And in the second place cometh the married-ham liar, and indeed his sins are many and various. He telleth his wife that he cometh home at 9 o'clock when he leaveth for radio club meetings, and he returneth not till 11. His wife asketh him how much his new two-step costeth and he saith $8. She reproacheth him for the new tubes he buys, and he explaineth that they are only four bits per. He spilleth acid on the rug, and claimeth that it doeth it good. He promiseth his wife a new hat, and lo, the money goeth for a new panel and a pair of Baldwins. He condoleth with other hams who hath taken unto themselves wives, and claimeth that *his* wife loveth his radio, and encourageth him to spend his time humped over the operating table. Yea, the perfidy of the married radio liar knoweth no bounds; he telleth the tax assessor that the radio set is merely a bunch of worthless junk, albeit, the latter sin is confined not to married hams! (Nor, saith some, is it a lie!)

The operator of the spark station blinketh the lights for a block, and agreeth with his wrathful neighbors that the service is rotten. He causeth sparks to jumpeth out from the gas stove in the house of the folks next door, and calmeth them by saying that it is only their personal magnetism leaping to a ground. He causeth various uproars in the telephones of his neighbors, and then taketh the lead in asking them if they noticed the horrible noise, and lo, they suspecteth him not, as was his aim. He bloweth fuses in his own home continually, and telleth his father that it is due to the culminative effect of mother's new percolator. And his father, having respect for the wisdom of his first-born, believeth him. He telleth his dad that he getteth an "A" in four subjects, so that he getteth that new rotary and signeth his father's name to a report card that beareth as its highest mark a "B—." He truly is an Ananias the Second.

The new owner of a radiophone receiving set becometh a most proficient, albeit innocent, liar. He telleth of the many and mighty carrier waves he picketh up, and lo, it is only his tubes howling. He saith that he heareth long distance telephones (very faint ones, that surely cometh from afar off), when it is only young Winters in the next block experimenting with a microphone in the ground lead of his receiving set. He denieth indignantly that he is causing trouble by using an oscillating regenerative set, and sweareth that his is a Westinghouse, and not an oscillating regenerative. He almost persuadeth his dealer to make good a tube that burneth out with half the rheostat in the circuit, until the dealer learneth that the battery in use was "the small one," as "the current consumption of the filament is very low" and the plate potential quite high, according to the instruction books. He lieth convincingly because he lieth unknowingly; truly he is a lovable liar, and the time will soon come when he will lie with intelligence and understanding, as becometh a real ham.

Of late there hath sprung up a new variety, and he is called the dabbler in C. W. Truly is he a great liar, for he claimeth that he hath discovered an electrolytic rectifier that heateth not up. He cutteth up his mother's favorite saucepan for aluminum, and the water-pipe for lead; when they are found to be missing he calmly layeth the blame on the junkman. He contendeth that his modulation is good in the presence of divers and enthusiastic witnesses to the contrary. He causeth weird gurglings and howlings and sputtering and rasping in the air, so that the ears of his fellow hams are blasted, yet he stateth that he doeth no such thing. He burneth out divers 5-watters, and replaceth them hastily, fearing to admit his ignorance in burning them out. He laugheth at spark stations and calleth them obsolete and old-fashioned, asking the owners thereof where their magnetic detector is, and other questions in the same spirit. He even claimeth that he hath a good I. C. W. scheme that is efficient, simple, cheap and that giveth a good and steady tone. Truly, he is a mighty liar.

Thus concludeth the report of the investigator, who submiteth it to his superiors with the feeling of having accomplished a good job. But lo, and the end was not yet, for his chief calleth him upon the carpet and saith unto him, "Thinketh thou that this report is complete. Wherefore hath thou found not the radio liars who write some of the copy we see in the daily papers? Art blind? And by what token hast thou neglected to report on the radio liar who filleth out his government license blanks with information on a set that existeth only in his imagination, and diagrameth an aerial that would be his were it altered in some five or six ways? Hast thou never been an amateur? And how come——" his chief continueth for an hour.

And our hero returneth to his office, and he sitteth there wrapped in thought for many hours, and then rewriteth his report in this wise:

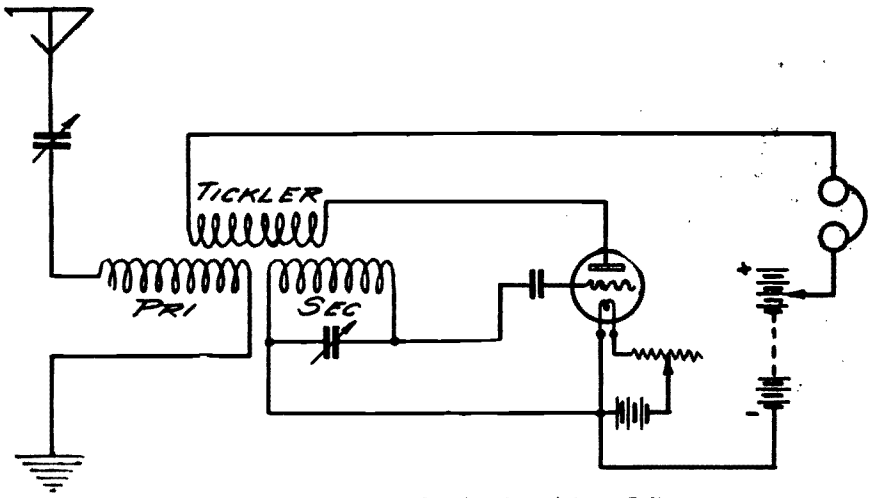
"It is written that 'All men are liars.' That goes double for radio men."

And lo, he hath said a mouthful!

A Regenerative Set with "Duodirectional" Tickler Coil for Short Waves

By B. F. McNamee

BEFORE describing this set, let us say a word about connecting tickler coils. It is a familiar fact that if the current flows in the wrong direction through the tickler coil the signals will be weakened instead of strengthened by it. To be sure, there is a method of figuring out the proper way of connecting it up, but most of us simply try it first in one direction and then in the other, and compare results. The trouble with this method is its inconvenience, and the fact that it sometimes leaves us in doubt as to the right direction when we test on certain signals.



Hook-up for "Duodirectional" Tickler Coil

Some experienced amateurs have adopted the following rule: first place the two wires on the tickler terminals the way you think they should go and then, before fastening, reverse them, on the theory that you're sure to get them wrong the first time.

The following is a description, with dimensions, of an excellent short wave regenerative set in which the tickler coil cannot be connected in the wrong direction. The additional excuse for this article is that the set can be made with a minimum of time and expense.

Take a 4-in. diameter cardboard tube about 6 in. long and shellac it inside and out. For the primary wind 45 turns of No. 20 or 22 double cotton covered copper wire and bring out the two ends only. The primary and secondary windings are to be placed end to end on the same tube, so start the primary winding near one end. Start the secondary winding about half an inch from the end of the primary. The secondary consists of 30 turns of any small size of insulated wire wound with the turns slightly separated; No. 26 or 28 cotton or silk covered will do. The turns may be separated by winding a heavy thread with the wire. No taps are taken on either coil.

The tickler consists of 70 turns of any small insulated wire (the writer used No. 32 double silk covered) wound on a cardboard tube, or turned block of wood, just small enough to slide back and forth inside the 4-in. tube with clearance. This clearance should not be greater than one-eighth of an inch all around; a smaller clearance would be better.

The method of mounting the coil and tickler is left to the builder; for experimental purposes they can be successfully used without any mounting. The tickler coil must be capable of sliding at least the full length of the outer tube.

The series condenser in the aerial circuit has a maximum capacity of .0005 mfd., and the shunt secondary condenser is .001 mfd. maximum. With these values this set will work efficiently and regenerate or oscillate on wave-lengths from below 200 to above 600 meters.

If used with an amplifier, the primary of the amplifying transformer should be shunted by a fixed condenser of about .0005 mfd. capacity.

Now for the special tickler feature. Connect the tickler coil in any direction you please. Try it under the secondary; if it works there, O. K., but if it doesn't, simply slide it under the primary and it's sure to be right.

The answer is that the current at any given instant in the primary is flowing around in the opposite direction to the current in the secondary; consequently if the tickler current is in the wrong direction for one of them, it must be right for the other.

ANNOUNCEMENT OF UNIVERSITY OF CALIFORNIA EXTENSION DIVISION

CORRESPONDENCE COURSE IN ELEMENTARY RADIO

By Ellery W. Stone

The text for this course will be published in RADIO (Pacific Bldg., San Francisco), commencing with the October, 1922, issue and running for seven months thereafter. Questions covering each assignment will be supplied and corrected by the Extension Division of the University of California, 301 California Hall, Berkeley, to whom all requests for enrollment should be sent. The enrollment fee for the entire course is $7.00, which includes a subscription to RADIO during the period that the lectures are published.

There will be fifteen assignments in accordance with the following outline:

1. Electronic Theory of Matter; Electrical Definitions.
2. Radiation; The Family of Electromagnetic Waves.
3. Radiators and Receivers; the Antenna-Ground Circuit.
4. Tuning.
5. Single and Double Slide Tuners; Variable Condensers.
6. Loose Couplers; Variometers.
7. Detection; Crystal Detectors.
8. Telephone Receivers; Loud Speakers.
9. The Vacuum Tube as a Detector.
10. The Vacuum Tube as an Amplifier.
11. The Armstrong Principle of Regeneration.
12. Tube Transmitting Circuits for Radiotelephony.
13. Tube Modulating Circuits for Radiotelephony.
14. Radiopone Broadcasting.
15. Practical Hints for Radiophone Reception.

A RADIOPHONE WITHOUT A WAVELENGTH

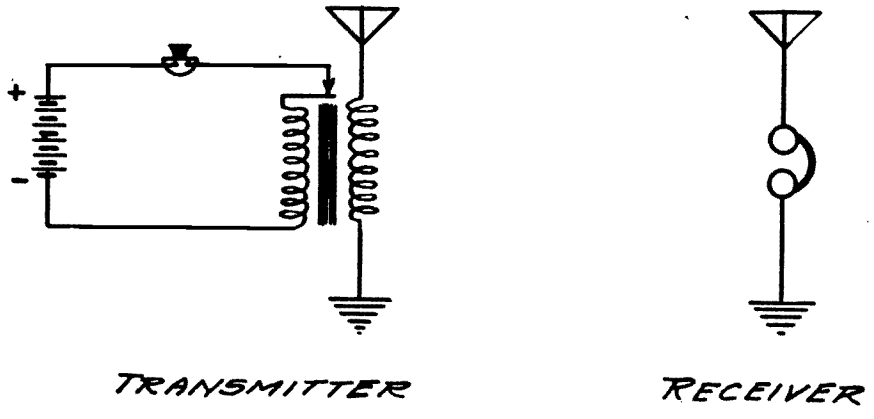
By LYNDON F. SEEFRED, RADIO 6EB

FOLLOWING is a simple experiment showing how one may talk by voice over the radio and still not interfere with radio telegraphy. There is also no wavelength to this system, as it could not be heard on an ordinary radio receiving set. The receivers were connected between the antenna and ground at the receiving end.

Voice was heard distinctly until the arc lights were turned on at the street corners and interfered with same. Voice could be heard approximately 100 feet from the transmitter with just a pair of "Brandes Superior" 2000-ohm receivers and by holding one of the terminals of receiver cord in my hand. Later I walked down the street and still holding one terminal of cord, I connected the other to grounded guy wires of electric light poles and still heard the voice clearly. Finally, being at a distance of two blocks, I was only able to hear the voice faintly. Then I went over to an amateur radio station one-quarter of a mile away, where there was a good-sized four-wire antenna. I connected the receivers across the antenna and ground, and the voice was heard again very plainly.

With a little experimenting I believe one could use a large X-ray coil with necessary condensers or a small extra transformer to keep the high amperage from burning out the transmitter, and talk much greater distances with such a hook-up and a few alterations.

The following is a hook-up and the important instruments used:



Hook-up for Radiophone without a Wavelength

1. Antenna—Four wires No. 12 soft drawn copper, 400 ft. long, counting lead-in, and 15 ft. spreaders. Poles—45 and 50 ft. high, respectively.
2. Ground—Water-pipe and wires buried.
3. A ¾-in. "Splitdorff" spark coil with vibrator screwed up tight.
4. Long distance transmitter.
5. Seven Columbia dry cells.
6. The receiving equipment is described previously in this article.

Using the same transmitting instruments with the exception of an antenna and ground, a one-wire line telephone was tried out with success, the voice sounding "ghostly-like." Connect one terminal of the secondary to the line and leave the other blank.

A TWENTY KILOWATT VACUUM TUBE

By DR. IRVING LANGMUIR

IT has long been realized that, following out the principles made use of in the smaller tubes, it would ultimately be possible to construct tubes of large power. There have been many difficulties to overcome, however. After years of work by W. C. White and H. J. Holte, they have succeeded in designing and perfecting pliotrons which are capable of generating about 20 kw. of high frequency current. In principle these tubes resemble the smaller tubes which are now usually called radiotrons, in that they also have three electrodes. These large tubes are used in circuits much like those used by amateurs when they cause the tube to generate oscillations. In the construction, however, there are many differences.



Dr. Langmuir with 20 kw. Radiotron and Peanut Tube

The 20 kw. tube has a very large, rugged filament, many times the diameter and length of the ordinary radiotron. The grid is in cylindrical form and surrounds the filament, and the plate is a metallic cylinder about 1½" diameter and 8" long, which is sealed directly to a glass tube through which pass the leads carrying current to the filament and grid.

Thus the plate, instead of being inside the tube, as in ordinary radiotrons, forms a part of the outside wall of the tube. In order to dissipate the relatively large amount of energy liberated at the plate, the plate is water cooled, which is rendered particularly easy by the fact that part of its surface forms a part of the wall of the tube.

These 20 kw. tubes are ordinarily operated with about 20,000 volts d. c., which is obtained from ordinary 60 cycle alternating current by rectification, using two or more kenetrons, together with large condensers for smoothing out the rectified alternating current.

A bank of ten tubes of this kind operated in parallel is capable of generating 200 kw. of power, which is about all that is required for most transoceanic radio communication. It is probable that outfits of this kind will displace the larger and more expensive alternators, the most successful type of which has been the Alexanderson alternator.

The 20 kw. tube merely marks one stage in the development of still larger tubes. It will undoubtedly be possible when the need arises and when the necessary development work has been completed, to construct tubes of many hundreds or even thousands of kilowatts. Such devices will probably be used not merely for radio purposes, but may ultimately play an important part in such problems as the electrification of railroads and the transmission of power to long distances by means of direct current.

CONTROLLING IRRIGATION BY RADIO

Radio control of an irrigation project comprising some 200,000 acres in Arizona is the latest use to which radio has been put by the government. The Salt River Valley Water Users' Association has installed a radio equipment at the head of the Verde River, their natural water supply. There is no railroad or means of communication between Phoenix, Arizona, and the upper reaches of the river, where sudden storms cause the ordinarily low water to rise with great rapidity, frequently flooding the ranches and farms below and causing enormous damage. Gauges are placed in the upper Verde and also at Cave Creek, so that any appreciable rise can be noted and broadcasted from the station to the manager's office in Phoenix, and to all ranch owners who listen in.

An Amplifier with A. C. Filament and Plate Supply

By P. D. Lowell

Associate Physicist Bureau of Standards. Adapted from July, 1922, A. I. E. E. Journal

WHEN an electron tube is used as the detector with a. c. supply, there is impressed on both the plate and the filament a 60-cycle hum which, although small, becomes very objectionable when amplified by one or two stages of audio-frequency amplification. When a crystal detector is used with radio-frequency tube amplifier no 60-cycle voltage is supplied to the detector circuit. The radio-frequency transformer whose output is delivered to the detector circuit prevents the passage in any appreciable amount of 60-cycle current supplied to the radio-frequency stage, and such voltages are not present in the crystal detector circuit and do not reach the input of the audio-frequency stage.

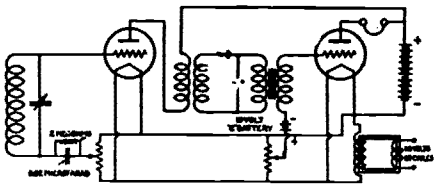


Fig. 1. Two-Stage Amplifier Using Crystal Detector

The employment of a crystal detector may at first seem objectionable, since with the crystal as ordinarily used, it is rather difficult to find a point of good sensitivity. But tests on this amplifier show that careful adjustment of the crystal detector is not necessary, because the radio-frequency amplification preceding the detector usually gives sufficient signal strength, so that a point of sufficient sensitivity can be easily found.

This circuit, as shown in Fig. 1, gives quite good results. The 60-cycle hum is practically eliminated and the crystal detector gives almost as good rectification as the tube detector. It is found that better amplifying action can be obtained by inserting condensers of about 0.02 microfarad capacity, shunted by 2-megohm grid leak resistances in the grid circuits, in series with the sliders of the balancing resistances. The grid condensers and grid leak resistances allow the grids to assume a normal voltage which is more favorable for amplifying purposes. The leak resistances allow any accumulated charge on the grids to leak off to the filaments.

Still better amplification and quieter operation was produced by replacing the series grid condenser and leak in the audio stage with a 10-volt battery giving a negative charge to the grid. A battery of dry cells was used for this purpose; since only an extremely small current is required, the life of the dry cells is practically their shelf life. This gave a circuit as shown in Fig. 2.

Alternating current rectified by means of a gas-filled two-element rectifier tube (a "Tungar") was tried as a source of filament power, but the residual hum was much greater than when unrectified alternating current was used. This is because of the fact that during rectification the wave form becomes distorted and it becomes impossible to stabilize the grid voltage by means of the balancing resistances.

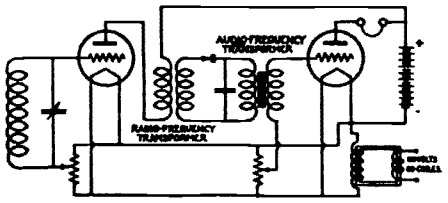


Fig. 2. Two-Stage Amplifier Using Crystal Detector with Grid Condenser for Radio Stages and Grid Battery for Audio Stages.

In the above-mentioned tests a plate battery was used for convenience, but this was replaced by alternating current, which had been rectified by means of an electron tube and smoothed out with condensers of large capacity. The rectification circuit for the plate voltage supply is shown in Fig. 3.

In Fig. 3 the primary P of the transformer T is connected to the power mains, and winding R gives 8 volts for the filament of the rectifier tube W. Winding S gives 300 volts, which is rectified by the tube W and smoothed out by the condenser Q, which has about 10 microfarads capacity. This gives at terminals M and N a high-voltage direct current, which is quite suitable for use on the plates of the amplifier tubes. Rheostat Z varies the brilliancy of the filament of the rectifier tube and, simultaneously, the voltage for the plates.

The use of a loud-speaking telephone receiver, such as the "Magnavox," was made possible by applying to the field coil of the loud speaker an alternating current rectified by a "Tungar" rectifier tube. The impedance of the field coil was sufficient to smooth out the pulsating current to such an extent that the hum was not annoying. It was also advantageous to couple the loudspeaking reproducer circuit to the plate circuit of the last amplifier tube by means of a one-to-one ratio telephone transformer with a 0.02-microfarad condenser in series with the telephone circuit. This helped considerably to reduce the residual hum in the telephones.

The final circuit is shown in Fig. 4, and included three stages of radio-frequency amplification, loud-speaking reproducer, and the necessary power transformer and rectification circuits.

This final circuit gives good amplification, with a slight residual hum which is not great enough to be objectionable

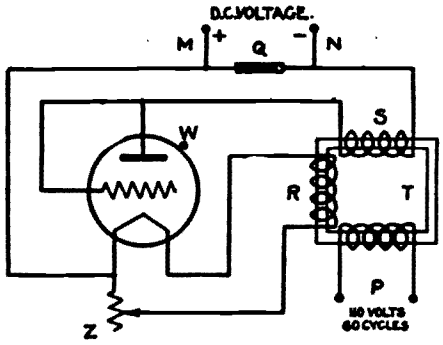


Fig. 3.—Rectification Circuit for Plate Voltage Supply

when receiving signals of ordinary readable strength. The residual hum is, of course, more objectionable when extremely weak signals are being received. Radiotelephone music and conversation are clearly reproduced.

The amplifier was operated under normal conditions, using the usual

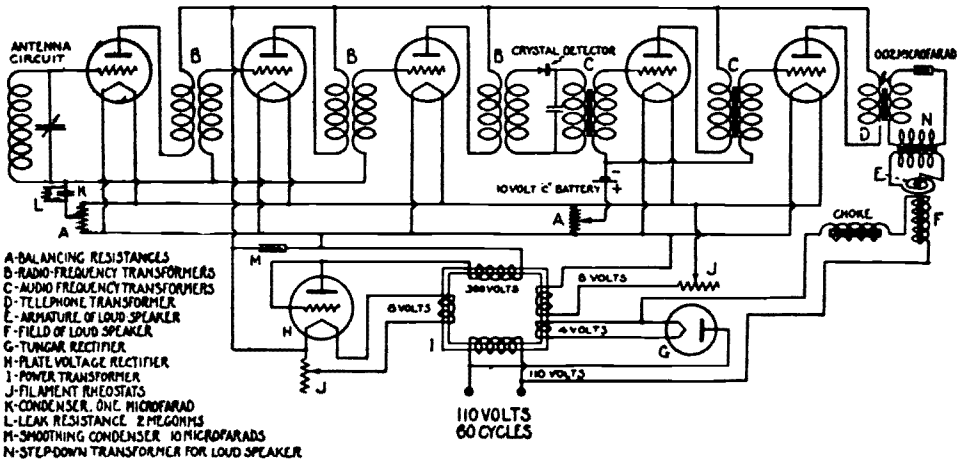


Fig. 4. Five-Stage Amplifier Using Crystal Detector

sources of direct-current supply, and then switched over to alternating-current supply. This comparative test showed the a.-c. supply to give as good amplification as the d.-c. supply.

For the reception of damped waves, the amplifier as constructed operated most satisfactorily for frequencies from 400 kilocycles to 1500 kilocycles per second (750 to 200 meters). This frequency range was determined by the working range of the radio-frequency transformers used. By using suitable radio-frequency transformers, it is expected that the amplifier will be effective for the reception of damped waves for frequencies as low as 30 kilocycles (10,000 meters). This amplifier has also been found effective for the reception of undamped waves when used with a separate heterodyne.

The special transformer with five windings and the rectifier tube were assembled in one box, and the amplifier tubes and amplifier transformers and other apparatus were assembled in a separate box. This was done to avoid having the amplifier immediately adjacent to the special transformer, from which it would pick up considerable 60-cycle hum. The assembled rectifier unit measured about 8 in. by 9 in. and weighed about 21 pounds. The assembled amplifier unit measured about 8 in. by 11 in. by 14 in. and weighed about 21 pounds.

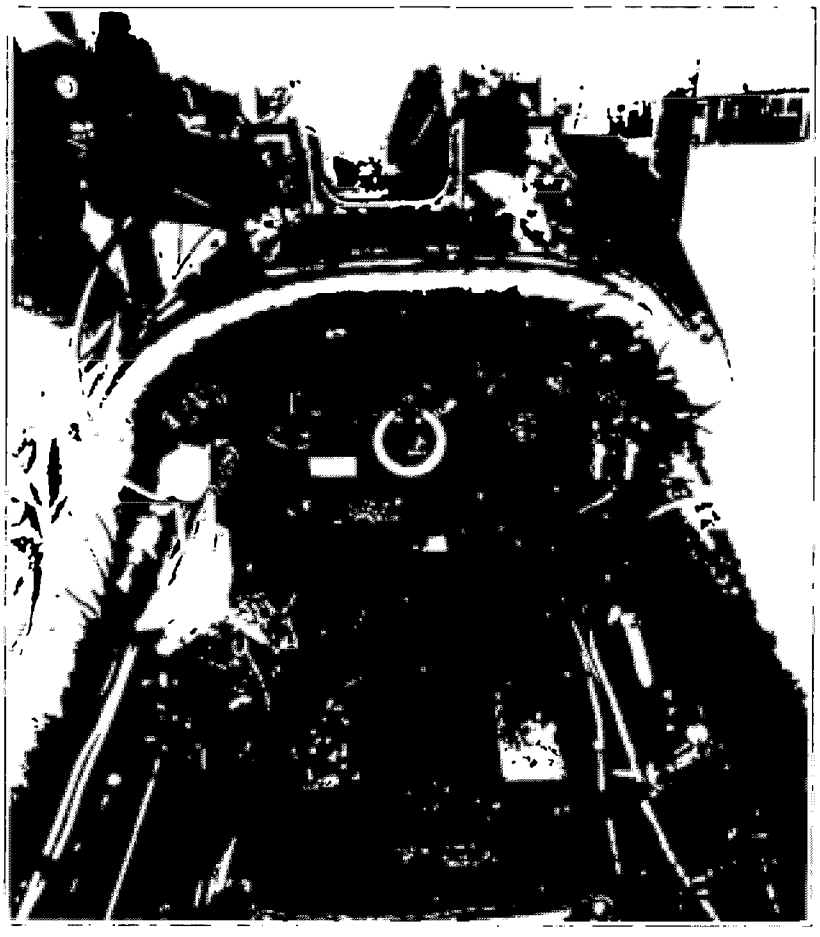
DUPLEX RADIO-TELEPHONE SYSTEM ON AIRCRAFT

By S. R. WINTERS

The transmission and reception of radio-telephone messages simultaneously from aircraft in flight are possible by an arrangement recently devised by the Air Service of the United States Army. Heretofore wireless installations on air-going machines have been primarily for the purpose of receiving messages. It was in this capacity that radio-equipped aircraft were so useful in scouting over enemy-occupied territory in the recent World War.

The twofold service—transmitting and receiving—afforded by recent installations of specially-designed radio-telephone outfits is known as the duplex system. Two electric generators are employed, with the introduction of a new change-over switch, which obviates the use of several instruments heretofore installed with the conventional installation of SCR-73 set. Two antennas are required, one for the transmitting and one for the radio-telephone receiver, but the sending and reception of music or vocal speech can be negotiated at the same instant.

Preliminary tests of aircraft thus equipped have been conducted, the results at reasonable distances being satisfactory. Long-range tests have not been made as yet, although it is probable that this duplex system may demonstrate its efficiency when subjected to distant assignments. Already music has been successfully relayed from a radio-telephone on the ground to aircraft soaring 4000 ft. in the air.



Installation of Radio Set on DH4

Official Photograph U. S. Army Air Service Photographic Section

ARMY AIRSHIP SETS

Army plans for new radio sets for their semi-rigid airships call for central power stations which would include generators geared to gasoline engines, after the fashion in which a magneto is driven, but never before attempted. The French tried out belt-driven electrical generators, but with little success. However, representatives of the Air Service Engineering Department at McCook Field expect to develop a central power plant that will give sufficient power for putting ½ kw. in the antenna and also power for lighting, heat and electrical control work.

The Army Air Service plans to use the new Signal Corps set 135, combining radiophone and telegraph circuits good for distances up to 75 miles and 200 miles, respectively. The range will be greater than is planned for the big Martin bombers, however, as better facilities for erecting aerials are available on airships than on planes. One method considered is to install the antenna within the envelope; another is to suspend it below the ship, drawing it up upon landing; while a third contemplates hanging the wires of the aerial along the sides and over the top of the ship. Experiments will determine which of these methods is the most efficient.

Naval radio experts are loath to reveal their definite plans for the radio equipment of the ZR ships, but it is said that they may parallel the Army's ideas, although their ships will be about twice the size of the largest Army semi-rigids now planned, giving them more latitude and more room for equipment.

TUBES NOW AVAILABLE FOR SHIPS

F. P. Guthrie, head of the Radio Division of the Shipping Board, states that all privately owned ships, as well as Government operated vessels, may now be equipped with a special receiving tube which will be produced by the Radio Corporation to sell for $10 each. The tubes, which can also be used for amplifying and transmitting, will be a big improvement over the crystal detectors and spark transmitting sets now in use. Heretofore the Radio Corporation has refused to sell its tubes except to amateurs and for experimental use.

Radio Equipment at KDKA

By D. G. Little, Radio Engineer Westinghouse Electric & Manufacturing Co.

KDKA, the Westinghouse broadcasting station at East Pittsburgh, Pa., has gradually grown since November, 1920, until today it has a power output of 1000 watts. In keeping with the growth of the station a special studio was arranged for the artists and announcer, particular attention being given to the acoustic properties, so that echoes, reverberation and other disturbances have been largely eliminated. The usual carbon microphone has been replaced by a condenser type transmitter for picking up the sound waves. Resistance coupled amplifiers are employed for increasing the relatively weak output of the pick-up transmitter to a power sufficient to control the radio set. The natural oscillating frequency of all the units in the pick-up and amplifier system has been placed, so far as possible, outside of the audio frequency range, so that the radio signal is practically a perfect reproduction of the original sound. Special filter circuits are arranged to eliminate generator hum in the power supply to the radio transmitter.

The path of the speaker's voice from the studio to the receiving station is shown in diagrammatical form in Fig. 1. The sound wave picked up by the transmitter in the studio, theater or church is amplified before it is transmitted by means of a telephone line to the radio station, where it is further amplified and used to control the output of the radio transmitter. The radio transmitting set is supplied with power directly from the works' power plant through a step-down transformer for the vacuum tube filaments and through special motor generator sets, which change the 220 volts direct current to 2000 volts direct current for the tube plates. The radio transmitter changes this power from 2000 volts direct-current to alternating-current power at a frequency of 833,000 cycles per second (360 meters wavelength) which is supplied to the radiating system, consisting of an antenna and counterpoise.

A general view of the radio transmitter now in use at KDKA is shown in Fig. 2. This set furnishes about one kilowatt high frequency power to the antenna. Fig. 3 shows the circuit diagram. For convenience in studying the circuits represented by Fig. 3, which carry a wide variety of frequency, this diagram has been divided into four sections by means of the dotted lines at the right. The lower section, which may be considered as the power supply, carries only direct current at 2000 volts and low-voltage alternating current at 25 cycles. This 25-cycle current is used only for heating the filaments. To prevent any of the 25-cycle current being superimposed on the grid-filament and

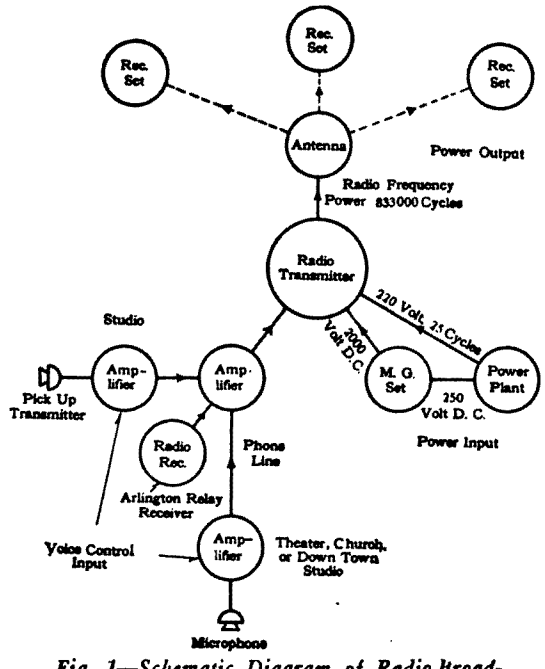


Fig. 1—Schematic Diagram of Radio Broadcasting Station

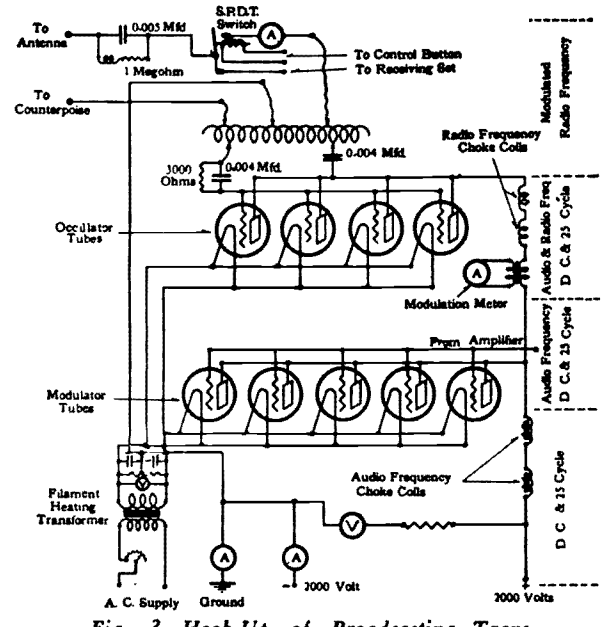


Fig. 3—Hook-Up of Broadcasting Transmitter

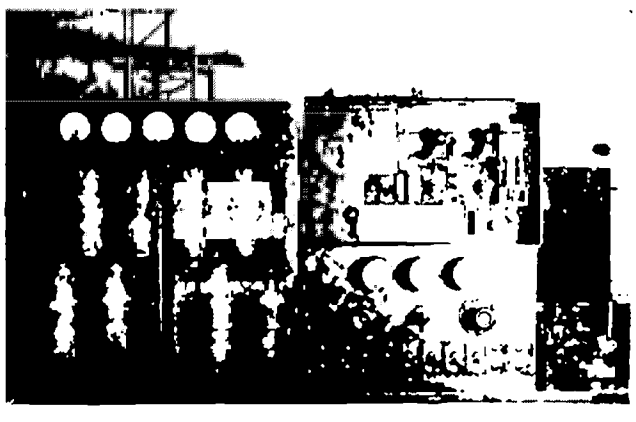


Fig. 2—General View of Equipment in the Operating Room

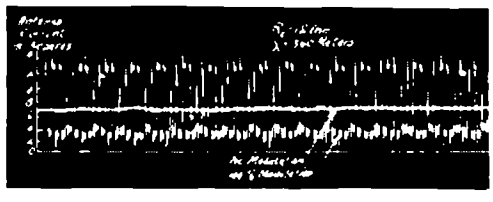


Fig. 4—Oscillogram of Rectified Antenna Current for Modulation of Vowel a

plate filament circuit, the return of the grid circuits and the 2000 volt circuit is connected to the mid point of a resistor, which is shunted across the filament, each half of the resistor being shunted by a condenser for by-passing the radio and audio frequency circuits.

In the next section of Fig. 3, in addition to the power circuits described, audio frequency voltage is impressed upon the grids of the modulator tubes, varying the potential of these grids with respect to their filaments according to the voice waves, through the medium of the pick-up transformer and amplifiers.

The four 250-watt power tubes in the upper part of the set are the oscillators, which, in conjunction with the condensers and oscillation transformer, change the 2000-volt direct-current power into alternating-current power at 833,000 cycles, thus generating the carrier wave, which is impressed on the antenna through a remote controlled double throw switch, which allows the same antenna to be used for receiving when the station is not broadcasting. The amplitude of the radio frequency wave thus generated is constant as long as the plate voltage remains constant, and fluctuates with the plate voltage when the latter is varied. Thus, the upper section of Fig. 3 carries only modulated radio frequency waves, while the third section carries both radio frequency and audio frequencies, in addition to the 2000 volt direct-current and the 25-cycle alternating-current power circuits.

The function of the five modulator tubes, also rated at 250 watts each, is to vary the voltage on the plates of the oscillator tubes according to the voice frequency impressed upon their grids by the speech amplifiers. This system is known as power modulation, the modulation being accomplished by means of the constant choke coil in series with the positive lead to the modulator and oscillator tube plates. The modulator tube grids are held at a static potential of 80 volts negative with respect to their filaments, by means of a battery. The audio frequency from the speech amplifier then adds to or subtracts from this 80-volt grid potential. At an instant when the modulator tube grids have impressed upon them by the amplifiers a low negative, or zero potential with respect to their filaments, the tube impedances from the plate to the filament are low and a large plate current flows in the 2000-volt direct-current circuit to the modulator tube plates. Because of the very large inductance (50 henries) of the audio frequency choke coils in series with the plate supply, the total generator current can change very little in a brief interval of time. Hence, part of the generator voltage occurs across the choke coils, thus lowering the voltage impressed on the oscillator tube plates and hence the radio frequency output of the set. The next instant, when the modulator tube grids have a high negative potential with respect to their filaments, the plate impedances are high and little or no current flows through the modulator tubes. The choke coils, tending always to keep the total generator current constant, create a voltage which adds to the generator voltage and thus forces most of the current into the oscillator tubes, which increases the radio frequency or antenna output accordingly. In this way the audio frequency choke coils cause the voltage applied to the oscillator tube plates to fluctuate in proportion to the speech voltage impressed on the grids of the modulator tubes by the speech amplifier. As the amplitude of current in the antenna varies directly with the plate voltage on the oscillator tubes and as this voltage varies from nearly zero to 4000 volts, the antenna current varies accordingly. Fig. 4 shows an oscillogram of rectified antenna current taken when the announcer is speaking loudly into the pick-up transmitter. It is seen that the antenna current varies from nearly zero to nearly twice its no talk value. This variation in antenna current at voice frequency is know as modulation.

The radio frequency choke coils in series with the oscillator tube plates serve to stop any radio frequency from entering the modulator and power supply circuits. These choke coils are of air core construction and are about five millihenries inductance each. They thus offer a high impedance to the radio frequency, but negligible impedance to the audio frequency.

In order to indicate the amount of modulation, a so-called modulation meter has been developed. This consists of a current transformer, the primary of which is connected in series with the direct-current supply to the oscillator tube plates and the secondary of which is connected to a thermo-ammeter. The transformer ratio is such that an audio frequency variation in the direct-current from zero to twice its normal value gives full scale deflection. An air-gap is provided in the transformer core to prevent saturation due to the direct-current component of the plate current. The meter has a current scale marked from 0 to 100 per cent modulation. When the announcer is speaking into the transmitter the modulation meter averages about 40 per cent with maximum

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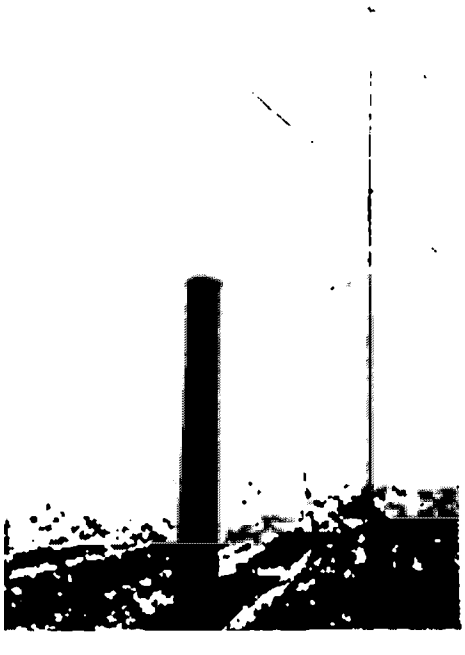


Fig. 5—Antenna at KDKA

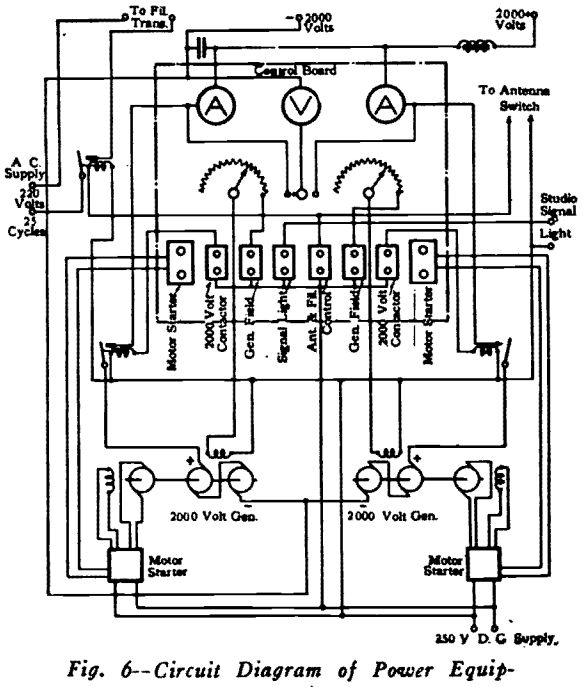


Fig. 6—Circuit Diagram of Power Equipment

LETTERS TO THE EDITOR

Radio Fire Caused by Lightning

Sir:—On July 14th the following item appeared in the New York *Evening Journal:*

A fire caused by lightning striking the radio set of Charles Down, of No. 410 West Forty-fourth street, was said today to be the first of its kind.

The set was near the window of a room on the top floor of the apartment house. Down, who is an electrician, blamed the lightning arrester for the blaze.

While the small instrument worked successfully during the many electrical storms of last month, Down said yesterday's static was too much for it.

On the other hand, Dr. Alfred N. Goldsmith, Professor of Electrical Engineering at City College and director of its laboratory, did not think Down's theory plausible. He regarded the occurrence as "almost a phenomenon," and believed that a heavy bolt of lightning penetrated the porcelain-shelled arrester and struck the inside aerial.

Another explanation offered by Dr. Goldsmith was that Down's ground wire, which connected with a water pipe, was not properly adjusted.

When Down arrived at his apartment after firemen had extinguished the small blaze, he made a careful examination of the apparatus and found the outside aerial and the roof antenna in perfect condition.

On the ledge outside the window was the arrester and ground wire.

"Instead of jumping the gap to the ground," said Down, "the electricity went through the indoor aerial. The lightning seemed to be of greater voltage than at any other time since I installed the set and the static in the air was apparently heavier than the arrester could bear."

The rubber insulation covering the aerial from the arrester to the set was completely burned off, but no harm came to the ground wire. Recently adopted rules of the Board of Fire Underwriters make it permissible to connect grounds to the inside of a building instead of having them extended to the earth on the outside. Down's connected with a water pipe in his bath room.

Since the fire I have had this "arrester" tested by the New York Board of Fire Underwriters and they found that the arrester was full of water (from rain), which should help and not hinder the path of current, but regardless of this, on testing same it refused to pass current until the voltage reached 1240, whereas it should operate at 500 volts or less.

Arrester was outdoor type and was on window ledge with antenna and ground leads coming through casing of window in a ¾-in. porcelain tube, ground lead going to cold water pipe in bathroom (10 ft. long) and antenna to set with another ground wire from set to same water pipe but two separate ground clamps.

Underwriters' inspectors said it was put in in an approved manner.

The attached sketch gives an idea of the hook-up.

The leadin wire from antenna was burnt to a crisp but the ground wire was only burned for about 15 in. Current followed antenna leadin to set, passed through coupler to ground side and fused the shielding on panel, tearing several holes ranging from ⅛ in. to 1 in. in size, burned base board and discolored wiring and back of panel, proving the ground wire from arrester received no current to speak of. Otherwise why take the path of fine wire in set in preference to a nice No. 14 wire with a first-class ground at the end of 10 ft. Showing that everyone should use a single pole double throw switch as well as an arrester.

Damage to set and other apparatus on table was about $150; burned coupler, Atwater-Kent potentiometer, phones (not connected) two pair, four tubes A. P. and several other pieces of apparatus.

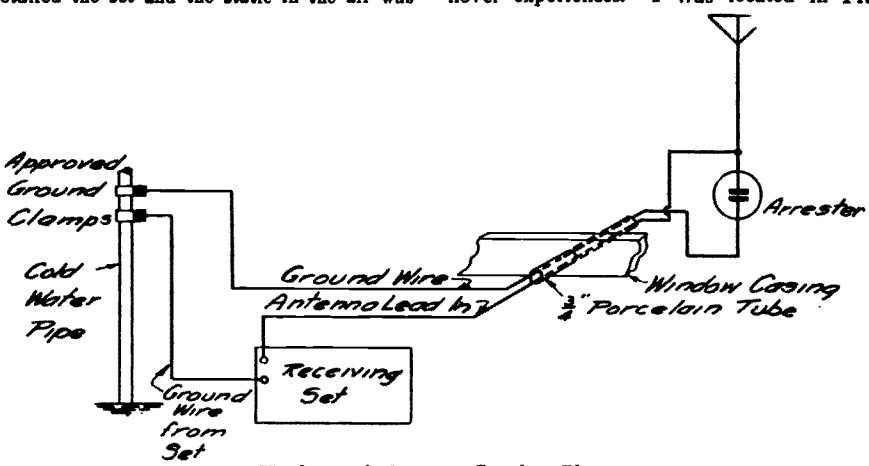
Set consists of two Atwater-Kent variometers and coupler, three step amplifier, Dunaphone loud speaker and regular short wave regenerative hook-up.

Trust this will keep some one else from having a similar experience, I am,

Very truly,

CHAS. DOWN.

410 West 44th Street,
New York City.



Hook-up of Arrester Causing Fire

Transmitting on a Crystal

Sir:—In regard to transmitting on a crystal, I have had some very interesting and novel experiences. I was located in Pittsburgh until a short time ago, when I moved to Wheeling, West Virginia. I did not bring my battery down, so I resolved to try a crystal detector. I used a honeycomb coil with series antenna condenser and found that I was able to hear Annapolis NSS at several periods during the day, and at other times I could hear NAA arc. The mineral was some I made in a school laboratory by grinding galena and iron pyrite, then compressing them together into pellets.

The fact that I heard the arc's natural wave and could hear no compensation or carrier waves was another fact that aroused my curiosity. I then began to log the time I received these stations and found that I could always hear them during the hours of transmission from KDKA, in Pittsburgh. I scarcely thought it possible that KDKA should have a harmonic at 16,000 meters and a lower one at 6000 meters, and even if that were possible I did not see how they could affect my crystal detector at a distance of 60 miles air line.

I had noticed that the people down here were getting the habit of using 5-watt tubes for detectors and putting 60 or 70 volt B batteries on them. There were two sets within four blocks of me that used 5-watt detectors and each one had an antenna over 200 ft. long. Then I smelled a rat. I took an ammeter to each station and found that on about 350 meters each station had an antenna current exceeding 1/10 ampere. The reason for my being heterodyned on several waves as doubtless because the two stations had such long antennas.

I then read Mr. Seefred's article in May RADIO and resolved to try it. I found it worked satisfactorily and that the voice, which I tried later, could be heard in my receivers, and also at both the second and third stations there was considerable distortion. When using an L25 honeycomb coil and the condenser, which is a C. V. 1500 De Forest, was set at 50, the wave being 210 meters both stations, in order to have their sets oscillating and at the same time get the voice, tuned their sets to 120 meters. We also fund that a telephone line about 1000 ft. long, which runs parallel with our antenna (all three are nearly parallel), would absorb considerable energy, which after a test we found to be about 5 milliamperes, and I believe that this, by re-radiating a small part of this energy, was heterodyning my receiver on higher wavelengths. All three of us are able to talk to one another any time in the day or night by simply tuning our sets to a set place and speaking in the transmitter.

A great deal of QRM has been caused around here lately by the 5-watt detector fad. I have found a very good way to stop this is to use one step of radio-frequency, which will not allow any energy from the detector to be radiated to the antenna.

I should like to hear some more from other fellows who have had some of the same experience with heterodyning and absorption.

Yours respectfully,
F. EUGENE MAGUIRE, Radio 8CH1.

329 So. Huron St.,
Wheeling, W. Va.

Effect of Mountains on Radio

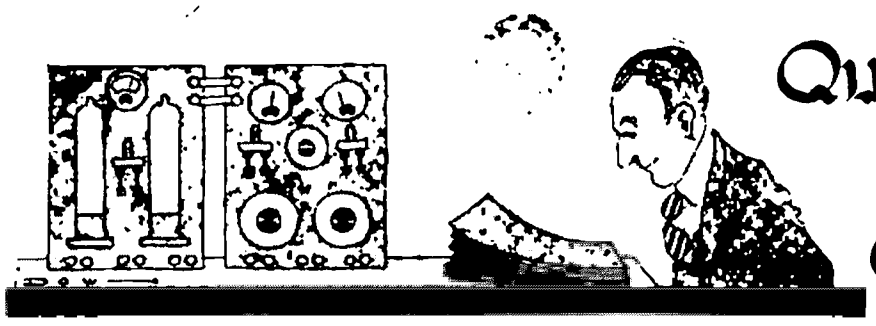
Sir:—Thinking some of the readers of RADIO might be interested in the effects of mountain ranges on radio transmission and reception, I will give the results of a few tests which I have made in that respect.

While located at Fullerton, Orange County, Calif., for years, we always had trouble receiving with any degree of loudness and sometimes hardly readable were the 1 kw. sets operating at Riverside, Calif., not 30 miles air line from us, there being a range of mountains lying at right angles between us; these same stations working east and north to limits around 1000 miles or better at times.

Another similar effect is experienced with San Diego amateur stations when receiving from Fullerton station. While not quite so weak as were Riverside station's signals, the San Diego signals were very weak when distance of 90 miles air line is considered, although these San Diego amateurs are able to reach out north and east with ease. In this case mountains lie across at right angles between San Diego and Fullerton, but Los Angeles is not so cut off, having more over water route air line.

At my Antelope Valley station, 8 miles east from Lancaster, Calif., I find very different results, though mountains lie on a line almost due east and west between my present station and Riverside, San Diego, Fullerton and Los Angeles. Here tests show just the reverse conditions and those same stations in Riverside and San Diego come in on a detector (vacuum tube) set with an unmistakable punch. While amateurs in Fullerton and Los Angeles, much closer, sound like they were a thousand miles away, so to speak, except that C. W. stations seem to kick through better than spark. In fact, very few spark sets can be heard from

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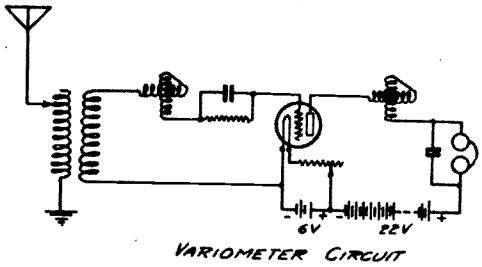


Queries & Replies on C.W. practice by Gerald M. Best, Technical Advisor.

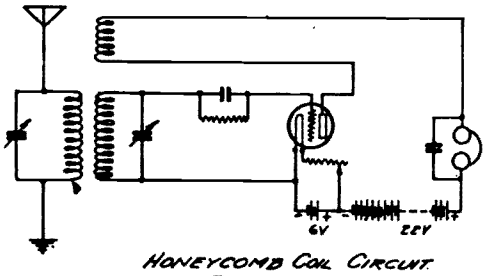
Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

Ques. Please inform me the necessary equipment to be used with the Armstrong regenerative circuit. R. E. H., San Francisco, Calif.

Ans. The necessary equipment would be either a variocoupler and two variometers, with a detector tube and batteries, or three honeycomb coils, two air condensers and the necessary tube and batteries. The circuit arrangement is shown in Fig. 1.



VARIOMETER CIRCUIT



HONEYCOMB COIL CIRCUIT

Fig. 1

Ques. Where can I get the sheet aluminum for making the rectifier explained on page 80 of July RADIO? How long will it take to charge the battery? M. C. B., Wheatland, Calif.

Ans. Sheet aluminum for chemical rectifiers should be absolutely pure aluminum. Would suggest your trying one of the large chemical manufacturing concerns who have offices in San Francisco. The length of time it takes to charge your battery depends entirely upon the capacity of the battery, the charging rate, and the efficiency of the rectifier. If your battery is 40 ampere hour capacity, the rate is 2 amperes, and the rectifier fairly efficient, the battery should be fully charged in 30 hours.

Ques.—Would it be possible to use radio frequency amplification in connection with a single coil regenerative receiver using variometers? B. F. R., Montague, Calif.

Ans. Not efficiently, when you have only a single coil circuit, unless you completely change the arrangement of all the apparatus and add a considerable amount of new material.

Ques. Please advise if two steps of radio frequency can be added to the circuit of the tuner shown on page 21 of June RADIO. F. C. S., Cleveland, Ohio.

Ans. It would be impractical to add radio frequency amplifiers to this set without dismantling it and rearranging the apparatus, thereby destroying most of its present usefulness and appearance.

Ques. Can a variometer be constructed that will function on wavelengths up to 3000 meters? What book is there that will give the details of constructing radio instruments? W. V. H., Massachusetts.

Ans. A variometer that would work on 3000 meters would be very large and cumbersome, and would have a minimum inductance value far above that required for the shorter wavelengths. For such long waves, bank wound or honeycomb coils are necessary. Try the McGraw-Hill Book Company, of New York City, for a list of radio publications such as you desire.

Q. Please publish a circuit for a two stage amplifier with Remler cam switches instead of plugs and jacks. P. E. R., Los Angeles, Calif.; M. L. W., Eureka, Calif.

Ans. This circuit is shown in Fig. 2.

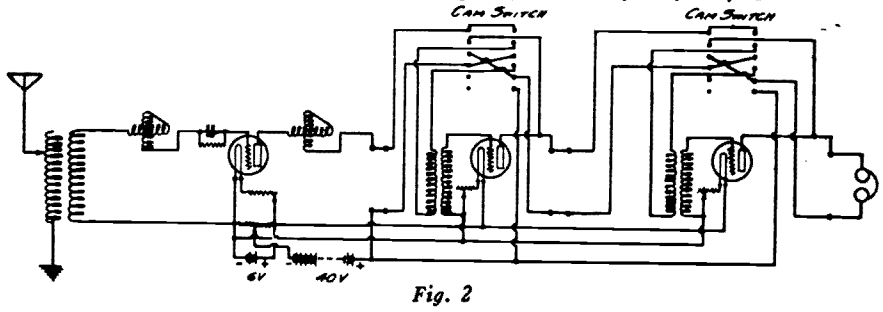


Fig. 2

Ques. Please publish a diagram showing how filament control jacks may be used to control the audio frequency amplifier in the enclosed hook-up. F. E. R., Nampa, Idaho.

Ans. If you require a circuit which has everything shown pictorially, I would advise you not to attempt such a complicated circuit as that which you request. A filament control circuit is shown diagramatically on page 29 of March RADIO.

Ques. Is this appliance which is supposed to utilize the electric wires as an antenna by screwing it into the socket practical? P. L., Toppenish, Wash.

Ans. Yes, provided that the article has been passed by the Board of Fire Underwriters. There are several types of this equipment on the market that are approved and are safe to use. The results obtained, however, are not as satisfactory as with a good antenna.

Ques. What size should the condenser shown in the set illustrated on page 24 of March RADIO be? R. J. C., Brunswick, Ga.

Ans. .0005 M. F., or about 23 plates.

Ques. Please publish a circuit for a three stage power amplifier employing 5 watt tubes, to be used in conjunction with a Magnavox. E. F., Los Angeles, Calif.

Ans. A complete description of such an amplifier is given by A. K. Aster on page 68 of March RADIO. If you have no copy of that issue, I will send you a circuit diagram.

Ques. Please tell me how to make the coupling ring and bank winding of Mr. R. C. Anderson's set shown in June RADIO. E. H. F., Woodlawn, Pa.

Ans. Would suggest that you write to Mr. Anderson at Long Beach, Calif., for a more detailed description of how to make this set.

Ques. I wish to put a station on a small yacht, and have it work with my amateur station at home, and with other amateurs, as may be convenient. What kind of licenses should I have to cover this? G. T. R., Eureka.

Ans. It is not possible for such licenses to be issued. If you wish to have a station on the yacht and one at home, they both must be licensed as "limited commercial," and they will not be permitted to handle any other correspondence unless in emergency, when they may be required to assist vessels in distress. They will not be permitted to operate with amateur stations, in any case. The operators of such stations must hold commercial second class licenses, or higher.

NEWS OF THE AMATEUR OPERATORS

6ARK, Ukiah, Calif., was recently struck by lightning. This started a fire, due to the melting of a kick-back preventer. A few leads were burned and a line transformer was damaged before the fire was extinguished.

Carlos S. Mundt, 6AJ, has moved from Concord, Calif., to 3715 Leighton Street, Oakland, Calif.

TRANSCONTINENTAL SPARK TRANSMISSION

Sir:—Wish to inform you that the spark signals of 60M, Los Angeles, have been heard on May 6, 1922, at 10:50 p. m. by 1BIY of Hartford, Conn., and by 1BDU of Winthrop, Mass. The reception has been verified by 60M, and any further information will gladly be furnished by and of the above mentioned stations.

Sincerely,
G. F. HUTCHINS, Radio 60M.
403 North Benton Way,
Los Angeles, Calif.

NEWS OF THE BROADCASTERS

KFAF: A NEW 500 WATT BROADCASTER

KFAF, the new Denver broadcast station installed and operated by the Western Radio Corporation, is now on the air with news and entertainment supplied through the co-operation of the Denver *Post*. It was installed and will be operated under the direction of Elden F. Horn, who supervised the construction of KYW, the Westinghouse station at Chicago, and was nationally known some years ago as 9AJA.

The station employs two 250 watt tubes as oscillators, one 50 watt tube as modulator and a second 50 watt tube as a high-frequency pilot oscillator, giving an output of 550 watts.

The aerial is a six-wire flat-top "T" supported on 24 ft. spreaders carried on two 120 ft. steel towers. Power is supplied by a 2000 volt generator direct-connected to a three phase motor.

The studio is draped with heavy fabric to absorb echoes and is provided with every convenience for the artists who will entertain Denver fans.

The station is also equipped with a two-step receiving set and a three-step radio frequency amplifier to pick up distant stations.



(1) View of KFAF broadcasting room, showing a part of the control panel. Engineer Elden F. Horn at the microphone, George De Forrest Walker, vice-president and manager of sales, operating the wave meter, and George S. Walker, president of the Western Radio Corporation, standing.

(2) Sectional view of the apparatus, showing the two 250 watt tubes.

(3) Interior of the big transmitting set

(4) The two 120-foot aerial towers

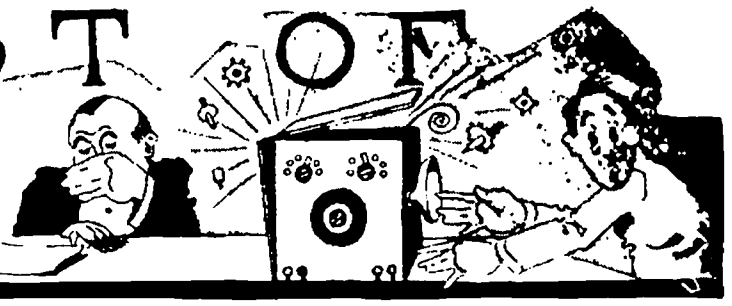
LIST OF LIMITED COMMERCIAL BROADCASTING STATIONS LICENSED BETWEEN JUNE 24 AND JULY 22.

Call — Station

WGAJ—W. H. Gass, Shenandoah, Iowa.
WGAL—Lancaster Electric Supply & Const. Co., Lancaster, Pa.
WGAN—Cecil E. Lloyd, Pensacola, Fla.
WGAH—New Haven Elec. Co., New Haven, Conn.
WGAM—Orangeburg Radio Equipment Co., Orangeburg, S. C.
WGAT—American Legion, Department of Nebraska, Lincoln, Neb.
WGAU—Marcus G. Lumb, Wooster, Ohio.
WGAQ—W. G. Patterson, Shreveport, La.
WGAS—Ray-di-co Organization, Chicago, Ill.
WGAR—Southern American, Fort Smith, Ga.
WHAA—State University of Iowa, Iowa City, Ia.
WHAB—Clark W. Thompson, Galveston, Texas.
WGAZ—South Bend Tribune, South Bend, Ind.
WGAW—Northwestern Radio Co., Madison, Wisc.
WHAD—Marquette University, Milwaukee, Wisc.
WHAE—Automotive Elec. Service Co., Sioux City, Ia.
WHAC—Cole Brothers Elec. Co., Waterloo, Ia.
WHAF—Radio Elec. Co., Pittsburgh, Pa.
WGAW—Ernest C. Albright, Phila., Pa.
WGAV—B. H. Radio Co., Savannah, Ga.
KFAJ—University of Colorado, Boulder, Colo.
KFAR—O. K. Olsen, Hollywood, Calif.
KFBA—Ramey and Bryant, Lewiston, Idaho.
WHAG—University of Cincinnati, Ohio.
WHAH—J. T. Griffin, Joplin, Missouri.
WHAI—Radio Equipment & Mfg. Co., Davenport, Iowa.
WHAJ—Bleufield Daily Telegraph, West Virginia.
WHAK—Roberts Hardware Co., Clarksburg, W. Va.
WHAL—Phillips, Jeffrey and Derby, Lansing, Mich.
KFAN—Electric Shop, Moscow, Idaho.
KFAP—Standard Publishing Co., Butte, Mont.
KFAQ—City of San Jose, Calif.
WHAM—School of Music, Rochester University, New York.
WIAC—Galveston Tribune, Galveston, Texas (applied).
WHAO—F. A. Hill, Savannah, Ga.
WHAP—Dewey L. Otta, Decatur, Ill.
WHAN—Southwestern Radio Co., Wichita, Kansas.
KFBB—F. A. Buttrey & Co., Havre, Mont.
WHAS—Courier Journal & Louisville Times, Louisville, Ky.
WIAA—Waupaca Civic & Commerce Assn., Waupaca, Wisc.
WHAQ—Semmes Motor Co., Washington, D. C.
KFBD—Clarence V. Welch, Hanford, California.
WHAR—Paramount Radio & Elec. Co., Atlantic City, N. J.
KFAS—Reno Motor Supply Co., Reno, Nev.
WHAU—Corinth Radio Supply Co., Corinth, Miss.
WIAB—Joslyn Automobile Co., Rockford, Ill.
KFBC—W. K. Azbill, San Diego, Calif.
WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y.
WIAK—The Stockman Journal, Omaha, Nebr.

Continued on page 35

DIGEST OF RECENT RADIO PATENTS



Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

L. M. Clement, Pat. No. 1,415,992; May 16, 1922. Receiving Station.

The receiving circuit described is arranged to detect ordinary signals, whether damped modulated, continuous wave, or heterodyne, by a detector D. For this purpose switch 9 is in its upper position. One or two stages of amplification may be had through amplifiers A, A', by having switch 11 either in its upper position or in its lower position. When detecting continuous waves, the feed back coil 7 is made use of by throwing switch 8 on contact *b*, so as to provide a local source of heterodyning frequency. When it is desired to detect signals which are modulated a plurality of times, or heterodyned a plurality of times, switch 9 is thrown down, and in this way detector D' is placed in tandem with D. The input circuits of D and D' are tuned respectively to the frequencies making up the compound signal.

Pupin & Armstrong, Pat. No. 1,416,061; May 16, 1922. Radioreceiving System Having High Selectivity.

Continuous wave signals are detected by using a local source of oscillations 5 which together with the relay 4, produce heterodyne beats of low frequency below audibility, of say 100 cycles. By making this frequency low, the selectivity is greatly increased, due to the fact that the two values of received frequencies which produce this beat are closer together the less this beat frequency is. The transformer 6 sends this beat frequency through filter 7 to reduce the higher harmonies and after the signal passes through amplifiers 8 and 9, an induction motor type frequency changer 11, 14, is used to raise the frequency to audibility. A relay 15 and phone 16 thence serve to render it preceptible. The frequency changer 11, 14, produces two frequencies, equal to the sum and difference of the beat frequency and the frequency of rotation. By proper choice of frequencies it is possible to obtain distinctive harmonious musical intervals in phone 16, and the recognition of the signal is rendered easier.

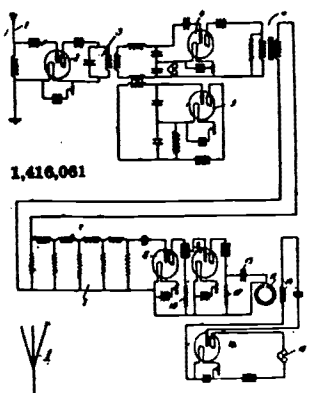
A. M. Curtis, Pat. No. 1,415,999; May 16, 1922. Static Reducer for Wireless Signals.

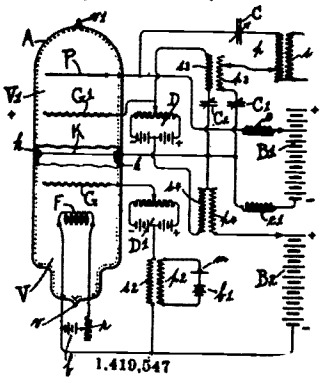
A crystal detector comprising a carborundum crystal with a metal feeler is so adjusted, by experiment, that the resistance of the detector to impulses of high voltage is equal for both half waves, but unequal for impulses of comparatively low voltage. In this way the crystal is a good rectifier for only the weak signal impulses; and the strong impulses, such as those due to static or interfering signals, are not appreciably rectified.

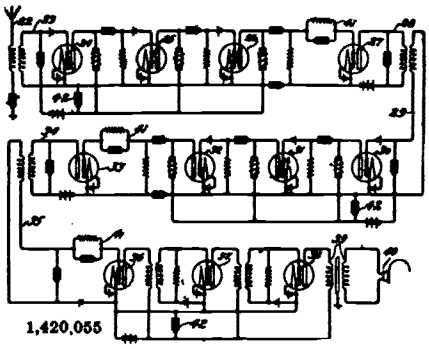
C. Bardeloni, Pat. No. 1,416,774; May 23, 1922. Device for Receiving Radiosignals.

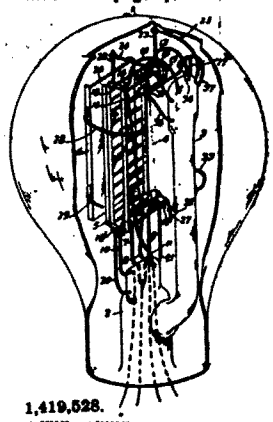
A thermonic detector 24 is connected up in the usual way to an oscillating circuit 7, 8, tuned to the frequency of the signals to be received, in the antenna circuit 1-2-3-4-5-6. In order to eliminate static or other disturbances, a second oscillating circuit 10-11 is used, tuned to the disturbing oscillations or else to a value slightly different from that of the signals. This circuit is connected to a cold electrode 23 influencing the flow of current in the device 24, and by proper adjustment of the circuits, the potential of plate 23 can be made opposite always to that of grid 12, when due to

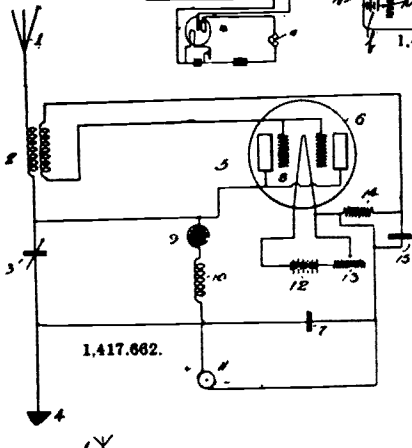
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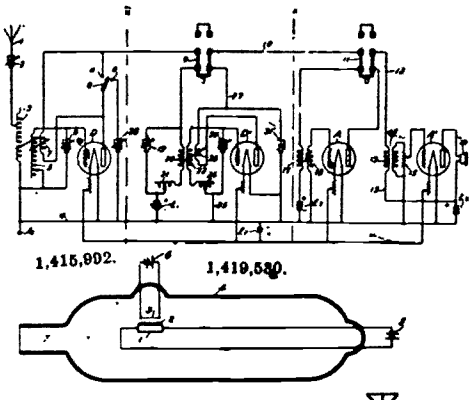


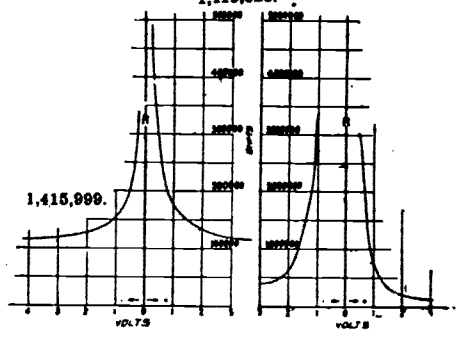


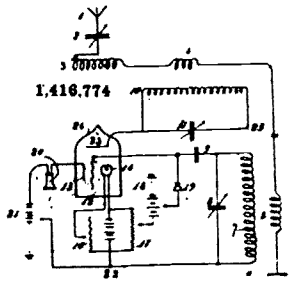


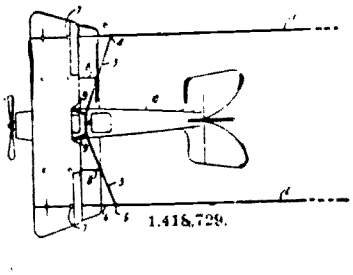


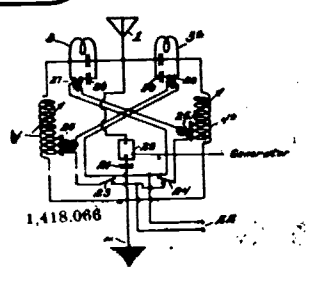


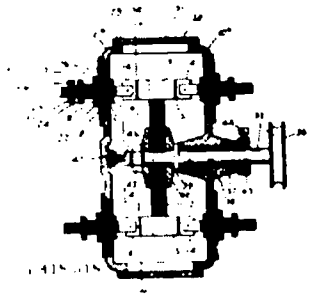






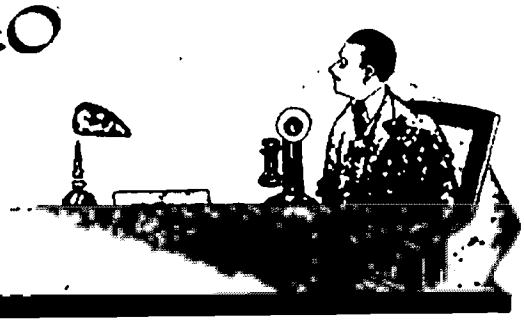






With the U.S. Radio Inspector

Conducted by Major J. F. Dillon



Ques. What is the lowest wavelength an amateur may work on? H. K., Los Angeles.

Ans. As it stands at present, there is no lower limit, as long as the station is adjusted to 200 meters or below. If the recommendations of the Conference are adopted, the lower limit will be 150 meters.

Ques. Why can't apparatus generally be worked on waves lower than 200 meters? Same.

Ans. This is due more to the faulty design of the antenna and tuning apparatus than to any inability of the actual wavelength or frequency limits, as such. It is understood that by very special means, and carefully adjusted circuits, wavelengths of a few meters have been obtained. There is no reason why 125 or 130 meters should not be easily obtained on amateur apparatus, if it were properly designed, although this would, doubtless, be restricted to tube sets.

Ques. I have had 11 months' experience on a commercial second grade license, and 10 months on a first grade license. I feel that I will have no trouble with the 25 word speed test. Am I eligible for examination for the first grade, first class exam.? J. U. I., Chicago.

Ans. The regulations say that service for a license of this grade must be under a *first* grade, and therefore, until you have had 18 months' experience on such license, you will not be eligible for the examination.

Ques. If an amateur who is unlicensed, but possesses a regenerative single coil circuit receiver, puts a key in his ground circuit and is able to transmit a few blocks with his receiving tube oscillating, is he working in violation of the law? Y. B., Reno.

Ans. Yes. The law does not specify the kind or type of apparatus that require licenses. All transmitters require such license, as they may interfere with the reception of signals from beyond the state; therefore the receiving set mentioned becomes liable to cause such interference and must be licensed, and, of course, must be operated by a licensed operator.

Ques. I am about 4 miles from the commercial station KFS in San Francisco, Calif., and whenever he sends he breaks up the concerts. I am unable to tune him out, and others complain of the same trouble. Can't something be done to have this station keep out, at least during the evening hours? J. H. G., San Francisco.

Ans. This station is operating on its lawful wavelength and decrement, and as the class of business handled is "general public service," i. e., correspondence with ships at sea, and cannot be interfered with for any reason, and especially for the concerts, as these are at best non-essential, while ship to shore communication is of vital importance. At the distance you are away from this station, it seems that a great deal of the interference could be eliminated by using extremely loose coupling, unless you are using a single coil type of receiver.

PROHIBITION OF BROADCAST CLASS PROPAGANDA

Several informal complaints have reached this office regarding a sermon broadcasted from a radio station in this district recently, in which the speaker is said to have maliciously attacked the exponents of other religious creeds, impugning their motives and otherwise reflecting upon their character and integrity.

This incident, if reported truly, is most regrettable, as the introduction of religious controversies is, in effect at least, an insidious perversion of the license privilege, as the provoking of sectarian strife and animosities, instead of supplying clean entertainment and instruction to the listening public, which is the real purpose for which the licenses are granted.

It is desirable to emphasize the fact that there is no intention or disposition on the part of this office to criticize the doctrine of any creed or to question the truth or logic of their contentions. It is insisted, however, that speakers refrain from broadcasting attacks upon other religious creeds or their proponents, as such a course will only create resentment and sectarian strife and inflict the same upon the innocent listening public, who are maintaining their receiving instruments for the purpose of entertainment and instruction and who, as a rule, have no interest in the fanatical denouncement of any denomination or sect.

In order that the public shall enjoy the maximum benefit from the operation of radio broadcasting stations, it is imperative that the transmission of all political, religious, labor or class propaganda which would tend to engender factional controversies and strife, be prohibited and that broadcasting be confined to legitimate entertainment and instruction on subjects that are of general interest to a majority of the radio public.

NEW RADIO PUBLICATIONS

A paper by R. T. Cox entitled "Standard Radio Wavemeter, Bureau of Standards Type R7OB," describes a standard wavemeter constructed at the Bureau of Standards and used in the standardization of radio apparatus.

"An Electron Tube Amplifier for Amplifying Direct Current," a paper by H. A. Snow, describes an amplifier which has been developed at the Bureau for particular applications in electric signaling work and can be used in place of a polarized relay and also for various other purposes, including the recording of telegraphic and radio signals.

E. L. Hall and J. L. Preston have prepared a report entitled "High-Voltage Storage Battery for Use with Electron Tube Generators of Radio-Frequency Currents," describing a special type of storage battery developed at the Bureau. This battery employs a considerable number of small storage cells contained in small glass jars about 1½ inches square and about 4 inches high. The cells are assembled very compactly in trays which can supply 100 volts.

NEWS OF THE BROADCASTERS

Continued from page 33

KFAU—Independent School District, Boise City, Idaho.
WHAT—Yale Democrat & Yale Telephone Co., Yale, Okla.
KFAT—Dr. S. T. Donohue, Eugene, Ore.
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, Ohio.
WIAJ—Fox River Valley Radio Supply Co., Neenah, Wisc.
WIAI—Heers Stores Co., Springfield, Mo.
WIAH—Continental Radio Mfg. Co., Newton, Iowa.
WHAY—Huntington Press, Huntington, Ind.
WHAX—Holyoke Street Ry. Co., Holyoke, Mass.

The Northern Radio and Electric Co., 606 Pine Street, Seattle, which has been operating KFC in conjunction with the *Post-Intelligencer,* is now operating independently. The "P.-I." has turned over its facilities and all programs are being arranged by the Northern Radio and Electric Co., who will continue the service on even a higher standard of service than has been done in the past. This service will include news items furnished by the "P.-I."

A musical program will be given between 11 a. m. and 12 m. and 4:30 p. m. and 5:30 p. m., week days, over the new radio broadcasting station WBAY, which was recently erected on the Walker Street building of the American Telephone and Telegraph Company at New York City. A program will also be given on Thursday evenings from 7:30 to midnight, to be later announced.

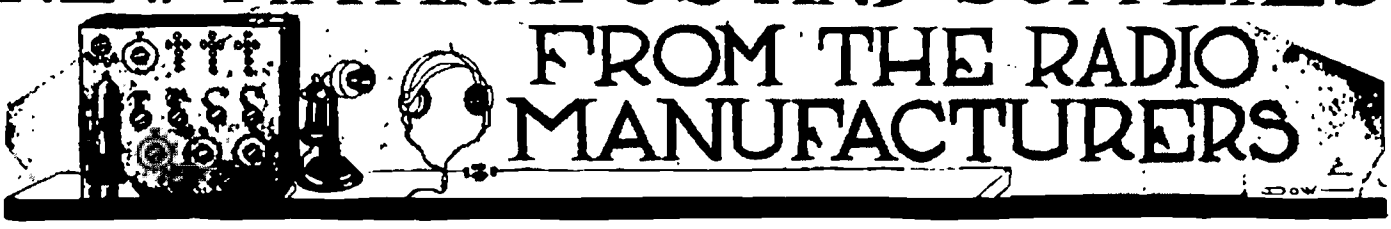
A. W. Drake, general commercial manager in charge of this station, says that there have been close to 100 applicants for the use of this station and he has taken steps to arrange with these applicants for the programs which they will provide.

While radio advertising has not as yet been prohibited by laws or regulation, it is considered, in the public interest, that applicants for the use of this station should provide programs of general interest.

Until the details of the scheduling of private programs can be arranged, WBAY will continue to furnish a miscellaneous musical selection.

The Oakland (Calif.) Tribune has taken over the time of KZM, the Hotel Oakland, by agreement with the Western Radio Institute, and will broadcast under that schedule pending the allocation of wavelengths or a rearrangement of the present schedule. KZM will broadcast once daily, between 6:45 and 7:00 on the time of KZY, the Atlantic-Pacific company, by arrangement with that concern. The Tribune's daily schedule, excepting Sunday, will be as follows: 7:15 to 7:30—General news summary, cable reports and sports. Tuesday, 7:30 to 8:15—Entertainment. Friday, 8:15 to 9:00—Entertainment. KLX will also broadcast occasionally in the afternoon, and as regularly as possible on the time of KZY.

NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS



A NEW RECEIVER WITHOUT GROUND OR AERIAL

"Impossible," you will say, but hearing is believing! The Atlantic-Pacific Radio Supplies Co. of San Francisco in the course of a series of tests with their "A. P. Special," using the Oard phantom no-ground circuit, has proved to the satisfaction of a number of radio fans, representatives of the U. S. Army and of the San Francisco Fire Department that broadcast concerts can be satisfactorily picked up at any time that music is on the air. This is the invention of Paul Oard, a California engineer.

All that is necessary to hear the concerts is the set, a six-volt storage battery and about 10 ft. of insulated copper wire laid along the ground or table. Furthermore, the same equipment works to perfection in



"A. P. Special" on Running Board of Fire Truck at San Francisco

an automobile running 40 miles an hour, with the 10 ft. wire stretched inside the auto top.

This circuit, while based on an entirely new principle of radio reception, is extremely simple and free from complicated wiring. It is ultra-sensitive in comparison with circuits now in general use. When used with a very short antenna the results obtained approximate those of radio frequency, although audio frequency amplification only is made use of. Contrary to accepted theory and practice, this circuit will not function except at very short range with a ground connection. If a counterpoise is used it becomes less sensitive according to the size of the counterpoise. The nearer an actual ground connection is approximated, the weaker the signal strength. The circuit operates at its fullest efficiency on a single wire antenna not more than 50 ft. in length, placed in any convenient position, thus obviating the necessity of an out-of-door aerial. It is an interesting fact that an antenna of greater length than 50 ft. reduces the strength of signals.

The company is not yet ready to give out the details as to how this is accomplished but these facts will be available shortly. The set is portable, being mounted in a covered cabinet with carrying space for phones and extra tubes. The control is exceedingly simple.

During tests at Berkeley, Calif., the Avalon-Long Beach phone of the Pacific Telephone and Telegraph Co. was clearly heard. Other distant stations are picked up with care, and the nearby ones come in as loudly as with the usual regenerative set.

VACUUM TUBE PROTECTION

The high cost of vacuum tubes justifies the amateur in taking every precaution to prevent the filament's burning out—the usual cause of failure. Of several available protective methods, the simplest and cheapest is to attach a Radico safety fuse to the filament terminal. In case of too great a current supply from the B battery the fuse "blows" and thus saves the filament. These fuses are made by the Radio Equipment Co. of Boston, with carrying capacities of ½, ¾, 1, 1½, 2, 2½ and 3 amps., and are designed to fit the terminals of any standard tube used in any standard socket.

A NEW BINDING POST

The H. H. Eby Manufacturing Company, 605 Arch Street, Philadelphia, have added another design to their line of metal binding posts. This new style is the same in all respects as the type they are now marketing, with the exception that instead of having a tapped base to take a standard machine screw, it has a solid threaded stem.

It is made in three sizes and is known to the trade by the code words SERGEANT "SS," BUDDY and MIDGET; the first ½" diameter with ½"x 10-32 stem, the second ⅜" diameter with ⅜"x 6-32 stem, and the latter 5/16" diameter with ⅜"x 4-36 stem. This design permits the posts to be mounted more quickly by simply screwing a hexagon nut on the stem.

THE BRISTOL AUDIOPHONE OR LOUD SPEAKER

The Bristol Company of Waterbury, Conn., has recently produced and placed on the market a loud speaker horn under the trade mark name "Audiophone" for receiving radio concerts, speeches, etc. While the Audiophone is a comparatively new development in the radio field, it is not an experiment, but the result of thirty years' experience in the development and manufacture of precision recording and indicating instruments, and six years' research work in sound reproduction. The Audiophone is the result of long and careful research work carried out at the research laboratories of The Bristol Company, to develop a loud speaker for use with the new Bristol talking moving pictures, which are soon to be placed before the public. The result of this research produced a loud speaker which gives a large volume of amplified sound, and yet faithfully reproduces the original.



The Bristol Audiophone *The Sergeant "SS" Binding Post*

The Audiophone as shown in the illustration is of a compact and artistic design finished in bronze. The bell of the horn is 15 in. in diameter. The complete design of the bell, neck and electrical characteristics of the receiver box, together with materials used, are such as to produce a loud speaker remarkable for its rich, natural and clear tone. Songs, speeches, announcements, conversation and instrumental music are reproduced by it with a clearness and audibility which has not been the case with the majority of radio receivers.

It is rugged and simple in construction, thus insuring durability. It requires no separate storage battery for magnetizing current. In order to make the horn suitable for all types of radio amplifier circuits, a transformer is mounted in the base which provides the impedance about equal to that of the vacuum tube amplifier, into the plate circuit to which the horn is connected. When connected to a third stage of amplification operating on 100 volts or over, the volume of sound is great enough to be easily heard in a room seating five hundred people. For smaller rooms, such as in private houses, good results are obtained from the Audiophone when connected with a two stage amplifier.

RADIO MANUFACTURERS FORM NATIONAL ORGANIZATION

In order to develop the support broadcasting, in order to stabilize trade conditions, an association must be formed which is composed only of reputable members of the radio industry interested in the future development of radio. For this reason the Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies has been formed to place the radio industry upon a sound basis, to study the public taste in the matter of broadcasting programs, and to support and promote broadcasting stations. This Radio Apparatus Section was organized on March 19, 1921, at a meeting held at the Hotel Pennsylvania, New York City. At the second annual meeting, which was held at Spring Lake, N. J., during the week of June 19th, the Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies, definitely announced its program and the part that it intends to play in promoting the best interests of radio. At this meeting the object to be attained by the Radio Apparatus Section was proclaimed as follows:

"To advance and protect the interests of the manufacturers of radio apparatus; to promote the standardization of radio apparatus; to collect and disseminate information, and to promote co-operation among the members."

The membership of the Radio Apparatus Section is confined to bona fide and trustworthy manufacturers. That this ideal will he realized may he inferred from the names of the following members who constitute the Radio Apparatus Section at present:

Acme Apparatus Co., American Radio and Research Corporation, L. S. Brach Supply Co., C. Brandes, Inc., Burgess Battery Co., Clapp-Eastham Co., Cutler-Hammer Co., De Forest Radio Telephone and Telegraph Co., Dictograph Products Corp., Edwards & Co., Electrial Products Mfg. Co., General Insulate Co., A. C. Gilbert Co., Holtzer-Cabot Electric Co., Manhattan Electrical Supply Co., W. J. Murdock Co., Pacent Electric Co., Radio Corporation of America, Signal Electric Co., Stromberg-Carlson Telephone Mfg. Co., Telenduron Co., Western Electric Co., Westinghouse Electric and Mfg. Co.

Of equally high standing are the officers of the Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies. Mr. M. C. Rypinski, who is now vice-president and sales manager of C. Brandes, Inc., is chairman of the Radio Apparatus Section. The Eastern vice-chairman is Mr. L. G. Pacent, president of the Pacent Electric Co., Inc. The Western vice-chairman is Mr. C. E. Hammond, secretary-treasurer of the Signal Electric Co. Mr. Charles Gilbert, president of the De Forest Co., is treasurer of the association. The secretary is Mr. Elmer Bucher, who is sales manager of the Radio Corporation of America.

The following standing committees have heen created to fulfill the purposes indicated by their names: Committee on Publicity, Committee on Receiving Sets and Equipment, Committee on Aural Devices and Accessories, Committee on Standards, Committee on Support of Broadcasting, and the Executive Committee, which is composed of the chairman and treasurer of the Radio Section and of the chairmen of the standing committees.

This is the nucleus of an organization which will eventually include every important enterprise in the radio industry.

M. C. RYPINSKI JOINS C. BRANDES, INC.,

M. C. Rypinski, formerly radio sales manager of the Westinghouse Electric and Manufacturing Company, has associated himself with C. Brandes, Inc., 237 Lafayette Street, New York City, as vice-president and sales manager.

Mr. Rypinski was actively engaged in the erection of KDKA and other Westinghouse stations, and was also in a position to study at first hand the various commercial and



M. C. Rypinski, formerly radio sales manager Westinghouse Electric and Mfg. Co., now vice-president C. Brandes, Inc., and newly elected chairman Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies.

merchandising problems that naturally grew out of such a unique situation. In allying himself with C. Brandes, Inc., he is placing at the disposal of this organization, manufacturing radio phones, an experience in the radio field which has come to but few men. Occupying a position of great responsibility in the very center of the radio industry, Mr. Rypinski had occasion to familiarize himself with every phase of commercial radio as related to hroadcasting.

VICTORY SELECTOR JACK

The Victory Radio-Electro Company of San Francisco and Chicago has a new selector jack which eliminates the use of the common radio plug and also the last jack in an amplifying set. By simply pressing a button the nuisance of jerking a plug in and out of the jacks and the dangling of long cords or wires in the front of the panel is entirely done away. On a detector and two stage amplifier for example, to get its entire range of selectivity it has heretofore heen necessary to equip the set with three jacks and one plug. All this equipment can now be replaced by two Victory selector jacks giving simpler and more efficient operation. Incidentally, there are also fewer holes to drill on the panel. One is placed between the detector and first stage, and the other between the first and second stages, as indicated in the diagram, and the second or last stage is connected directly to the output binding posts where the phones or loud speaker is permanently connected. This jack can be used in any circuit where a standard radio jack is used without changing any connections.

SPECIAL INTRODUCTORY OFFER

This issue of "Radio" contains the first chapter of Volney G. Mathison's new feature—

"The Professional Radio Operator"

Additional chapters will be published in future issues. In order to give you an opportunity to get every issue of "RADIO" containing chapters of this remarkable man-to-man feature story, we will send you "RADIO" for—

SIX MONTHS

for **$1.00**

This Special Offer Good For a Limited Time Only. Don't Wait Until Tomorrow. Subscribe TODAY!

By subscribing at this special rate you are assured of receiving your copy regularly for six months.

Many new features will appear in the coming issues of "RADIO." Don't miss them. You also save money by subscribing for six months. Why pay $1.50 for six copies on the news stand when you can subscribe for a dollar?

Pin a dollar bill, money order or check to the coupon and mail it now!

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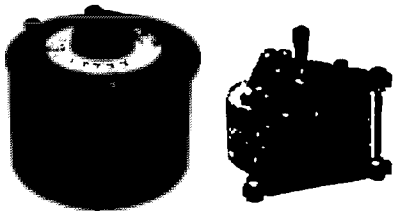
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SEPT.

Experienced Radio Men



Type 247 Condenser

REALIZE THE WISDOM AND ECONOMY of using radio equipment of proven quality rather than that which is built to a price.

The GENERAL RADIO CO. has produced a condenser of laboratory quality at a price suited to the experimenter.

Consider a few of its advantages:

75% lower losses ***Special Bearings***
Direct reading scale of capacity ***Low zero capacity***
The Condenser is Shielded

Price, completely mounted, shielded.....**$5.50**
unmounted, balanced **3.25**

GENERAL RADIO COMPANY

Massachusetts Ave. and Windsor St.
Cambridge 39, Massachusetts

Standardize on GENERAL RADIO CO. equipment throughout

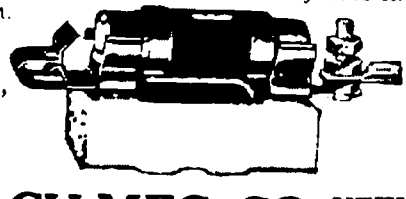
Bulletin 911C will be sent on request

Do not confuse the products of the GENERAL RADIO CO. with those of other concerns using the words "General Radio." The GENERAL RADIO CO. has manufactured radio and laboratory instruments for many years. It has no affiliation with any other companies.

BRACH
Vacuum
LIGHTNING ARRESTER

Here is a vacuum lightning arrester that is absolutely dependable, that does the work expected of it, that is **simplicity itself** in operation, gives the radio user no trouble, requires **no attention**—stands like a sentinel, day and night, guarding radio and **home.** The Brach Vacuum Lightning Arrester has a record of **performance** over a period of 16 years. Big railroad, telegraph **and telephone** companies rely upon it. New York and other big fire **alarm systems** are equipped with it. The United States Army uses it. **Skilled radio** engineers specify it.

Listed By Underwriters' Laboratories



Sold By Leading Dealers

L. S. BRACH MFG. CO. NEWARK, N. J.

Coast Representatives: Pacific States Electric Co., San Francisco, California

16 Years Specialists in Lightning Protective Apparatus.
Also Makers of SOLDERALL

CALLS HEARD



Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station

BY E. ROPES, GEN. GRANT NATIONAL PARK, SIERRA NEVADA MOUNTAINS, CALIF.

Spark—6ar, 6dd, 6gt, 6gr, 6hc, 6iv, 6tc, 6tu, 6uq, 6vh, 6vk, 6zb, 6zy, 6aak, 6ajw, 6akt, 6ali, 6amk, 6amz, 6anq, 6asc, 6asx, 6atu, 6bin, 7mf, 7iw.

C. W.—Kmc (concert), klp (concert), kuy (voice), kzm (voice), 6ka, 6bcd, 6bjc, 6bsc.

BY 6AKW, ROUTE 1, LANCASTER, CALIF.

Due to the terrific static here on desert, I am not doing much transmitting, but with detector only I am able to receive fairly clear of static, so to speak, on average night, but find days much freer of it.

Will be in this winter with 100 watts A. C.—C. W.

Sparks heard June and July—6ex, 6zu, 6ajr, 6vx, 6gr, 6aan, 6kl, 6tu, 6qr, 6cc, 6avb, 6acr, 6xai, 6abw, 6hc, 6ib, 6hf, 6ala, 6ars, 6gx, 6hp, 6atp, 6bar, 6vk, 6qy, 6abu, 6qu, 6tj, 7zu, 7mf, 7nw, 7in, Canadian 9bd.

C. W.'s heard June and July—6nx, 6gy, 6alv, 6ni, 6awt, 6km, 6bhk, 6zf, 6ze, 6pj, 6bqc, 6abw, 6fh, 6uj, 7na, 9ayu.

On two step one night in July—9zaf, 9aog, 9es.

BY GEORGE AND CHARLES C. WHYSALL, MARION, OHIO. STATION 8CMI (ex 6TV).

1yb, 2fp, 2sz, 3ajd, 3awe, 3abb, 3arn, 3bfu, 3hj, Canadian 3ds and 3gx, 4gl, 4gh, 5da, 8ea, 8ev, (8bde), (8bbu), 8bo, (8ajx), (8un), (8wu), (8zo), 9aaw, 9afk, 9aiy, 9anp, 9agr, 9aly, 9dhz, 9dzy, 9dkk, 9fd, 9lf, 9tv, 9uh, 9wa, 9zn.

Fone stations — wwj, wcx, wgy, wgl, kdka.

Eighteen mags. handled from May 28 to 29, 1922.

8CMI radiates 2.25 amperes into a single wire antenna 150 ft. long with one 5-watt tube. Effective resistance of antenna is 2.5 ohms at 200 meters.

BY G. B. MADDOX, BOX 958, KETCHIKAN, ALASKA

3hj, 4cb, 5xu, 5ax, 6zi, 6pl, 6sk, 6uq, 6aw, 6kq, 6ad, 6ab, 6mq, 6xga, 6pt, 6pd, 6jd, 6pr, 6pc, 6cn, 6hc, 6bx, 6bc, 6bd, 6ale, 7ib, 7dp, 7nn, 7nf, 7dh, 7mp, 7ax, 7qr, 7jd, 7zm, 7qt, 7gp, 7bd, 7bk, 7gj, 7zp, 7bc, 8pj, 8bum, 8ay, 8dj, 9dva, 9zac, 6xad.

BY 7TH, WALLA WALLA, WASH.

Spark—6gf, 6gi, 6hc, 6abu, 6acr, 6amz, 6ark, 7bk, 7ge, (7jw), 7nw, 7of, 7ra, 7to, 7uw, 7ve, (7vf), (7aby), (7ala), Canadian 9bd.

C. W.—6en, 6ff, 6ft, 6ka, 6awt, 6baa, 7ia, 7lu, (7na).

Fones—7ia, 7rn, 7xf, 7zu.

All stations hearing my 10-watt C. W. please QSL Arthur W. Enigh.

Sir:—On the night of July 29th at 9:43 p. m., 120th meridian standard time, while tuning around in an endeavor to pick up a local broadcasting station I heard WSZ of the Atlanta Journal, Atlanta, Ga., signing off for evening.

His wavelength was about 370 meters.

At the time of reception I was laying on the Columbia River Bar awaiting arrival of vessel.

The aerial here is low and poorly insulated, having a high resistance.

I have written WSZ informing him of the reception and asking him to arrange tests in an endeavor to repeat the performance.

PHILIP I. MERRYMAN,
Tug "Oneonta," Sparks WPX.
Astoria, Ore.

BY 6AWP, EVERETT W. THATCHER, 407 W. FIRST ST., SANTA ANA, CALIF.

C. W.—(5za), 6aif, 6aiy, (6ak), (6akw), 6aot, (6asj), (6atp), (6aun), (6awt), 6bjd, (6bpu), 6bqf, 6bsa, 6df, 6ek, (6fh), 6gh, 6ib, 6ku, (6lu), 6nn, 6ov, 6pi, (6ti), (6tw), 6xas, 6xh, (6za), 6zaa, 6zac, 6zae, (6zaf), (6zf), 6zc, 6zi, (6zn), (6zt), 6zx, (6sz), (7dp), 7nf, 7na, 7ni, (7mf), (7oz), 7sc, 7xg, 7xf, (7zu), (9ayu), Canadian 9bd, 9wd, (9wu), (cl-8).

Spark—(6aak), 6aau, (6abu), (6aeh), 6agt, (6ahf), (6ajh), 6ajr, (6ald), 6amz, 6ar, 6as, (6atu), 6bdq, (6bju), (6bjy), 6bjv, 6cc, 6cs, 6gr, 6gx, 6hc, (6ic), 6iu, (6kc), (6vk), vx, 6zam, (6zb), 6zq, (6zu), 6zx, (6zz), 7kb, (7ly), (7mf), 7mp, 7nf, (7ot), 7tj, (7zu).

All hearing 6AWP C. W. please QSL.

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Hobrecht's Operating KVQ Broadcasting Station

New Address Kay at 11th, Sacramento, Calif.

Distributors

Tell them that you saw it in RADIO

Los Angeles, July 30, 1922.

Sir:—In August RADIO I notice a little item about reception of U. S. amateurs in South American waters. I would like to submit some of my own log from the voyage of the schooner "Vigilant," December 15 to June 15, in southern waters. I believe that I have logged stations farther than any so far reported. I used an Armstrong hookup with two steps of audio frequency amplification. The following are extracts from my notebook kept on that voyage:

Jan. 16, Lat. 1.20 S, Long. 120.00 W, 7:35 p. m.—CQ by 9pi plain, 6xac plain.

Jan. 18, Lat. missing, 7:20 p. m.—9xaq C. W. A. P. fone plain.

Jan. 20, Lat. 10.30 S, Long. 120 W, 8:10 p. m.—QST by 9bu. Called 5zl, 8gi. 8:25 p. m., CQ by 9x—. 8:26 p. m., CQ by 9xah, 60 cycle C. W. 9:50 p. m., CQ by 5xo Msg. 9:52 p. m., nmw. 9:54 p. m., 9dtm (probably 9xm).

Jan. 27, Lat. 21.00 S, Long. 121.22 W, 8:15 p. m.—Copied NPL arc on about 350 meters plain.

That is somewhat strange to me. He must radiate considerable on that chord. Hear C. W. from Catalina.

Feb. 17, Lat. 33.09 S, Long. 106.45 W, 6:10 p. m.—Modulated wave playing banjo piece. Music good but voice faint, unreadable. 7:40 p. m., Catalina alarm and voices. 8:15 p. m., 6baj, several other C. W. 8:30 p. m., 6baj. 8:31 p. m., 9zaa.

This is about the farthest south we went and is about 4900 nautical miles from San Francisco.

March 5, Lat. 30.43 S, Long. 90.50 W, 5:00 p. m. to 5:05 p. m.—Hear C. W. and voice, probably Catalina, very plain. Conversation said had a nice trip over, outside the three-mile limit, etc. Then said goodbye three times before party let him go. 5:05 p. m.—Now two girls talking but their voices do not carry so well.

March 7—I experimented with a loop 4 ft. in diameter. Results not very good, but copied CCC over 300 miles. Then with the loop for an aerial and the aerial for a ground, heard both speech and C. W., but did not log them. The regular ground was disconnected.

Just a little about my receivers. The aerial is 65 ft. long with 145-ft. leadin. The ground was a copper plate on the keel and the conduct and water pipe system of the ship. The transmitter was a K. C., one-half kilowatt spark, and I made any distance up to 1750 miles with KPH and KFS. The power supply was a 110-volt Delco light, which I made do for both transmitting and A and B batteries in reception.

Sincerely yours,
L. V. DAVENPORT,
Operator KOZP.

3914 Wisconsin Place,
Los Angeles, California.

BY 7NW, HOQUIAM, WASH.

Spark—(6abx), 6abw, 6acr, 6ala, (6amk), 6ang, 6ark, (6avm), (6cc), (6dd), (6ex), 6ff, (6gf), (6ib), 6ic, 6tu, (7aea), 7bh, (7bk), 7bz, (7ey), 7fh, (7fi), (7ge), 7hf, (7iw), (7iy), (7ke), 7kz, 7mf, 7of, 7ow, (7to), (7tw), (7ve), 7vf, 7wg, 7zk, (8ec) Canadian, 5ct Canadian, (9bd) Canadian.

C. W.—6aat, 6abx, 6bcd, 6gr, 6ka, 6rm, 7aea, 7dd, 7lu, (7mf), 7na, (7oz), (7qw).

BY 6AVX, SAN DIEGO, CALIF.

Spark—6aak, 6aav, 6abu, 6aiu, 6aic, 6ajr, 6akg, 6ald, 6aqv, 6asc, 6up, 6avb, 6avd, 6avr, 6bem, 6bpz, 6ex, 6eb, 6gr, 6gt, 6ic, 6iv, 6od, 6oh, 6ol, 6tu, 6zu.

C. W.—5za, 6aag, 6ala, 6aqa, 6aqt, 6aqv, 6aub, 6awt, 6beg, 6bf, 6bgx, 6bqc, 6bqx, 6cu, 6du, 6ea, 6eb, 6ec, 6ef, 6en, 6ik, 6ka, 6ku, 6rr, 7na, 7sc, 9amb.

BY 6ASJ, 929 60TH ST., OAKLAND, CALIF.

Spark—(6ajh), (6apy), (6gr), (6ke), (7bb), (7to), (7vf).

C. W.—6aeh, (6agh), (6akw), (6alu), 6aqa, 6bcd, (6bes), (6bjt), (6bkb), (6bqc), 6cu, 6en, (6ft), (6gd), (6gx), (6jd), (6ka), (6ku), (6pi), 6xad, 6zac, 6zf, 6zg, 6zb, (6zs), 6zz, 7nf, (7na), 7qe, 7qw, (7sc), 7xg, 9amb.

6cu, Los Angeles, Calif., was reported by 9daz, Jefferson City, Mo., as being the "loudest station heard outside of nines." The distance is over 2000 miles air line. 6cu was using a ten-watt A. C. C. W. set and radiating 2.8 amperes. 9daz's receiver was a home-made regenerative set with detector and Murdock phones.

BY 6AHR, 659 CLAYTON ST., SAN FRANCISCO

Spark—6ak, 6cc, 6dd, 6eb, 6gi, 6gt, 6im, 6jh, 6kc, 6ke, 6lc, 6mi, 6od, 6ol, 6yy, 6zk, 6zu, 6aak, 6acr, 6acy, 6ada, 6aen, 6agk, 6ahp, 6ahq, 6ahz, 6aic, 6aje, 6ajh, 6akl, 6ala, 6ald, 6amf, 6ano, 6aoa, 6ars, 6atj, 6atr, 6bgd, 6bmv, 6bnu, 7mf, 7st.

C. W.—6ea, 6eb, 6en, 6ft, 6jd, 6ka, 6lw, 6nm, 6pi, 6sg, 6zf, 6zz, 6aib, 6akw, 6alu, 6aqa, 6bes, 6bkb, 6bka, 6bkb, 6bla, 6xad, 7mf, 7zu, 9amb, 9ayu. My 3-watt C. W. been heard in Seattle, Wash., using 400 volts on plate, antenna current .5 amp.

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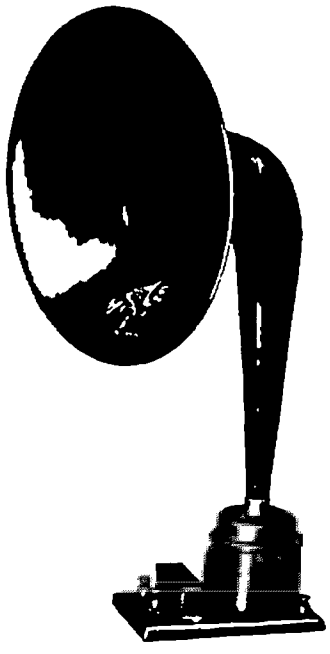
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R-3
Magnavox Radio with 14-inch horn

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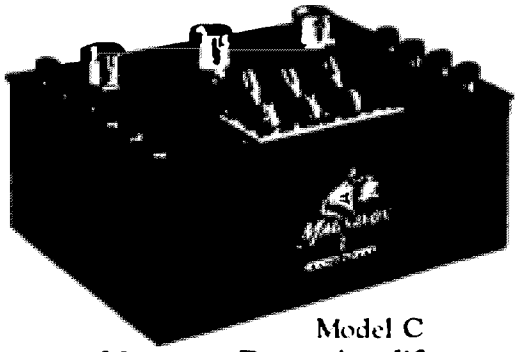
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Magnavox Power Amplifier

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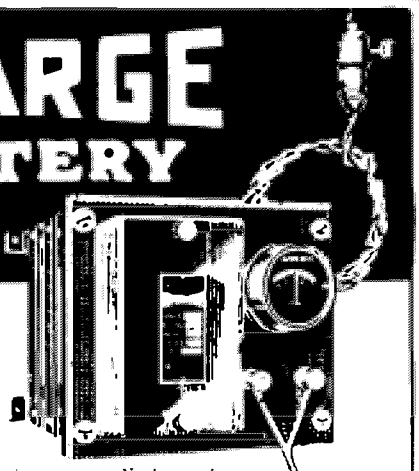
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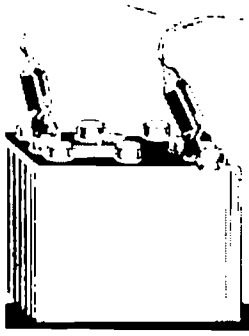
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BY 6ARB, BERKELEY, CALIF.

C. W.—(6ea), (6eb), 6en, (6fh), 6ft, 6ka, 6ku, 6rr, 6zb, 6zf, 6zn, 6zx, 6zz, (6aeh), 6akw, (6agp), 6alu, (6awp), 6beg, 6bes, 6bjc, 6bkb, (6bmn), (6bqc), 6bqg, (6bqq), 6bfk, 6zac, (7dp), 7ic, (7mf), 7na, (7oz), (7qt), 7qw, 7rn, (7sc), 7zu, 8awl, (9amb), (cl8).

Spark—6ec, 6cr, 6ct, 6ov, 6zd, 6ajr, 6akl, 6ald, (6ara), 6ars, 6asc, 6atf, 6avr, 7bh, 7bk, 7jd, 7nw, 7mf, 7tj, 9bd Canadian. All those hearing 6arb pse. QSL to C. E. Duncan.

BY 6BQL, 575 21ST AVE., SAN FRANCISCO, CALIF.

Spark—6cc, 6dd, 6eb, 6fh, 6gt, 6ic, 6iv, 6kc, 6ke, 6mh, 6od, 6oh, 6ol, 6up, 6va, 6wg, 6zu, 6aak, 6abw, 6abx, 6aei, 6ahp, 6ajh, 6ajr, 6akl, 6ald, 6all, 6aqv, 6aqx, 6ark, 6ars, 6asc, 6avb, 6avd, 6avm, 6avr, 6awx, 6bem, 6bmg, 6bpx, 7bk, 7fi, 7iy, 7kj, 7mf, 7nw, 7to, cl8, 9bd.

C. W.—5za, 6bf, 6ea, 6eb, 6ec, 6en, 6fh, 6ft, 6gy, 6jd, 6ka, 6ku, 6lo, 6oh, 6oy, 6rr, 6zb, 6zf, 6zg, 6zs, 6aat, 6aeh, 6alu, 6aos, 6awp, 6bbc, 6beg, 6bes, 6bet, 6bhk, 6bjc, 6bjy, 6bkb, 6bmd, 6bmn, 6bqc, 6bqq, 6bqp, 6bts, 6xas, 7na, 7qw, 7sc, 7xg.

All stations hearing my C. W. signals over a hundred miles please QSL with card.

BY 4KL, ASHEVILLE, N. C.

1ii, 1xm, 1qp, 1cak, 2zk, 2aab, 2sp, 2wi, 2ayv, (3rf), (3ca), (3bhl), (3blf), 3km, 3qu, 3fs, (4gh), 4do, (4ds), 4by, (4mi), (5ds), (5ku), 5za, 5aam, 5ho, 5fv, 5jb, 8ago, (8to), (8zg), (8and), 8awo, 8adm, 8agz, 8aii, 9akd, 9amd.

BY 7SY, GERARD DE BROCKERT, EUGENE, ORE.

6bk, 6cc, 6dp, 6fh, 6ku, 6lk, 6pj, 6tu, 6tw, 6xb, 6xf, 6xw, 6yr, 6zf, 6zg, 6zq, 6zr, 6zx, 6aak, 6aat, 6abx, 6acr, 6abw, 6abx, 6ajr, 6ale, 6alu, 6amk, 6ark, 6awh, 6beg, 6xam, 6xac, 6xad, kwg, klp, kij, kvq, kdn, kyj, kzy, kfu, kqw, ag1, 7ad, 7ba, 7bj, 7bk, 7bz, 7cd, 7ck, 7cv, 7fc, 7fi, 7ge, 7jd, 7kj, 7ly, 7mp, 7mu, 7nl, 7nn, 7nw, 7nz, 7rn, 7sf, 7wg, 7xf, 7xh, 7ya, 7yg, 7yj, 7yl, 7zp, 7zt, kfc, kgw, kyg, cl8, kgb, kgy, 7iy, 7ku, 9ax, 9bd, 9pi, 9amb, dd5.

BY 6OD, SOUTH PASADENA, CALIF.

Spark—5if, 5of, (5za), (6ak), (6ar), (6as), 6bm, (6bw), 6cc, 6cp, 6cv, (6dp), (6ex), (6fh), 6fj, (6fk), (6gf), (6gr), (6gt), (6gx), (6hc), (6hp), (6ib), (6ic), (6im), (6iv), (6km), (6kx), (6lu), (6mz), (6ng), (6oc), (6oh), (6pj), (6po), (6pr), (6qk), (6qr), 6qy, (6to), (6tu), (6tv), (6vk), (6vx), (6wg), (6wz), (6xh), 6zd, 6ze, (6zi), (6zj), (6zk), (6zu), (6zx), (6zz), 6zam, (6aah), (6aak), (6aau), 6abm, (6abu), (6abw), (6abx), (6acr), 6acw, (6ada), (6aeh), (6afp), 6afy, (6agf), (6ahf), (6aif), 6ajd, (6aln), (6ajh), (6ajr), (6akl), (6ala), (6amk), 6ang, (6ani), (6aoe), (6aor), 6ape, (6aqu), 6ark, (6ars), (6arw), (6atu), (6aud), (6avb), (6avm), 6avx, 6bak, 6bcj, (6bgl), (6biu), (6bjv), 7bk, 7bh, 7bp, 7fi, (7fj), 7ga, 7gj, 7gq, 7hf, 7in, 7iy, 7jd, (7mf), (7ot), 7tj, 7xd, 7zj, 7zt.

C. W.—5za, (6ak), 6fh, (6gf), 6hc, (6jj), 6ku, 6oo, (6zi), 6zs, 6zx, 6zz, 6aat, 6aeh, 6aav, 6awt, (6atp), 6bjy, 6bmd, 7mf, 7xf, 9dn, 9wd, 9ayu, 9amb, 9bji, 9dvs.

BY 6EA, 343 SO. FREMONT AVE., LOS ANGELES, CALIF.

C. W.—6fh, (6gf), (6gx), (6gy), 6lv, 6ni, 6nx, 6xc, 6zi, 6asj, 6atp, (6awt), 6bcd, 7lu, 7xg, 9amb.

Spark—6as, 6bw, 6cc, 6dp, (6ex), (6gr), 6hc, (6hp), 6ib, (6ic), 6kl, 6km, (6tu), 6uh, 6uo, 6vk, 6vx, (6xh), 6ze, (6abu), 6agf, 6aln, (6ajr), (6ala), (6amk), 6amz, 6aqu (Berkeley, Calif., now), 6ark, 6ars, 6atu, 6avb.

BY 6BQC, WM. SCHLAH, 1629 VINEYARD AVE., LOS ANGELES, CALIF.

C. W.—6ak, (6fh), 6gf, (6gy), 6gx, (6lo), 6lv, 6nx, 6oh, 6ti, (6zb), 6zs, 6aat, (6aeh), (6arb), (6asj), (6awt), (6bcd), (6bjy), 6bmd, (7na), 9amb.

Sparks—6ex, 6km, 6gr, 6zu, (6akl), (6ajh), 6ala, 6amk, 6aun.

Anyone hearing my C. W. pse. QSL.

BY 5KC, PLAQUEMINE, LA.

Spark—2fp, 3ao, 4as, 4bk, 4cg, 4ci, 4co, 4cs, (4cx), (4dh), 4gl, 4id, 4le, 4tg, 4zf, 5aa, 5ae, 5al, 5an, 5bi, 5bn, 5bq, 5bx, 5by, 5da, 5dw, 5ek, 5ed, 5er, 5ew, 5fa, 5fo, 5fv, 5gi, (5hk), 5hz, 5ic, (5ir), 5ji, (5jd), 5jr, 5kk, 5kp, 5la, (5lb), 5lo, 5mf, 5mt, 5my, 5nn, 5nc, 5nk, (5ns), 5pd, 5pe, 5py, (5px), (5qa), (5qt), 5qq, 5qs, 5ra, 5rj, 5rl, 5ro, (5sm), (5tg), 5tp, 5tu, 5uc, (5ue), 5ug, 5uj, 5we, 5wc, (5xa), (5xb), (5xi), (5xj), 5xl, 5xq, 5xt, (5xu), 5ya, 5yb, 5ye, 5yg, 5yk, (5yl), 5ym, 5yn, 5za, 5zb, 5zc, 5ze, (5zl), 5zn, 5zo, 5zr, (5zs), 5zt, 5zu, 5zv, 5zw, (5zx), (5zz), (5aat), (5aba), (5aby), (5zaa), (5zab), (5zac), (5zae), (5zaf), 5zai, (5zak), 5zan, 5zap, 5zar, 5zax, 8aa, 8aj, 8bk, 8vj, 8xi, 8xm, 8xv, 8ym, 8yu, 8xu, 8agz, 8afb, 8ard, 8axy, 8bbu, 8bfx, 8box, 8zac, 8zae, 9ac, 9ak, 9ap, 9ay, 9ca, 9dw, 9et, 9ev, 9ff, 9fk, 9fm, (9fu), 9fy, 9fz, 9gn,

Don't Strangle

Your Radio Set With a *Wire* Rheostat!

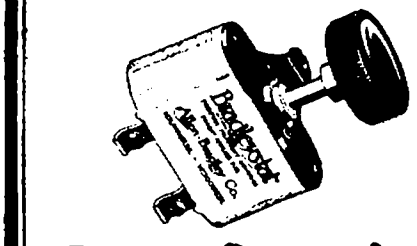


Install a Bradleystat for vacuum tube control

When you build a radio set, do not overlook that *vital* part of the set, the filament rheostat. Install a Bradleystat in each vacuum tube circuit, and you will be sure to get —

1. *Clearest and Loudest Reproduction,* because the Bradleystat stepless control locates the precise filament current for greatest amplification or detection.
2. *Quickest and Easiest Tuning,* because one knob, without vernier, does the work. There are no interfering noises, no loss of time, and no worry, as with complex wire rheostats.
3. *Greatest Receiving Range,* because noiseless control detects weak radiophone waves, and by locating exact filament current, amplifies the waves to fullest extent.

Remember, the most critical part of all tuning is done with the filament rheostat. Use Bradleystats in place of wire rheostats and get the most out of your radio set.



Bradleystat

REGISTERED U.S. PAT. OFF.

PERFECT FILAMENT CONTROL

Two columns of graphite discs (not loose carbon grains) provide the delicate control so vital and essential for vacuum tubes in radio sets.

A single adjusting screw gradually applies or removes pressure from the discs, thereby changing the filament current in such a smooth and stepless manner that you quickly find the loudest and clearest reproducing point of your tube.

The Bradleystat is so simple and efficient that thousands of radio enthusiasts are using them to the exclusion of all wire rheostats. Twenty years of experience and research have made such perfection possible.

Allen-Bradley Co.
Electric Controlling Apparatus
288 Greenfield Avenue
Milwaukee, Wis.



Retail Price

$1.85

Postage 10c extra

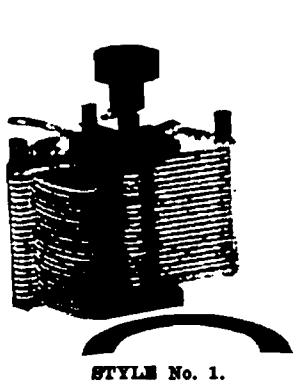
MAIL Coupon for FREE BOOKLET on V. T. CONTROL

Allen-Bradley Co.
Electric Controlling Apparatus
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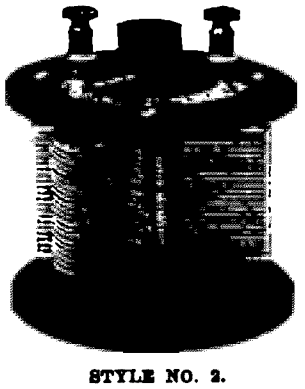
Please send me latest bulletin on Bradleystat Perfect Filament Control explaining how it will improve my radio set.

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STYLE NO. 2.

Three Styles: No. 1, Panel; No. 2, Open Type as shown; No. 3, Fully Encased. Anti Profiteer. Less than pre-war prices. Fully assembled and tested.

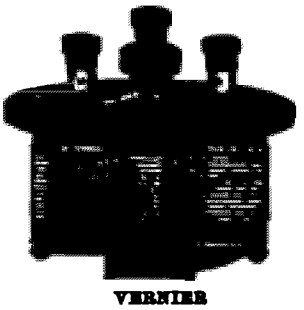
	Style No. 1	No. 2	No. 3
67 Plates,	$7.00	$8.00	$8.50
43 "	3.50	4.50	4.75
23 "	2.75	3.75	4.00
13 "	2.25	3.25	3.50

Money back if not satisfied. Just return condenser within 10 days by insured Parcel Post.

Options:—With Style No. 1—Instead of Scale and Pointer, a 3. inch Metal Dial at 50 cents extra, or a 3. inch Bakelite Dial at $1.00 extra. Large Knobs. Both excellent values. Or we will, if desired, supply the Condenser with smooth 3/16 inch center staff, without Scale, Knob and Pointer, at 15 cents off the list to those who prefer to supply their own dial.

Vernier with single movable plate applied to 13, 23 or 43 plate condenser, $3.00 extra.

We allow no discounts except 5 per cent on orders of 6 or more.

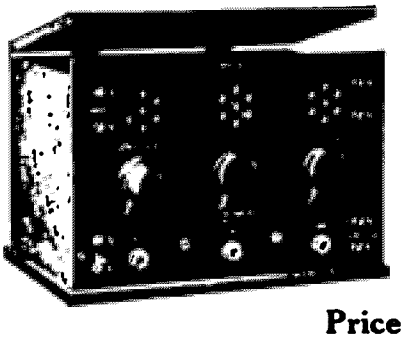


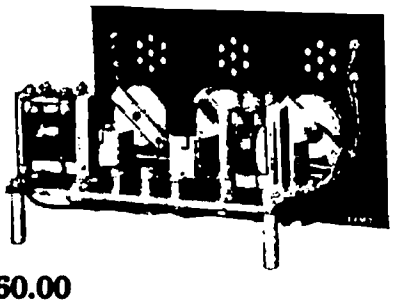
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Sent Prepaid on Receipt of Price
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Foreign Orders other than Canada not solicited.

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Detector—2 Stage Amplifier Unit

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Tell them that you saw it in RADIO

Continued from page 44

9hi, 9hm, 9hr, 9ht, 9iv, 9jn, 9jq, 9jt, 9jx, 9ka, 9kf, 9ko, 9lo, 9mc, 9mw, 9nr, 9oa, 9ox, 9pe, 9pg, 9ps, 9qj, 9rr, (9ry), 9tq, 9tv, 9ug, 9uu, 9vl, (9wi), 9wj, (9wt), 9wu, 9xi, 9xj, 9xm, 9ya, 9yb, 9yc, 9yi, 9yk, 9ym, 9yo, 9yq, 9yr, 9zf, 9zh, 9zj, 9zn, 9zy, 9aap, 9aby, (9acb), 9aeg, 9aek, 9aey, 9aig, 9ajh, 9ams, 9amj, 9amk, 9amo, 9amr, 9ams, 9anf, (9anq), 9aoe, 9aoj, 9aou, (9apn), 9aps, (9aqc), 9aqm, 9arx, 9ast, 9atn, 9avd, 9ave, 9avh, 9avk, 9avp, 9avz, (9axu), 9ayk, 9ayw, 9aza, 9azf, 9azh, 9bbf, 9bfg, 9bid, 9blo, (9bsa), 9dbs. 9dcx, (9deh), 9dhz, 9dmj, (9dqq), (9dsd), 9dsm, 9dwj, 9dzi, 9dzy, 9jif, 9mxu, 9xae, (9yae), 9yak, 9zac, an5, nzo.

C. W.—1bcg, xfi, 2xi, 2zk, 2zl, 3aqr, 3blf, 3zy, 4bb, 4bf, 4bk, 4bq, 4by, 4dc, 4eb, 4ft, 4id, 4ii, 4iv, 4kc, 4lp, 4ya, 4xb, 5aj, 5an, 5ba, 5bn, 5bl, 5dd, 5do, 5dv, 5eu, 5fo, 5fv, (5hb), 5ho, 5hr, (5jb), 5jl, 5ku, (5la), (5lj), 5ma, 5nd, (5nn), 5nk, 5nz, 5oi, 5ou, (5pb), 5rs, 5rl, 5sp, 5tk, 5tu, 5un, 5xb, 5xj, 5xm, 5xr, (5yg), 5yi, 5za, 5zg, 5aac, (5aba), 5acf, 5zad, 5zag, 6jd, 6zz, aa7, 7zu, 8bo, 8hj, 8hm, 8iv, 8pt, 8sp, 8uc, 8xb, 8xy, 8yz, 8zg, 8zz, 8abp, 8abv, 8aby, 8acf, 8aim, 8aqf, 8aqv, 8awv, 8azf, 8bau, 8bfx, 8box, 8brl, 8cfp, 8xak, 8zaw, 9ao, 9ar, 9as, 9dv, (9ei), 9fm, 9hk, 9hw, 9io, 9jd, 9jq, 9kp, 9lq, 9lz, (9nx), 9ps, 9sl, 9wa, 9wq, 9wu, (9uu), 9xi, 9xm, 9xr, 9ze, 9zg, 9zx, 9zy, 9aas, 9aav, 9aco, 9aix, 9aja, 9ajp, 9ajh, 9akb, 9akr, 9als, 9amb, 9aog, 9avn, 9aua, 9ays, 9bbf, 9blk, 9biz, 9bjb, 9bkz, 9blo, 9bsg, 9dax, 9ddf, 9dgq, 9dkh, (9dky), 9dts, 9dtw, 9dun, 9dyn, 9dxo, (9dxq), 9vno.

Phones—6wv, 9vno, cm4, kdka, kyw, nof, wfc, wha, whb, wjz, wok, wpk, wrr, wrw, wsb, wwj, wbap.

All stations who have heard Radio Station 5kc please QSL. Use both spark and C. W.

BY 7SG, ABERDEEN, WASH.

Spark—6abu, 6abw, 6abx, 6aih, 6ajh, 6akt, 6ala, 6amk, 6amz, 6ang, 6ar, 6ark, 6avb, 6bb, 6bne, 6cc, 6fh, 6gf, 6gr, 6gt, 6hc, 6hp, 6ic, 6km, 6tc, 6tu, 6vx, 6zu, 7adr, 7aea, 7aeq, 7agi, 7bg, 7bk, 7bs, 7ck, 7ey, 7fi, 7fq, 7ge, 7ic, 7in, 7iy, 7jw, 7ke, 7mz, 7of, 7ot, 7pq, 7tj, 7to, 7tw, 7ve, 7vf, 7zp, 7zs, cl8, Canadian 3ec, 9bd.

C. W.—6aat, 6aot, 6arb, 6asj, 6awp, 6awt, 6bmd, 6bmn, 6bql, 6bsa, 6ea, 6en, 6fh, 6ft, 6ik, 6ka, 6km, 6ku, 6zf, 6zg, 6zx, 7fr, 7lu, 7na C. W. and voice, 7oz, 7qb, 7qw, 7rn, 7zo, 7aea, bq3.

RECENT PATENTS

Continued from page 34

the disturbances. A by pass circuit including a rectifier 19 is also provided so that only the negative half waves of the signals influence the grid 13. When the plate 23 is positively charged it increases the flow of plate current, and when negatively charged it has no effect since it is not interposed between the electrodes. The result is that the negative half waves of the disturbances can have no effect because the potential of plate 23 nullifies any effect, and positive half waves are shunted through the rectifier 19.

L. DeForest, Pat. No. 1,417,662; May 30, 1922. Radiosignaling System.

An oscillating audion circuit is disclosed. There are two branches to the plate-filament circuit—one through condensers 3 and 7, and the other through conductors 9 and 10 and d. c. source 11. A so-called "tickler" circuit, which is the feature of the invention, is provided from the grid to the filament 8, and includes a coil coupled to the antenna coil 2, high leak resistance 14 and a condenser 15 across the resistance. It is claimed that such a circuit as disclosed is simple and efficient in operation.

T. R. Bunting, Pat. No. 1,418,066; May 30, 1922. Radiotransmitting System.

A duplex transmitting system is described, in which there are two paths, 3, 4, and 3a, 4a for the transmission of radiations. The arrangement is such that when radiations are sent from one branch, the constants of the other branch are so fixed that it is opaque to the transmitted signal.

E. F. Bell, Pat. No. 1,418,518; June 6, 1922. Quench Rotary Spark Gap.

A rotatable insulating disc 12 carries flat electrodes 13, arranged to be driven by shaft 35 past stationary posts 14. The sparks are formed between members 13 and 14. The entire mechanism is enclosed in an air tight

Continued on page 48



A Word About Price!

Something that everyone interested in Radio should know

THE Automatic Electric Head Set has been developed and completed to give a maximum loudness and clearness under all conditions.

Some of the outstanding features have been discussed in these pages. Price has been quoted at $10.00, with plug attached $11.50. This is a *fair* price. It covers development and manufacturing costs plus a reasonable profit.

On account of the widespread demand for Radio equipment, it is difficult to judge real values by the various prices you see quoted. High price may not necessarily mean commensurate quality. That is why it is safer to buy a product whose origin you *know*.

Automatic Electric Company has been making high class telephone apparatus for over thirty years. This perfected Radio Head Set is the result of years of experience and technical knowledge, backed by the reputation of this house. And it is our aim to give you the best Head Set ever produced, to fit all requirements.

Some of the Important Points of Superiority of the Automatic Electric Head Sets are:

Single pole construction —(a single powerful electro-magnet which takes effect at the exact center of the diaphragm).

The ***soft iron magnetic path*** assures minimum loss of strength and character to the diaphragm vibrations.

The ***coil design*** — a single coil wound on a cylindrical core. No sharp corners. The core of the coil is very small and the electric resistance per average turn is correspondingly low.

High resistance, as you know, sounds impressive but means practically nothing. The thing that counts most is PROPER effective impedance. This is governed chiefly by the number of turns of wire, amount of iron in the magnetic circuit, and its construction.

If your dealer sells high class Radio apparatus, he can tell you all about Automatic Electric Head Sets. Ask him. If he cannot supply you, order from us direct. Price is $10.00, postpaid—with plug attached $11.50.

AUTOMATIC ELECTRIC LONG RANGE RADIO HEAD SETS

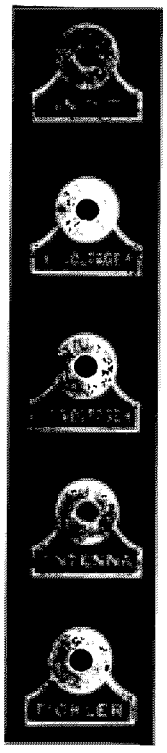
Automatic Electric Company

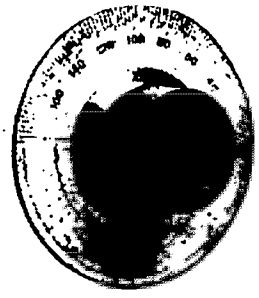
ENGINEERS, DESIGNERS & MANUFACTURERS OF THE AUTOMATIC TELEPHONE IN USE THE WORLD OVER

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This is the high grade plug that comes attached, when desired, to *Automatic Electric Head Sets*. It will take care of any kind of jack and will accommodate two head sets. With this plug attached to your Head set you can be sure the head set is properly "poled."







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4 FOR 25c

"Slip under the binding post like a washer"

Do away with engraving and prevent mistakes in hooking up your panel.

Stock readings are:

Antenna	Lo-Voltage—
Ground	Input
Hi-Voltage+	Output
Hi-Voltage—	Tickler
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WESTERN JOBBERS WRITE

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For 3/16, ¼ in. shafts
4 in. diameter.....$1.75
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Knob only ..... .60

Postpaid from us by return mail, or from your local dealer.

This is the first metal dial with flanged knob and has the following exclusive advantages over imitations:

The knob is of real bakelite and will retain shape and finish.

The dial is of brass, heavily plated with real silver and coated with a special non-peeling lacquer, which preserves the silver finish long after nickel dipped and "German" silver dials are mottled and tarnished.

The heavy brass bushings and special method of assembly assures a dial which runs true on the shaft.

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The dial is insulated from shaft bushing, and when grounded acts as a shield from capacity effect from body.

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..Transparent celluloid plate with black hair line allows a very accurate reading.

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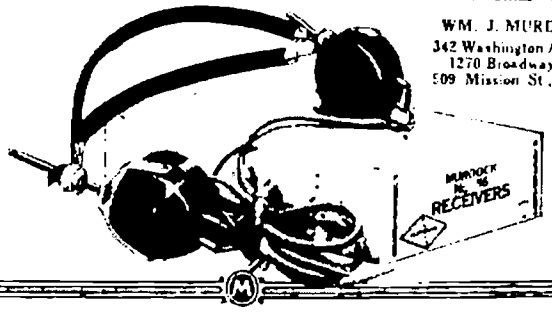
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Continued from page 46

case 10. The feature of the invention resides in the provision of the conical spring 45 bearing against the end of the driving shaft 35 for preventing this shaft from moving longitudionally and thus destroy the alinement of the contacts.

A. A. Oswald, Pat. No. 1,418,729; June 6, 1922. Portable Radiating System.

An antenna structure for an airplane is described, in which two wires 1, 2 are connected in parallel by wire 3, and form one side of the system. The other side of the system consists of the metallic body of the airplane. In order to reduce energy losses, the wires 1, 2, and 3 are spaced a considerable distance from the plane, as by means of the flexible cords 6 and 8, and the rigid strut 9. Such an antenna system has much better properties than a single wire, or a double wire in which one serves as the counterpoise for the other.

H. W. Weinhart, Pat. No. 1,419,528; June 13, 1922. Electron Discharge Device.

A three-electrode thermionic device is described having a pair of plates rigidly connected by wires 28 and 29, and a pair of grids supported by wires 24 and 25 at the top of a standard 3. These wires permit longitudinal movement of the grid. The filament 4 is supported at the top by resilient wires 12 and 13, which take up any expansion of the filament and insure that it be stretched always. These supports contribute to the reliability of the entire device.

W. Wilson, Pat. No. 1,419,530; June 13, 1922. Thermionically Active Substance.

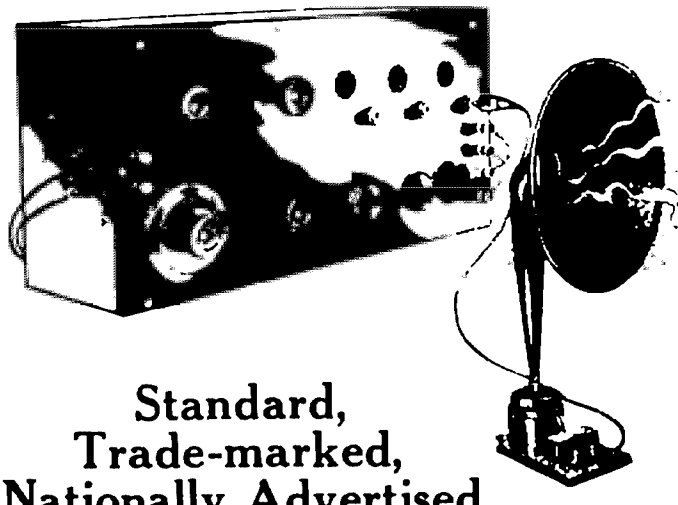
A thermionic cathode for tubes is described, and a method of making it. The cathode wire is iron or nickel, successively coated with carbonates of barium and strontium. The resulting activity is stated to be comparable to that of a platinum filament similarly coated. In order to manufacture it, an iron or nickel wire 3 is enclosed in an evacuated vessel 4, in which is located coating material 2 near the wire. Simultaneous heating of the wire 3 and of the material 2 causes the sputterings of the material to adhere to the wire.

C. D. Ehret, Pat. No. 1,419,547; June 13, 1922. Electronic Apparatus.

A thermionic device is described, including a vessel, the upper portion V of which is entirely separated from the lower portion V by a thin plate K forming a cathode. The elements F, G, and K in the lower portion operate as an ordinary 3-electrode device. Due to the thinness of K, however, and to the fact that it is coated with electron discharging material, the impinging of electrons on the lower surface of K causes the upper surface to emit electrons and thereby cause current to flow through the primary p. A source *a* may vary the quantity of this current by varying the potential of grid G, with respect to cathode K, or the quantity may be varied by the microphone arrangement m, or both means may be utilized.

H. W. Nichols, Pat. No. 1,420,055; June 20, 1922. Selective Receiving System.

In order to prevent interference from a strong station having a frequency near that of the station from which it is desired to receive, detector tubes 3, 6 and 9 are arranged in tandem, so that they transmit even harmonics of the carrier wave. It has been found that such tubes produce even harmonics in the plate circuit, and this property is taken advantage of. Thus circuit 2 is tuned to fundamental frequency, while circuits 4 and 6 are tuned to the first even harmonic. Circuits 7 and 8 are tuned to the second even harmonic. The process may be carried on until sufficient selectivity is obtained.





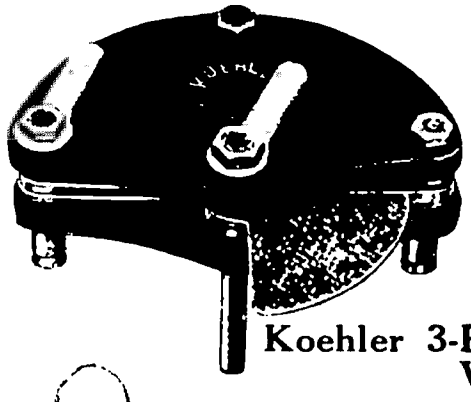
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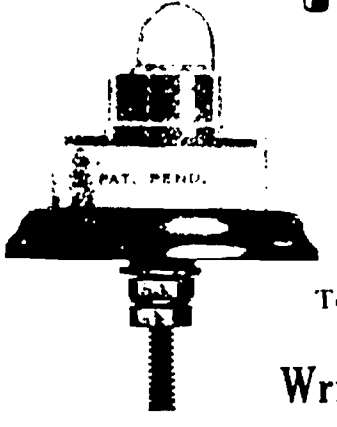
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Heavy aluminum plates, **thick Bakelite ends,** other parts of brass, **nickel-plated** .000075 MFD capacity. **Accurately manufactured** and carefully tested. **Koehler Condensers** have made good. Also **made in other sizes.**

List $1.50



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No trouble selling this **fixed detector. Stays** adjusted. Guaranteed **tested crystal in dust-**proof glass cup.

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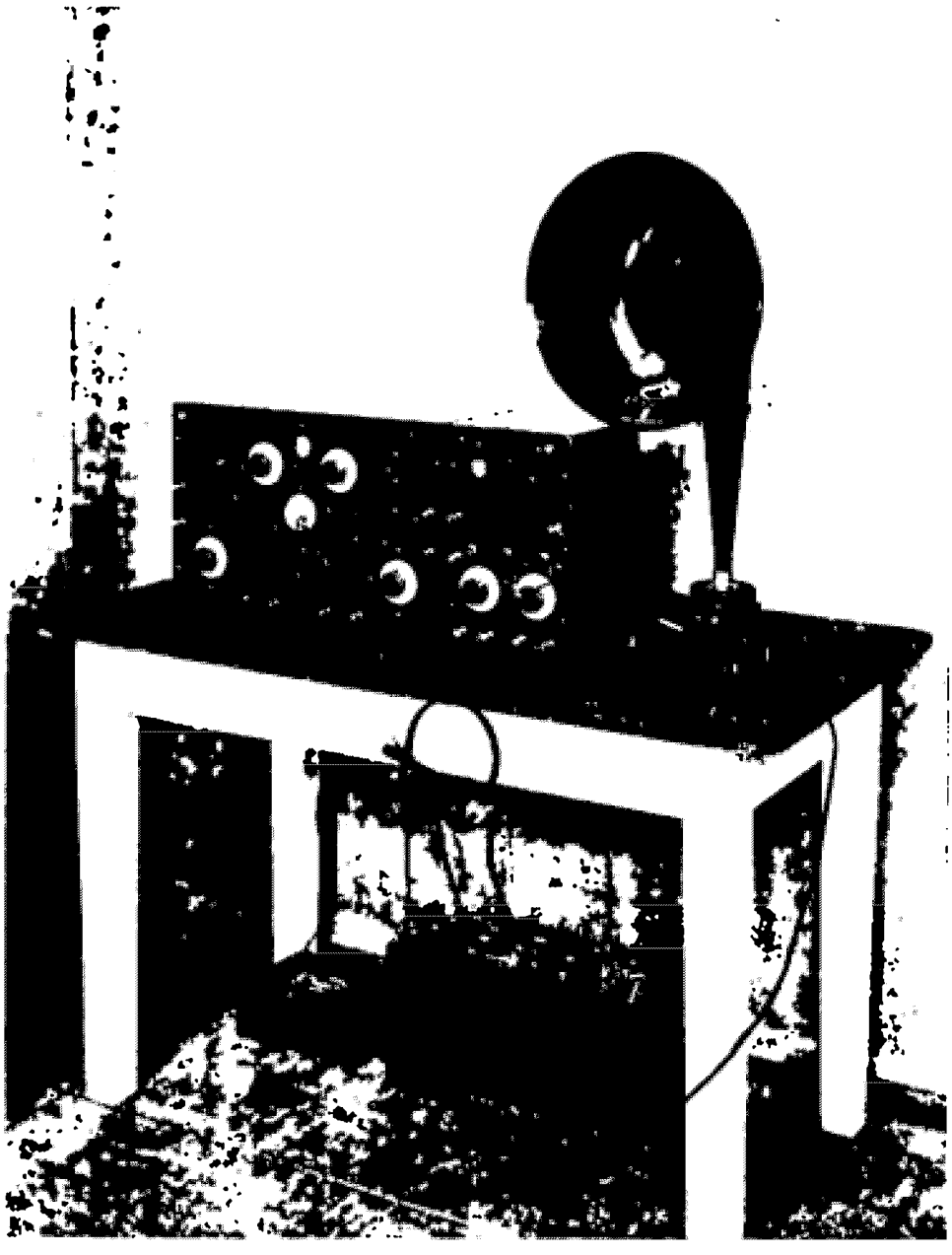
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We also have everything else in stock that you want

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PROFESSIONAL RADIO OPERATOR

Continued from page 14

Francisco every spring in the Alaskan salmon-fishing fleets to operate the fishing companies' land stations up in the Bering Sea and Alaskan Peninsula canneries. Since each salmon cannery relies wholly upon its wireless equipment for communication with the other canneries and with the outside world (via the Alaskan naval radio stations), the radio stations are regarded as very important units, and the fishing companies are therefore generally at pains to get experienced operators.

As these cannery stations are isolated, the operators must be competent to maintain and repair their own equipment, as well as operate a gasoline or Diesel engine. The radio men are taken up to Alaska with the fishing-crews on old-time sailing ships, or sometimes on small steamers, departing from the Pacific coast in April and returning in September—except that in some of the fisheries on the Pacific side of the Alaskan Peninsula, the operators stay the year round. The salaries paid to the radio men in these stations range from $110 to $160 a month, with food served in the superintendent's mess, a comfortably furnished shack, and plenty of free coal. During four years of the time when the dishwasher wages prevailed at sea, I made this region my stronghold; and being therefore extremely well acquainted with it, I advise no one to go into the Bering Sea country who does not have a thirst after adventure and is willing to suffer hardships. It is a place, however, where money can be not only made, but kept.

THE RADIO OPERATOR'S FUTURE SALARY

WITH international affairs and world commerce in their present chaotic condition, and with universal industrial unrest, temporarily lulled by war wages, again fomenting, it is as difficult to forecast what the future will bring to us in regard to wages as in regard to other things—though it may be safely assumed that the more technical and the more highly skilled a profession becomes, the more secure will it be from unfavorable change. Viewing the radio situation from all angles—and barring another great war, which of course is improbable just now—I think that the prevailing shipboard operator's salary during the next six or eight years will be about eighty dollars a month, and the land-station operators' $135.

One thing is sure: the radio operators' wage will never again descend to the scullery-boy stipend of 1914. This is as nearly an impossibility as anything can be. Under present conditions, with an ethereal inferno of interference to contend with, and with careful radio compass work being constantly required,

Continued on page 52

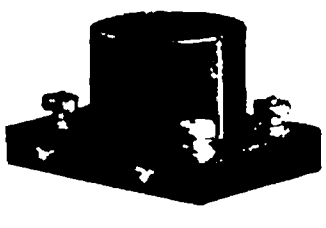
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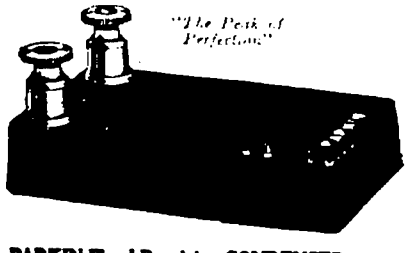
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Your dealer is glad to have you choose PARKIN "Peak of Perfection" Parts and Supplies—he knows he can stake his reputation on them. For PARKIN Parts are produced by *experienced* radio manufacturing—*PARKIN since 1911*. That is the dealer's assurance of dependability as well as your guarantee of perfect satisfaction. To be sure of getting "Peak of Perfection" quality, demand PARKIN every time you make a radio purchase. The price is no higher. Send us your dealer's name and we will send you FREE, postpaid, the PARKIN "Radio Buyer's Guide" No. 6



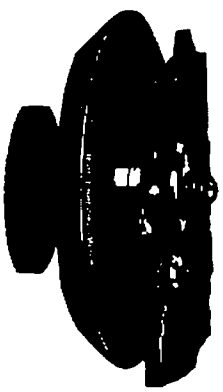
PARKIN VT SOCKET
panel or table mounting—$1.00

—for maximum insulation. Moulded of genuine Bakelite, highly polished; contact fingers, binding posts, screws, and washers nickel plated. Base 2½" by 2¼", marked for proper connections. Price includes screws for panel mounting, and holes drilled for table mounting. *Order No. 78*—price *$1.00*.



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Regulation type for use with receiving circuits. The binding post screws are soldered to the unit, and with the unit moulded solidly into an unbreakable Bakelite base, making a sturdy and attractive one-piece instrument. *Order No. 83*—price *70c*.

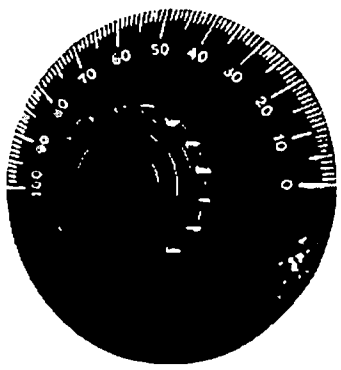


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75c



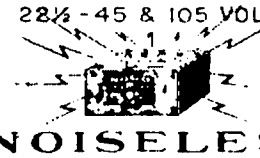
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Ask your dealer; if he cannot supply, write us.
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Davenport, Iowa, U.S.A.

Continued from page 50

radio operating has been placed beyond the abilities of the one-trip tourist and the "cheap" operator. But this is only one point.

The ship-owner, learning at last that there is no more occasion for renting a radio set than there would be in leasing the ship's engine or anchor-winch, is discarding leased wireless apparatus and buying his own. And then, since the set belongs to him, he expects his operator to maintain it for him; he expects the operator to make repairs and adjustments; and, in short, to handle the ship's radio department as the chief engineer manages his, and the chief steward his.

Even in the case of the leased wireless sets, of which, it is true, there are still a good many, especially on the Atlantic, the upkeep of the radio equipment is passing more and more into the hands of the operator. The Shipping Board, who are owners, not leasers, of their radio apparatus, furnish several hundred dollars' worth of spare parts and tools, and expect the operators to maintain their equipment.

This obviously requires a more competent and in turn a better paid operator than was formerly employed. Under the old regime of the leasing companies, the wireless operator was truly a mere thrower of switches and a key-puncher. A company inspector in every port made every trifling repair and adjustment; the finding of a pair of privately-owned head telephones anywhere in the wireless-room—even among the operator's private belongings—was the occasion of a severe reprimand; and the foolhardy brasspounder who, failing sufficiently to reverence the bit of dusty gravel in the crystal detector, dared to employ his own private piece of tried and true galena, if caught, was made to feel as if he were the perpetrator of some dastardly crime. Today, all is changed; so vastly changed, indeed, that it is sometimes hard to remember that the old order ever existed. The modern radio operator not only is allowed to be in full charge of his station, but is expected to be.

In view of all the foregoing, and considering the certain rehabilitation of the radio men's protective associations, which were almost wiped out during the 1921 strike, it may seem to some that the operators' salaries should increase rather than decrease; but in this I can hardly agree. If the reader does not agree with this, he will at least admit that the ship-owners are not going to pay anything more than they find necessary to obtain sufficiently good operators.

Compensations for Moderate Salary

IF the shipboard radio operator's salary is modest, there are, at any rate, many compensating advantages. He has

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his meals with his fellow officers and the captain; and his accommodations are of the best. The food supplies put aboard ship are usually of excellent quality—though they are sometimes indeed hodge-podged by incompetent cooks who missed their calling as concrete-mixers. This is the exceptional case, however; and in general the meals, service, and accommodations furnished the radio operator aboard ship would cost him fully seventy-five dollars a month ashore.

On the freight and oil-carrying ships, or on any vessel carrying but one operator, the wireless man's duties are very light, his traffic being mostly confined to messages concerning the movement or operation of his ship. Although he may be at his apparatus at various hours of the day and night, he is not confined to his instruments by specified watches. Even in cases where watches are specified, they are not at all onerous.

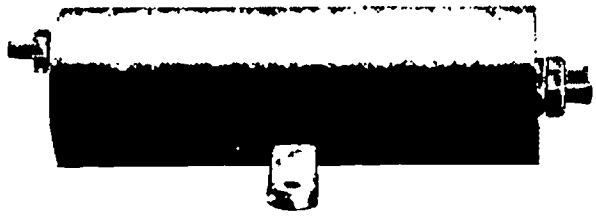
When approaching land in foggy weather, necessitating frequent radio-compass bearings, or when putting through important messages at great distances and under difficulties in the form of interference, static, and inefficient coastal station service, the operator may be obliged to put in a good deal of time at his set; but in the general run of things, his number of actual working hours daily need not be more than from six to eight. The wireless operator necessarily does most of his work at night, being up usually until midnight or sometimes later; but then he can sleep luxuriously until nine or ten o'clock in the morning—which is a privilege denied at least to milk-wagon drivers.

It will be seen that the radio operator has a great deal of spare time on his hands; and this he can devote to reading and study. Many, however, instead of taking advantage of their splendid opportunity for self-improvement by such means, choose rather to idle away their leisure hours in card-playing and other things of no account; and some again are veritable Rip Van Winkles, with a narrow trail worn in the deck from their napkin-rings to their bunks. A good many ambitious young operators, on the other hand, are subscribing to correspondence school courses in electrical engineering and other high professions; and while it is granted that such work can not be mastered solely by correspondence school training, yet companioning with good books and a little earnest study will do wonders.

Passenger Ships Less Desirable

IN the foregoing, only the position of the operator on the freight and oil ship has been presented. In the case of the passenger liner, the wireless operator's working conditions are in some respects a great deal less pleasant. The large Shipping Board passenger ships carry three operators, but the great ma-

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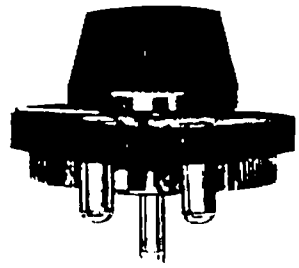
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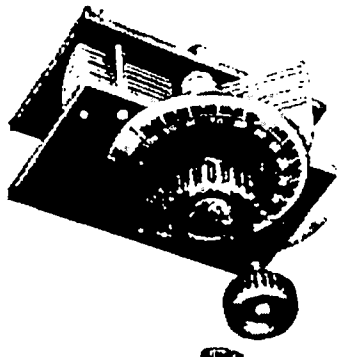
SAY, FELLOWS:

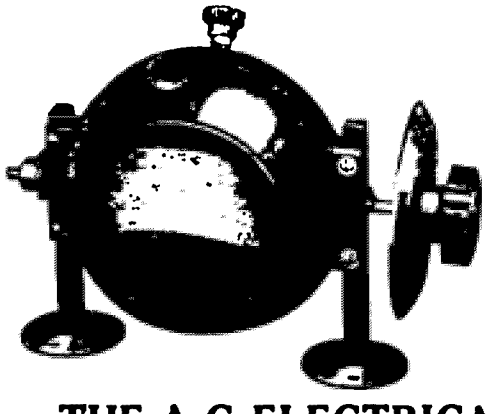
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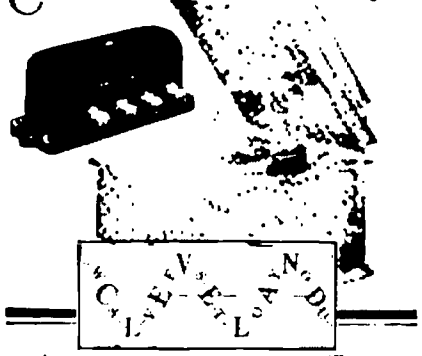
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jority of the passenger steamers carry only two; and since a continuous watch is legally required on such vessels, this means that each operator must put in twelve hours at the apparatus every day, usually in two six-hour shifts.

On the smaller passenger ships, the watch is mostly a mere matter of listening in, and here it is still possible for the operator to do some study work; but on the great liners there is a constant and heavy message traffic to be handled, and a large wireless newspaper to be prepared, which leaves no leisure time. It is a peculiar fact, too, that despite the vastly greater amount of work that must be done on the passenger liner, the remuneration on these ships is in no case more than fifteen or twenty dollars a month above the salary of the operators on the freighters and oil-tankers, and as a general rule the rate of pay on both kinds of ships is exactly the same. The passenger-ship operator receives a commission on wireless newspaper sales; but then again he is compelled to buy expensive uniforms, which the tramp-steamer operator does not have to wear. The cash bonuses formerly paid to passenger-ship men for commercial traffic handled have long since been discontinued.

There is one privilege enjoyed by both the tramp-steamer and the passenger-ship operator that is common to no other member of the ship's complement; while his vessel is in port he has no duties whatever aboard. He is free to put on his other shirt and shove off ashore to follow his own individual bent, whether it be ice-cream sodas or flirtations in the park. Herein lies an immensely valuable educational advantage peculiar to the radio operator; his profession enables him to become intimately acquainted with foreign countries and peoples, which others spend thousands of dollars merely to visit.

RADIO FREQUENCY AMPLIFICATION

Continued from page 16

Where quality of reproduction must be retained at all costs, the answer seems to be multi-stage untuned amplification. This means a large outlay for tubes, for with most present tubes the amplification from a single stage is not great. There is the possibility of using the same tubes again for audio frequency amplification, which reduces the importance of this factor.

So, now, what to expect from radio frequency amplification?

With care, good apparatus and an expert knowledge of your hook-up, expect an increase in range worth going after, but not phenomenal. After you have made one step "perc," try another.

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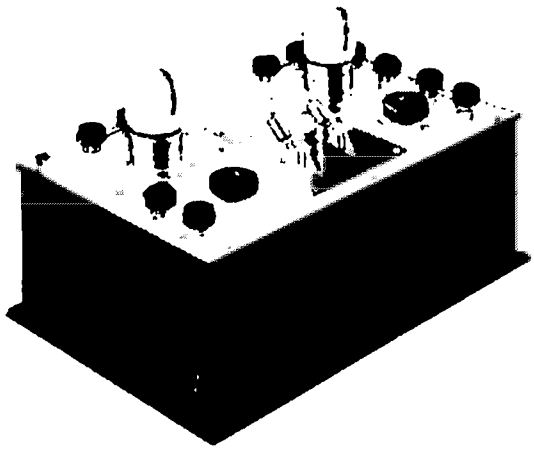
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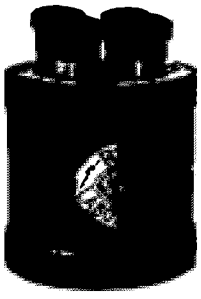
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THE CONSCIENCE SHOP

Continued from page 21

With the generator going steadily, he pressed the key and a large, peculiarly formed lamp bloomed forth with a soft light.

"That is the heart of the instrument—the auditron tube," Walter explained. "When I talk into the transmitter, the auditron tube converts the current into waves which my voice interrupts. These interruptions impinge upon the receiving instrument and are in turn reproduced into sounds. Now for the test!"

"Homer Madsen! HOMER MADSEN! HOMER MADSEN!" he said distinctly, each time with increasing loudness. There was a slight flurry of light particles in the lamp and that was all.

At the moment Walter turned on the auditron tube, Madsen, comfortably attired in his dressing gown and Chinese slippers, was following his nightly custom of dipping into a book before retiring. He was in the act of lighting a fresh cigar when, without warning, a voice spoke to him, coming, as far as he could determine, from nowhere at all.

"Homer Madsen! HOMER MADSEN! HOMER MADSEN!" it said distinctly.

Madsen jumped from his chair with a startled exclamation. The room was empty, save for himself. Through the half-opened door he could distinctly see the interior of his bathroom. The adjoining library was also unoccupied. The butler and other servants he knew were on the lower floor. Could it be that he was dreaming?

"I must have fallen asleep," he said to himself. He glanced at the clock; it was just 11. He had been home half an hour—more tired, probably than he realized. He would go to bed.

He had just removed his dressing-gown when out of thin space the voice spoke again.

"Homer Madsen!" it repeated.

Madsen halted. A cold chill crawled up his spine and into his hair. The cold perspiration began to start out all over his body. Slowly he turned his head and looked about the room. It was absolutely empty.

"Homer Madsen!" The voice was speaking again. There was a queer, incisive, metallic quality about it. "You are a crook. You have helped Marcus Waterford rob those who trusted in you and your company. You alone have been responsible for the juggling of the Development Oil stock. You must return that money. You will hear from me again!"

That was all. Motionless, hardly daring to breathe, Madsen heard the indictment through to the end. He stood frozen to the carpet, a figure of abysmal terror. He knew that he was awake,

Continued on page 58

"Northern Radio will supply it"

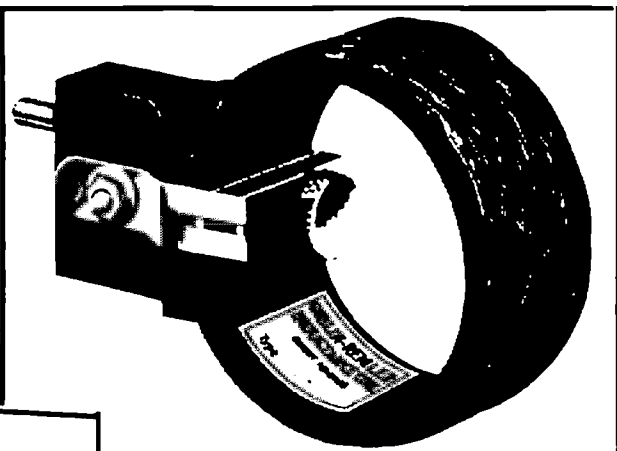
The above caption has become more than a trade expression. Every one who has ever placed an order with this house, regardless of how small, has realized the above statement. The slogan, "Northern Radio will supply it," has been broadcasted far and wide. We are not only living up to it—we are building our business around it.

Below we have listed a few of the many quality radio items upon which we can make immediate deliveries. Our stock is complete and is not devoted principally to any one manufacturer. Write or wire us your radio needs. Realize the pleasure as well as the profit of dealing with a house that can actually make deliveries.

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TYPE "C"
Loud Speaker Units

Price $7.75 each

Immediate Delivery

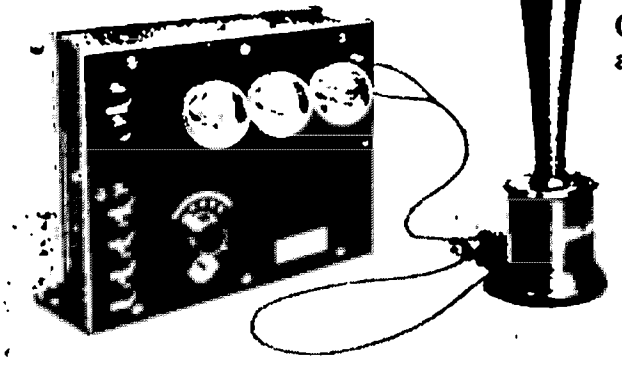


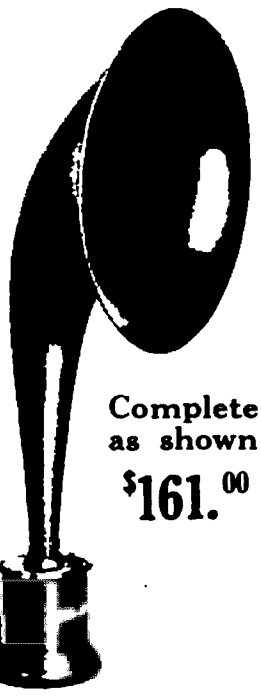
Giblin-Remler Inductance Coils
All sizes from 20 to 1500 turns



Remler Type No. 100
3-inch Bakelite Dial with Knob and Bushing
Price 75c

Western Electric 3 Step Power Amplifier. There is no distortion of signals and for true reproduction it has no equal.



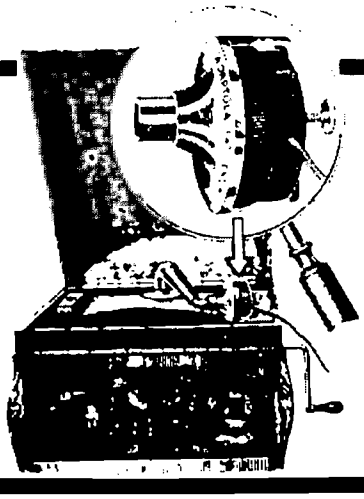


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The ADAPTOLA may be attached to the tone arm of any phonograph. It acquires the sound between the head-piece and the tone chamber of your phonograph and insures the finest possible reproduction of music or spoken voice. The ADAPTOLA offers those who own phonographs the most perfect loud speaker obtainable. Fits any standard phono and all makes of phonographs

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Has Underwriters' O.K.

Used and recommended by largest radio concerns in the world.

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Lead-in wires shall be..... approved copper clad steel: ...not less than No. 17 B & S gage may be used....

The ground wire may be..... approved copper clad steel: .....not smaller than No. 17 B & S gage....

The ground conductor may be .....approved copper clad steel, not less than No. 17 B & S gage....

Buy Copperweld Wire in Cartons

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No. 17 Rubber-Insulated (25 ft., 50 ft. and 100 ft. cartons)
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96 Worth St., New York. Phone Franklin 1144

Tell them that you saw it in RADIO

Continued from page 56

and that a voice had spoken to him out of space. A voice that threatened him with—what? His eyes roved about the room. There was nothing to explain it—absolutely nothing.

In a sudden reflex of fear he rushed across the room, stumbling like a drunken man. He pressed the call-bell and continued to press upon it until he brought the butler tumbling upstairs with the other servants at his heels. They found Madsen in a towering rage in which fear mingled closely with the simulated anger.

"There is someone in this room—someone who has threatened me," he roared at them. "Find him—find him. Look around, can't you? Don't stand there like a bunch of dummies. What do I pay you for?"

Obediently, not understanding what it was all about, the butler and the others began to poke about the apartment, peering into the closets, behind doors, under the bed and chairs. Their efforts brought them nothing. They returned to where Madsen, with shaking hands, was pouring himself a drink from the cut-glass decanter, and reported that no one was to be found.

"Tell the chauffeur to get out my car," he snapped with sudden decision. "I'm going to the club."

Ten minutes later he hurried from the house, and snapping the order to his astonished driver, sped toward the city in defiance of all traffic regulations.

While this drama was being enacted at Madsen's home, Walter and Katie, in the offices in the Mainwaring building, were almost hugging each other in pure joy. Walter was certain the experiment had worked. But if he had needed any proof of it he received it a few minutes later when in answer to a telephonic question of the exchange operator at the Papyrus Club, he received the assurance that "Mr. Madsen has just come in, sir."

"I'd give a fortune to look at his face," said Walter, as he turned toward Katie with the information that they had succeeded in driving Madsen from home. Katie laughed in delighted assent.

"I think we had better—or, I had better—go now. There is nothing more to do tonight, is there?" she asked.

"No," Walter cheerily replied. "We've ruined Madsen's rest for one night. However, that's not the big thing. We have begun to drive the idea home. And Madsen is not the only man who has been startled when brought face to face with his conscience for the first time!"

HOMER MADSEN faced the following day with a strange admixture of emotions. For one thing, he had

Continued on page 60

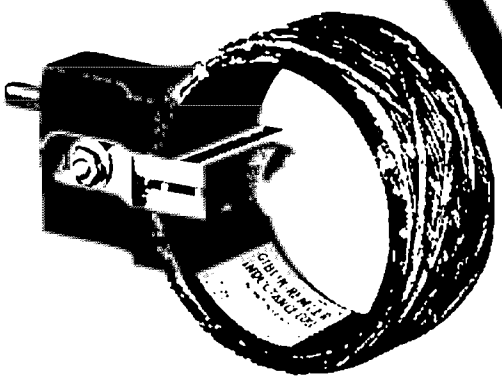
REMLER Cunningham

Giblin-Remler INDUCTANCE COILS

APPARATUS THAT RADIATES QUALITY

Type and Number of Turns, Mounted	Price, Mounted	Type and Number of Turns, Unmounted	Price, Unmounted	Inductance in Millihenrys at 1000 cycles. Accuracy ½%	Natural Wave Length in Meters. Accuracy ½%	Distributed Capacity, in micro-micro-farads, Accuracy 1%	Wave Length Range in Meters using Condenser of .001 max. and .00004 mfd. min. Min.	Max.	High Frequency Resistance in Ohms at Wave Length shown 200	500	1000	2000
RG 20M	1.50	RG 20U	.70	.030	39	14.3	63	334		1.1		
RG 25M	1.50	RG 25U	.70	.041	47	15.2	75	389		1.5		
RG 35M	1.50	RG 35U	.70	.083	87	25.4	128	550		3.5		
RG 50M	1.60	RG 50U	.80	.169	114	21.6	185	785		8.8	4.4	
RG 75M	1.65	RG 75U	.85	.377	163	19.8	266	1170		28.3	12.1	6.2
RG 100M	1.70	RG 100U	.90	.666	217	19.9	358	1550		80.3	26.8	12.6
									1000	2000	5000	10000
RG 150M	1.75	RG 150U	.95	1.503	281	14.8	512	2320	69.8	23.8	7.1	
RG 200M	1.80	RG 200U	1.00	2.68	374	14.7	690	3110		50.6	12.5	
RG 250M	1.90	RG 250U	1.10	4.20	424	12.1	860	3880		87.5	19.9	
RG 300M	2.00	RG 300U	1.20	6.11	494	11.2	1030	4680		141	29.3	13.8
RG 400M	2.10	RG 400U	1.30	11.04	618	9.7	1380	6300			54.6	22.3
RG 500M	2.30	RG 500U	1.50	17.50	747	9.0	1730	7900			93.1	34.9
									2000	5000	10000	20000
RG 600M	2.40	RG 600U	1.60	29.2	1024	10.1	2260	10250		111	43.8	
RG 750M	2.65	RG 750U	1.85	39.0	1249	11.3	2660	11850			64	
RG1000M	3.40	RG1000U	2.50	71.6	1620	10.3	3570	16000			123	
RG1250M	3.80	RG1250U	2.90	108.0	1930	9.7	4380	19700				
RG1500M	4.40	RG1500U	3.50	159.8	2300	9.3	5300	23800				

This table compiled by Robert F. Field of Cruft High Tension Electrical Laboratory, Harvard University, Cambridge, Mass.



Maximum Inductance and Minimum Distributed Capacity

The Ideal Loading Coil

These new inductance coils will increase the wavelength range of your short wave receiving set.

There is nothing more fascinating than the reception of radio messages from high-power stations located thousands of miles away. These stations use wave lengths between 1000 and 25,000 meters. This is far above the receiving range of the average receiver designed for amateur broadcast reception.

Inserting Giblin-Remler Coils of the proper values (determined from the table shown on this page) and shunted by a variable condenser, in series with the antenna circuit and the secondary circuit of your receiver, will increase its wavelength range any desired amount.

The Giblin-Remler Coil makes possible the reception of high-power, long wave foreign stations, as well as time signals, press and weather reports from various naval stations thruout the United States.

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RADIO EQUIPMENT

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Connecticut Tel. & Elec. Co., Meriden, Conn.

Tell them that you saw it in RADIO

Continued from page 58

been rocked to the foundations of his being by the strange occurrences of the night before. Had anyone tried to convince him that a voice could speak out of thin air and threaten him with some mysterious punishment for some connection with a business transaction, he would have laughed at them. And yet there was within him the still small urge of that mysterious something which Rivers had called conscience, which told him that the voice was right.

The manipulation of the Development Oil Company's stock had been a wholly unnecessary market gamble. He knew it; so did Waterford. It was merely one of those things that are done from time to time without excuse, to add to the revenues of the men who had the power and knew how to do them. Yet, without hesitation he had given the word that had sent securities cascading downward, to the financial loss of thousands of minority stockholders.

Buried beneath the activities of his daily routine was the realization that such manipulations were fundamentally wrong. But Madsen had grown calloused. He had pushed that realization aside, and as the days went by, continued pushings aside had made the task easy. But now, that strange, inexplicable voice had brought realization of guilt back with startling emphasis.

Waterford dropped in later in the morning to find Madsen locked in his office and pacing the floor in a frenzy of worry.

"Hello, Homer," was Waterford's greeting. "What's the big idea? Something gone wrong?"

"Yes—everything," said Madsen. He dropped into his chair. Waterford noticed that his hands were shaking. Something inside of himself began to grow tense.

"Explain," said Waterford nervously. He had never seen Madsen in this state before.

Madsen did explain. Without any attempt to be graphic he told Waterford of what had happened in his bedroom the night before. At first Waterford was inclined to laugh at the whole thing. But when Madsen repeated the conversation about the Development Oil Company and the voice's threat to return again, he grew serious.

"Hum!" Waterford rubbed his chin and stared out of the window. "Why don't you call in an agency man?"

Madsen glanced up in surprise.

"By George!" he exclaimed. "That's an idea! I didn't want the police in on this. The agency would be better."

He picked up his telephone and called a number, explaining to the head of the agency that handled the bank's private affairs that he wanted a man for a special case.

Continued on page 62

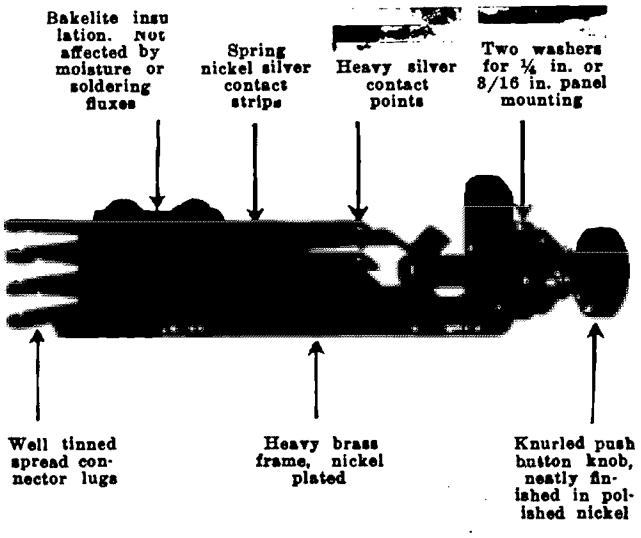
New Victory Selector Jack

Patent Applied For

Eliminates Cumbersome Parts

Simplicity and ease of operation outstanding features:

The new Victory Selector Jack marks an important advance in radio simplification. Its use entirely eliminates the common radio plug and also the last jack in amplifier sets, resulting in increased efficiency as well as simplification. Like all Victory Radio equipment, it is of best quality, handsomely finished.



Operation of Victory Selector Jack

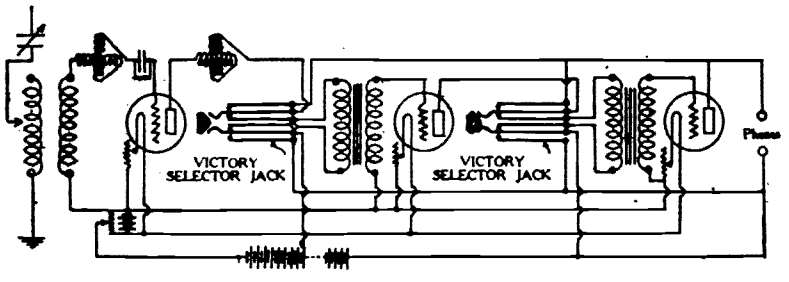
To obtain the range of selectivity of a set merely press the button! Nothing could be simpler! No cords or wires in front of panel to annoy! No plugs to jerk in and out! Fewer holes to drill in panel!

In diagram (below) of detector and two stage amplifier set, two Victory Selector Jacks replace the three jacks and one plug ordinarily used. One is placed between detector and first stage; the other between detector and second stages; last stage being connected to output binding posts, resulting in **Simplicity! A Saving of Expense! Improved Control! And Most Important—No Plugs to Buy.**

To listen in on the detector, press first button, automatically disconnecting everything beyond detector, then to select detector with first stage of amplification, press other button. Full output of set is obtained by leaving both buttons in "out" position.

Victory Selector Jack can be used in any circuit using standard radio jack, without changing connections. Victory Selector Jacks are also made for single or double automatic filament control.

Simplify your receiving set with Victory Selector Jacks!



PRICES

No. 300—Double Circuit	**$1.50**
No. 301—Single Filament Control	**1.60**
No. 302—Double Filament Control	**1.75**

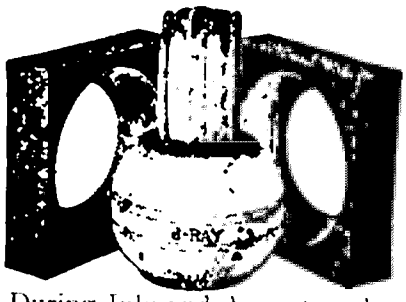
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During July and August, and ending August 31, 1922, we offer the above $14.50 combination for $11.50. The above listed instruments are the essential parts for a Regenerative Receiver. Build that long-planned set now and be prepared for the coming season. Varios are fully wound and ready for assembling with directions.

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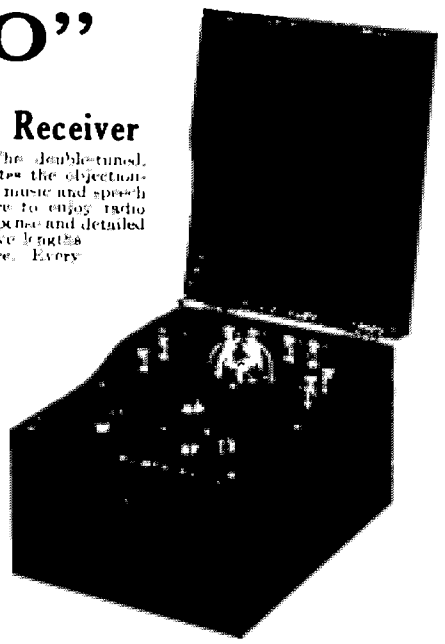
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A full line of quality apparatus—Receivers, Amplifiers, etc. Dealers, write for full details.

HANCOCK-RADIO

Austin, Texas

Continued from page 60

"I can't figure what is back of this thing," Madsen remarked while they were awaiting the operative's arrival. "The big puzzle is how the voice trick was worked. For all you know there might have still been a person in that room. And that being the case, it occurred to me that—well, suppose he got close enough to take a shot at you if he felt like it. Do you get me?"

Madsen sprang to his feet.

"Confound you, Marcus," he said. "Why do you tell me those things? Isn't this situation bad enough without that sort of nonsense?"

Waterford shrugged his shoulders.

"I was only trying to help," he said.

"Well, you've helped a whole lot—I don't think!" growled Madsen petulantly.

Further conversation was interrupted by a knock and the entrance of the man. He proved to be a heavy-set, squat individual of the unimaginative type, by the name of Neal. Madsen looked him over approvingly. He was just the sort of a man to put on a case of this kind—one who would not be worried by mysterious voices and such things.

Drawing up a chair, Madsen motioned Neal to a seat and in a few crisp words explained what had happened.

"I want you to go out to my house and give it the 'once over' from top to bottom," he said. "There is some funny business about this somewhere. You and I both know that it is impossible for there to be a voice without some person to make it. Find that person. That is your job. And if you don't find him, stay there till I get home."

KATIE and Walter met by appointment in the latter's office shortly before 11 o'clock that night. As on the previous night, Katie had kept vigil over the Papyrus Club in the curtained machine until Madsen came out, following him only long enough to be sure that he was headed toward Cloyn Court. She found Walter in ebullient spirits.

"I saw Madsen today," he began without preliminary. "He is one worried old codger. Don't tell me that a hand-made conscience will not bother a man as well as the real article, once you get it tuned up right."

"I'll admit it is more merciless," Katie laughed.

She pointed to the clock. Walter nodded. It lacked two minutes of the appointed hour. He ran his fingers over the various switches, testing them out. Then he took a long breath.

"All right, Mr. Madsen," he said softly. "Here goes your second lesson in the art of being honest."

THE Naval Radio station at McNear's Point is one of the most important on the whole Atlantic Coast. It

constitutes, in effect, one of the nation's most valued "listening posts." There are always trained operators at the instruments listening to the ceaseless drone of the whispering "waves" that oscillate perpetually across the spaces of the uncharted etheric ocean.

For this work "ZZR" was specially equipped. It never speaks to other stations, for it possesses no transmitting apparatus. Its duty is to hear and record silently and accurately the mysteries of the day and night. These are "logged," hour after hour, converted into official reports and dropped into the mail. To the assiduous alertness of this lonely shoreline post has been due much of the Government's understanding of European problems that would otherwise have remained inexplicable.

At 11 o'clock on the night of Walter River's second conversation with Homer Madsen over the air, Green, the night operator at "ZZR," was sitting with his feet cocked on the table amid the sensitive audions and amplifiers, the headtelephones of the set clamped over his ears. It was his customary attitude, for there were many lonely hours when commercial business chattered through, that he had little to do. Suddenly, into the murmur of it all there came a half perceptible stillness—a breathless "soundpocket" with the queer indefinable dissonance of an empty room. To the operator it meant one of two things—an arc-station getting ready to work or a wireless telephone.

He gave the knob of his variable condenser a turn, cutting in the intersecting plates that shortened the wave-length down to an approximate zero. As the antenna reduced electrically he caught a faint sound—a voice speaking over the wave from some small radio station:

"Homer Madsen! Homer Madsen! Homer Madsen!" it said.

Green glanced at the calibration on his instruments and then up at a chart over his head. The scaling showed the wave-length to be shorter than the average amateur station—less than 100 meters, in fact. Probably a "non-antenna" set or one working from a small indoor aerial, he reasoned. He squinted thoughtfully at the dials before him and "petted" the glowing audions into further sensitiveness.

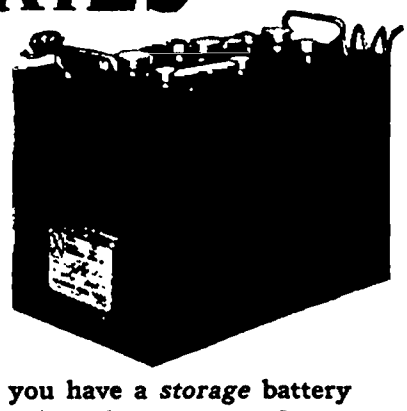
Homer Madsen! He racked his brain—oh, yes. The president of the Citizens Trust Company. Was he going in for radio? It seemed hardly credible. Yet why this faint call on the night?

A hollow rectangle of wire hung directly over the operator's head—the radio-compass of the Navy—a ship-finder that told to the smallest fraction of a degree the direction from which signals came. On an impulse the oper-

Continued on page 64

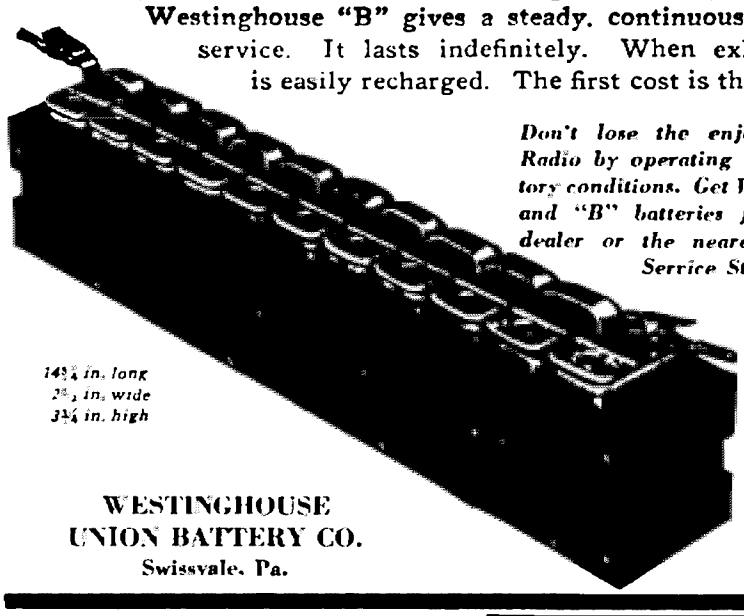
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WESTINGHOUSE RADIO BATTERIES



Westinghouse "A" Batteries are especially built for the peculiar requirements of radio work. They deliver a constant, dependable flow of low voltage current. They are built to give long, low-cost service. They demand a minimum of attention.

In the Westinghouse "B" battery you have a *storage* battery for "B" work—the latest development in radio practice. It has all the reliability and dependable performance of a storage battery and none of the disadvantages of a dry cell. The Westinghouse "B" gives a steady, continuous, noiseless service. It lasts indefinitely. When exhausted it is easily recharged. The first cost is the last cost.



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2⅝ in. wide
3¾ in. high

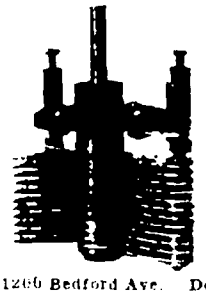
Don't lose the enjoyment of your Radio by operating under unsatisfactory conditions. Get Westinghouse "A" and "B" batteries from your radio dealer or the nearest Westinghouse Service Station.

The best Westinghouse can build."

WESTINGHOUSE UNION BATTERY CO.
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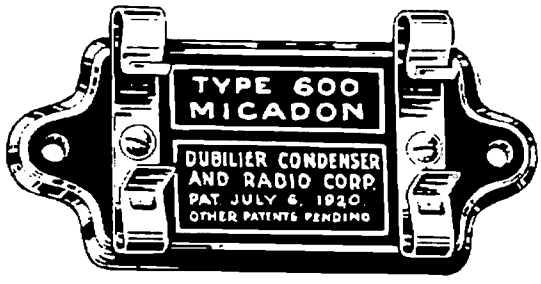
TRACO
Loud Speaker
Price $40
Complete F. O. B San Francisco
Vernier Controls $1.00
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VARIABLE CONDENSERS
PLATES 1/32" thick ALUMINUM
If in your opinion this condenser is not equal to the best on the market in workmanship, appearance and efficiency we will refund your money. Strongly built—Beautiful design—High efficiency.



Type as illustrated
43 plate .001, $3.50
23 plate .005, $2.75
11 plate .00025, $3
3 plate Vernier
$1.25

MONTROSE Mfg. Co.
1260 Bedford Ave. Dept P. Brooklyn, N. Y.



75¢ each

Perfect Broadcasting Reception with this Mica Condenser

Here we show the new Dubilier Micadon Type 600. It is a perfect Dubilier mica condenser. Use it and all the tube noises, due to fluctuations in the capacity of ordinary condensers disappear.

Dubilier Micadon Type 600 lasts indefinitely. Its capacity is *permanent* because the condenser elements are pressed together, so that they cannot dilate and contract with the oscillations in the antenna and thus cause the capacity to vary.

Dubilier Micadon Type 600 is provided with Fahnestock connectors and grid-leak clamps, but not with grid-leak. The grid-leak can easily be removed and replaced with the fingers.

Everything is soldered. The container is of molded composition. Provision is made for holding screws.

Price in capacities .001 and .002 mfd, 75c each, *without* grid-leak mounting.

Price in capacities from .0001 to .0005 mfd, 75c each, *with* grid-leak mounting.

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Order from your dealer

DUBILIER CONDENSER AND RADIO CORP.

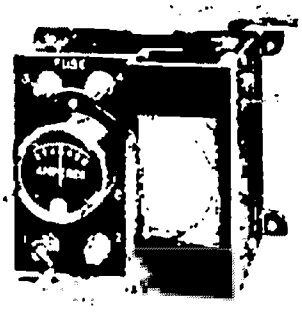
Department R

48-50 West 4th St., New York

Branch Office: 709 Mission Street, Suite 701-704, San Francisco, Cal.

LICENSEES:

England— Dubilier Condenser Co., Ltd., London
Canada— Canadian General Electric Co., Toronto
Germany—Telefunken Co., Berlin
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Advance Unit Charger

A perfect device for charging auto and radio batteries from A. C. lamp socket. Fully guaranteed. Made on an entirely new idea from any other on the market today. The most efficient, fool proof and reliable rectifier manufactured.

$18.50 Complete

Advance Electric Co.

1260 W. 2nd St. Los Angeles, Cal.

Write for particulars on service station equipment

Tell them that you saw it in RADIO

Continued from page 63

ator cut the instrument into his circuit with a small switch, pivoting the rectangle on its own axis and watching the compass indicator that marked the direction.

"Homer Madsen!" came the voice again. Green turned the rectangle until the signals came quite clear and distinct, the pointer indicating a direction north-northeast of "ZZR" station. With his finger on the audion's control grid he sat tense and silent.

"You must return the money you have taken. It is now Wednesday night. If you have not taken steps to do this by Saturday morning the vaults of your bank will be blown open at midnight. I mean business. You will hear from me again tomorrow night at this hour. That will be your last warning."

After a moment's indecision the operator picked up his telephone and called the private number of the "Morning Blade." With the paper finally on the line he asked for Carter in the local room, a personal friend and the "star" man on the sheet. A second later he had Carter on the wire.

"This is Green out at 'ZZR,'" he said.

"Oh, yes," came Carter's voice crisply. "What's on your chest?"

The operator dropped his voice.

"Something odd," he said quickly. "You have been hounding me for a story for some time. I think I have one for you at last. As this is not a government matter I have no hesitancy about giving it to you. Listen!"

Rapidly he poured into the newspaperman's ears the conversation he had just heard, reading from a pad on which he had copied it down.

"I put on the compass," he explained, "and I got a N-NE reading. That places the transmitting station somewhere in your city, as I make it."

Carter gave an exclamation.

"Bully!" he said. "Looks like you picked up a live one this time. How far away do you figure that was?"

"As near as can be determined from the strength of the signals and the wave-length used, I would say about fifteen to eighteen miles. It would be impossible to work much farther with a radio wave-length that short."

"Good work," Carter replied quickly. "I am much obliged to you. I'll go right after it."

He banged up the receiver and rushed into the office of his city editor, to whom he explained what Green had told him. The latter came to life instantly.

"What is the best bet on this?" he asked.

"Martin Brady, chief of police," said Carter. "I figure that Madsen, if he

knows about this, will beat it for Brady's house for a confidential interview. I know that bird and he always wants to work underground like a mole."

"All right," said his superior. "You slide for Brady's. I'll shoot Blain to the Madsen house and tell Hemhill on the police run to watch the Central Station. Have we got this exclusively?"

"As far as I know," said Carter.

"All right. Hump! I'm going to smash up the front page and hold for a makeover. You flip what you get on the wire and we'll bump the world with a headline that will make it sit up."

Carter was off on the instant, with Blain at his heels. Behind him he heard the speaking-tube whistle and the machinery of a special extra start to whirr.

WHILE all this was taking place much was transpiring in the apartment of Homer Madsen, banker. Madsen reached home from the Papyrus Club about 10:30. He was not in a pleasant frame of mind. The possibility that the voice would repeat its performance of the night before did not add to his peace of mind, however, he had resolved that he would not be deterred by it.

The detective was half asleep but managed to wake himself up and appear alert when Madsen came in. Together they went directly to the banker's apartment.

"If the voice is on the job it ought to start pretty quick," Madsen commented with a glance at his watch.

The detective was in the act of sitting down when without preliminary there came the same weird, hollow inhuman enunciation of the banker's name that had taken place the night before, apparently out of the very center of the room.

"Homer Madsen!" it said distinctly, three times.

The detective stared at the banker in amazement. Then he peered around the room. The voice continued, repeating the message as the operator at "ZZR" had copied it.

"My God!" exclaimed Madsen in sudden panic.

He began to back around the room, turning fearful eyes in all directions, his first terror clutching at him with icy fingers. The agency operative turned white and gripped the edge of the table. Then he pulled himself together and began to search through the apartment. After fifteen minutes of it, during which he thoroughly covered every available hiding place, he turned on the banker.

"I give it up," he said. "This is a police job."

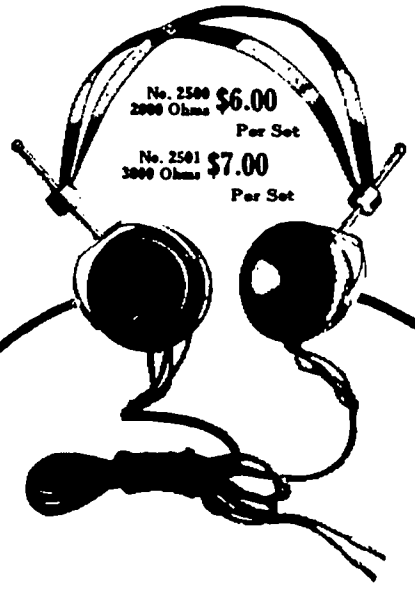
"But, but——" protested Madsen.

The operative turned a cold and cheerless eye on him.

Continued on page 66

You can identify genuine Manhattan Radio Telephone Headsets by the M-Seal-Flash on the back of each receiver case.

Look for it—it is your protection.



The Radio Headset Sensation of the Year—

Almost over night the new Manhattan Radio Telephone Headsets became famous. Since the first headset was produced on March 29th, over 130,000 have been made and sold; made with the precision of a watch and demanded by professional operators and amateurs who know.

Outstanding features of the new Manhattan Radio Telephone Sets:

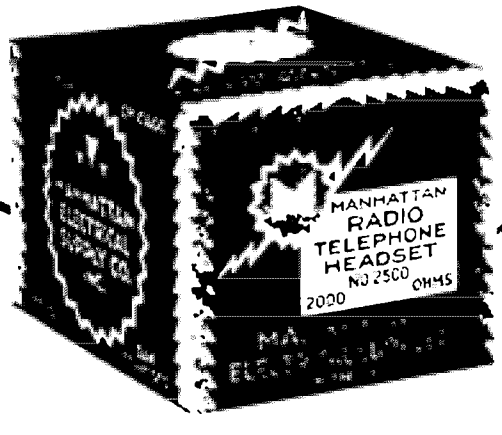
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Amplifying Qualities
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Sanitary Head Band with friction grip adjustment
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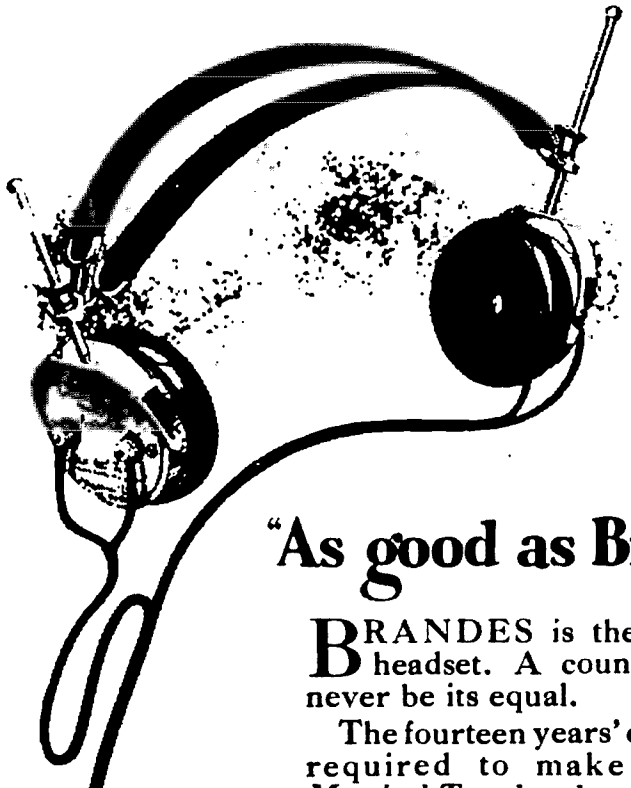
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BRANDES is the standard headset. A counterfeit can never be its equal.

The fourteen years' experience required to make Brandes *Matched Tone* headsets as supersensitive and as rugged as they are, is not acquired in fourteen weeks.

Only if a headset bears the name Brandes, can it be "as good as Brandes." And genuine Brandes *Matched Tone* headsets cost no more than imitations.

Send ten cents in stamps for the "Beginner's Book of Radio." It explains radio in terms that anyone can understand.

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Munsey Bldg., Washington, D.C. 76 Pearl St., Boston, Mass.
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International Electric Company, Wellington, N.Z.

C. Brandes, INC.
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RESULT OF 14 YEARS EXPERIENCE

Tested Galena Crystals

Direct from Mine

Two sizes. Twelve and Twenty-five cents.
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Our Radio Department is conducted by electrical engineers, which assures you dependable and highly efficient Radio equipment, either in complete sets or separate units, such as Head Receivers, Variocouplers, Variometers, Cabinets, Detectors, Antennas, Rotary Spark Gaps, Sliders, Panels, Dials, Knobs, Condensers, Grid Leaks, Contacts, Galena Crystals, etc.
We especially recommend our popular Receiving Set, RESODON, which is one of the most desirable outfits for the home, club, etc. This set comes in a beautiful mahogany finished cabinet. Write for literature.

R.E.S RADIO ELECTRIC SERVICE

PAUL G. NIEHOFF & CO., Inc.
Electrical Laboratories and Manufacturers
238 E. Ohio Street, Chicago, Illinois

Tell them that you saw it in RADIO

Continued from page 65

"But nothing," he said. "I'm through. I'm a good guy on a mystery. But I ain't no spook hunter. Good night!"

He left Madsen standing on the rug in front of the fireplace and went out into the night.

The banker, after a moment's hesitation, jerked his overcoat from the chair over which he had thrown it, and called to the butler, who had been an interested spectator of the detective's departure.

"Get the machine," he ordered. "I'll have action on this some way."

WHEN the machine in which Carter of the "Morning Blade" had negotiated the residence of Chief Brady on record time, swung up to the curb in front of the police head's house, it found another car before it. Carter glanced at the monogram "H. M." on the door of the limousine and whistled softly to himself.

"Just in time," he muttered.

He ran quickly up the steps and touched the bell. A sleepy servant girl answered.

"Carter of the 'Blade' to see Chief Brady," he said quickly.

"The chief's busy," said the girl.

"I know it," said Carter. "We're all together—or will be in a minute."

The girl gave back and he stepped inside. The hum of voices and a crack of light drew him to the end of the hallway. He pushed open a door to find Chief Brady in a dressing-gown in close conference with a man whom he knew instantly for Madsen, the banker.

"Good morning, gentlemen," Carter greeted cheerfully.

Madsen paused with his arm upraised and glared at the intruder. The chief nodded in surprise.

"Carter of the 'Blade,' Mr. Madsen," he introduced.

The banker jumped to his feet.

"I do not wish to be interrupted," he snapped.

"Neither did the chief," retorted Carter without hesitation, throwing his hat on the table. "But when a bank is going to be blown open, the circumstance rather interrupts everything, doesn't it?"

The chief gave Carter a quick look. The banker's mouth opened.

"What the devil do you know about it?" he demanded.

"Lots—and nothing," replied Carter good-humoredly. Then he became serious. "To be accurate, we have the message whispered to you tonight, just as you got it. I figured that you would come here, and here you are. I have an edition going to press and I want a few facts, that's all."

Madsen glared at him in speechless wrath.

"But I want no publicity," he said.

"Sorry," said Carter, "but you haven't anything to do with it. The story is public property. The only thing to do now is to be graceful about it and give me the rest."

"Damned if I will," said Madsen. "I came here——"

"Sure—I know," said Carter easily. "You wanted some underground wires pulled. What that voice said about the Development Oil Company wasn't nice. But that can't be helped. You fellows juggle stock, don't you? Very well. You've got to stand the consequences."

"Where did you get your information about the—the message?" demanded Madsen.

"That is a question no newspaper ever answers," Carter replied. "However, I will say this: it came from a radio man. He put a compass on it. He says it comes from somewhere about the city here."

The chief studied Carter thoughtfully. He had been in office too long not to appreciate the value of a reporter's tip. Besides he was a careful, conscientious man who had won his position through hard, painstaking work.

"That puts it up to us, all right," he said slowly. "I wonder just how far that message goes."

The banker stared at him.

"What do you mean?"

"I mean I wonder how far somebody is going to go as regards blowing up your bank!"

"You think it is as serious as that?" Carter asked.

"I didn't at first. I was trying to convince Mr. Madsen that some crank had fixed matters up to annoy him. Now I am beginning to believe there is something to it."

"Oh, my Lord!" Madsen groaned, burying his face in his hands.

"Then," said Carter decisively, "the wider we tear this thing open, the safer the bank is going to be."

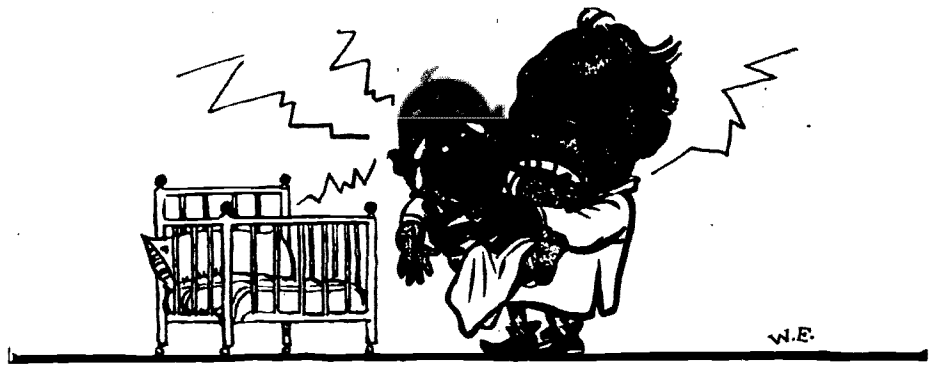
"How do you figure that?" the banker asked quickly, raising his head.

"Publicity will turn the city into eyes and ears," Carter explained. "Everybody will be on the lookout. Some one may get a valuable clue or remember a face or a remark. It turns the world into a detective force. Every man, woman and child will be at work on it by morning. Isn't that correct, chief?"

Chief Brady nodded. He had seen it work before.

"I think so, especially in this case," he said. "I think if I were you, I would tell Mr. Carter all the facts and let him go to it. You know it is one thing to catch a criminal after a crime and quite another to prevent him from perpetrating it in the first place. This latter is what we have to do."

Continued on page 68



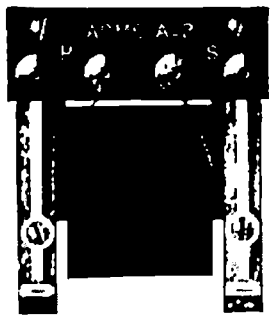
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THERE'S more than one "howler" to put to sleep these days. Your radio set can put on the greatest squalling and howling demonstration you ever dreamed of. The surest way to stop this howling and keep it peaceful is to add an Acme *Audio* Frequency Amplifying Transformer.

Most any amplifying transformer can magnify the incoming sounds but it also amplifies the howling and distortion of stray fields in the circuit. Acme Transformers with their specially constructed iron cores and coils eliminate this disagreeable feature—and it only takes five dollars to buy one.

Acme assures your receiving a large volume of sound that possesses the natural tones so lacking in the ordinary receiving set. Then, too, you will want the Acme *Radio* Frequency Transformer which costs the same as the Acme *Audio* Frequency Transformer. It can be used on both crystal detector and vacuum tube sets. It greatly increases the range of either.

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Type A-2 Acme Amplifying Transformer

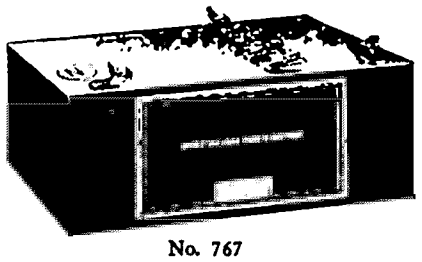
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A new

EVEREADY "B" BATTERY



No. 767

Made up of thirty large cells arranged in five rows of six cells each, gives 45 volts and is equipped with Fahnestock Spring Clips allowing the following voltages: 16½, 18, 19½, 21, 22½ and 45 volts. This is a remarkably high quality, long life battery. Dimensions: Length, 8¼"; width, 6¾"; height, 3½" over all. Weight 9 lbs. Price $5.50.

Two important characteristics are necessary for a satisfactory "B" battery; first, the battery must be designed for long life; second, the operation must be noiseless. The Eveready "B" battery meets these exacting requirements.

EVEREADY

Eveready "A" radio batteries are carried in stock by the best radio dealers in three different types — 60, 80, and 100 ampere hour capacity. These Eveready "A" batteries have a larger capacity and give longer service and require less frequent recharge than most other batteries of this type.

Made on the Pacific Coast by the world's largest battery manufacturers.

NATIONAL CARBON CO., INC.

599 Eighth St., San Francisco, Cal.
419 East 2nd St., Los Angeles, Cal.

Continued from page 67

Madsen nodded. He saw the psychology of it. Without further remonstrance he repeated all he knew about the affair to the newspaperman.

Long after Carter and Madsen had departed the chief sat in his study and smoked thoughtfully. He knew something of Madsen's record as a financier and his reputation for ruthless market smashes that brought disaster on all sides. Such a man was bound to have many enemies and it was not surprising that some one had demanded a reckoning.

"The wonder is that it has not happened before," he told himself.

THE following morning Walter Rivers, proprietor and manager of the "Conscience Shop," came down the front steps of Mrs. Parker's place in an amiable frame of mind. His plans were working out nicely and it gave him a feeling of optimism as to the final outcome of the scheme. He bought a paper from a passing newsboy and on the instant the joy was blotted out of life.

"Banker Threatened!" read the headlines. "Mystery Voice Hurls Threat in Madsen Home!"

Walter read it through, vivid with the colorful exaggeration of a street edition. As he read his jaw set. So Madsen was going to fight! He had called in the police. He was prepared to "see it through to a finish," he had said. He refused to be blackmailed by anything of that kind! If "they" thought "they" could blow up the bank, "let 'em try it," he said.

Walter stuffed the paper in his pocket and strode up the street, his face grim. At the office he locked himself in his laboratory. Katie found him there later, enveloped in an apron, with the air filled with the odor of strange chemicals. To her request to be admitted Walter returned a terse "Not today!" Something in his manner made her drop any insistence. After a bit he came out, wiping his hands.

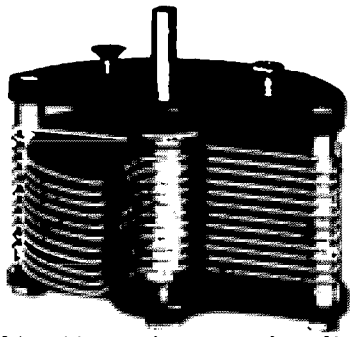
"Katie, girl," he said, and it was the first time he had ever addressed her so. "We are going to play with fire tonight. The situation has changed. Madsen has inducted the police into this and every move we make from now on is dangerous. As it stands today, there are thousands of trained detectives and eager citizens on our trail. Whatever we do from now on is under the chance of exposure, detection and arrest. Don't you think you had better get out of this mess before something happens?"

Katie shook her head.

"If it has become dangerous, Walter," she said, "why don't you pull out also? I have been afraid from the beginning——"

Continued on page 70

Variable Condensers



Variable condensers to be efficient must be well made. Loose joints or faulty construction soon allow the plates to get out of alignment and decrease their efficiency.

A seasoned organization backed by a half million dollar equipment has placed the United Condensers in the front rank with radio engineers the country over. *Prices:*

43 plate **$4.50**
23 plate **4.30**
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(without dial or knob)

Liberal discounts to jobbers and dealers.

We invite correspondence with Radio Manufacturers who are interested in using our facilities and services for manufacturing Radio Equipment.

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3000 OHM SETS, $4.50

2000 Ohm Sets, $4.00. 1000 Ohm Sets, $3.50
Plus 20c for Postage and Insurance
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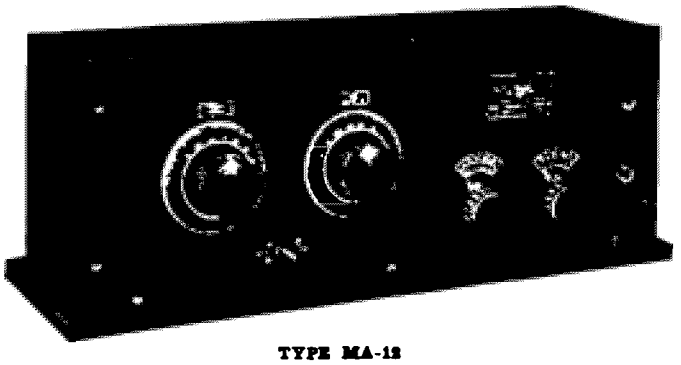


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TOWER MFG. CO., Brookline, Mass.
37 Station Street

MU-RAD BROADCASTING RECEIVERS

(Patents Pending)



TYPE MA-12

TYPE MA-12

SPECIFICATIONS

CABINET: Solid mahogany, varnished piano finish.
PANEL: Mirror polished black Radion.
DIALS: Non-warping, metal—prevent body capacity effects.
CONDENSER: 21 plate, permanent capacity.
MODIFIER: A circuit unit, dial operated from panel, for controlling signal strength and stabilising circuits.
RHEOSTATS: Special sector wound, smooth operation, positive contact.
FILAMENT SWITCH: Special positive toggle knife-blade construction.
BINDING POSTS: Polished nickel, all in rear, plainly marked.
NAME PLATES: Extra deep reversed etched, black with satin silver high-lights.
WIRING: Tinned copper bus-wire, all interior metal white nickel finish.
CIRCUIT: Three stages radio frequency amplification and detector.
PRICE: With 2 telephone plugs, $128.00.

TYPE MA-13

SPECIFICATIONS

CABINET: Solid mahogany, varnished piano finish.
PANEL: Mirror polished black Radion.
DIALS: Non-warping, metal—prevent body capacity effects.
CONDENSER: 21 plate, permanent capacity.
MODIFIER: A circuit unit, dial operated from panel, for controlling signal strength and stabilizing circuits.
RHEOSTATS: Special sector wound, smooth operation, positive contact.
FILAMENT SWITCH: Special positive toggle knife-blade construction.
BINDING POSTS: Polished nickel, all in rear, plainly marked.
NAME PLATES: Extra deep reversed etched, black with satin silver high-lights.
WIRING: Tinned copper bus-wire, all interior metal white nickel finish.
CIRCUIT: Three stages radio frequency amplification, detector and two stages audio frequency amplification.
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TYPE MA-13

THESE receivers have been produced with the deliberate idea of providing greater sensitiveness than has ever before been obtained in a commercially marketed radio receiver. Coupled with this is a beautiful sharpness, clarity and crispness of signal that is unfamiliar to users of the average highly sensitive receiver. Both sets are complete receivers, the only additional equipment required being vacuum tubes, batteries, telephone receivers and a small coil or loop to pick up the wave energy, or they may be used with an antenna if desired. A pick-up coil as small as 3 inches in diameter may be used for distances up to 200 miles from the average broadcasting station.

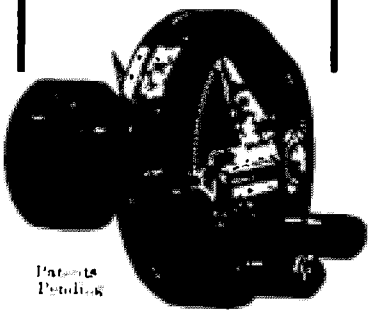
IN appearance these sets exemplify the art of the finest woodworkers, machinists and laboratorians. Their details of design and construction conform to the highest engineering standards. Complete instruction book is furnished with each set and each is tagged with our guarantee against defects. Bulletin No. 13 on request.

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MU-RAD LABORATORIES, Inc.

800 Fifth Avenue, Asbury Park, N. J.

Protect your VTS



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RHEOSTAT

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The Klosner provides micrometer adjustment for your critical detector tubes. One single knob controls both the rough and vernier adjustments. It is unsurpassed for loudest reception of telephone and CW, and is essential for detector tubes of radio frequency amplification. Awarded the New York Evening Mail's Certificate of Excellence. Insist on the genuine—made only by the originators. Look for the name "Klosner" moulded on the base. The cost is no more than for other Rheostats without these exclusive features. At your dealer or send for interesting literature.

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Dealers: **This is the fastest moving rheostat on the market. It is stocked by all leading jobbers. Get your supply from them.**

ONE SINGLE KNOB
NO SUDDEN STRAIN
$1.50

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Write for trade proposition

"PARADEX"
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"PARADIO"
Crystal
Receiving Set

Continued from page 68

"Because there is something yet to be done," the young engineer said quickly. "There is a wrong to be rectified. That can only be done by Madsen himself. Until his conscience tells him what is right to do, I have got to keep driving the lesson home. Sooner or later he will understand this himself. Then the lessons will be over. Until then——"

Katie smiled—a very brave little smile.

"I guess I'll—stick too," she said simply.

Walter's eyes glowed.

"Katie," he said with a catch in his voice, "you're a—a brick!"

He sat down beside her and outlined in detail what that night's work would comprehend. When he had finished they parted for the day, Katie expressing the intention of spending it for the most part in the open air. Walter returned to his laboratory and for the rest of the hours that followed until sundown the office of Walter Rivers, engineer and contractor, remained empty and deserted.

At 10:45 that evening the telephone bell rang insistently in Walter's office. Walter, who had been pacing the floor like a caged animal with a thousand fears for Katie's safety whipping him into a nervous frenzy, jumped for it. It was Katie herself on the wire, quite all "right" and a bit excited.

"Is everything all set?" Walter asked quickly.

"Yes," she said breathlessly. "Mr. Madsen and three men—one of them grey-haired and heavy-looking — just went into the house. The heavy man I think was the chief, at least he looks like the picture you showed me. The other two I have never seen before, but they looked like policemen in citizens' clothes."

"Central office men," Walter replied.

She hung up the telephone and Walter with a glance at the clock, sat down beside the wireless telephone and opened the switch to the generator.

At that precise moment the banker with Chief Brady and two central office men was standing beside the library table in his apartments. He was explaining in detail just what had happened on the previous nights.

"It was right here, I think," he said, pointing to his chair. "I recall placing it so that I could get the best light from the lamp——"

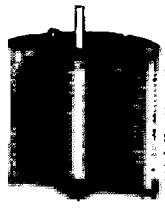
"Good evening, gentlemen!"

The words boomed into the room like the report of a cannon. The little group jumped. Madsen's face went white and he staggered back against the table.

"My God! There it is now!" He blurted out the words in a quavering voice.

Continued on page 72

RADIO DEALERS!
United Variable Condensers



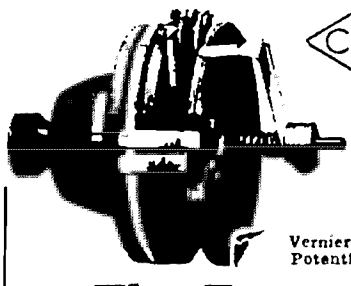
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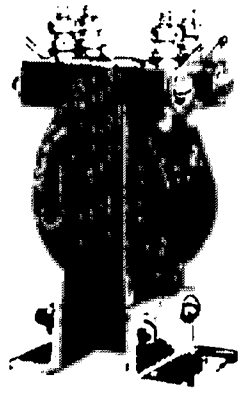


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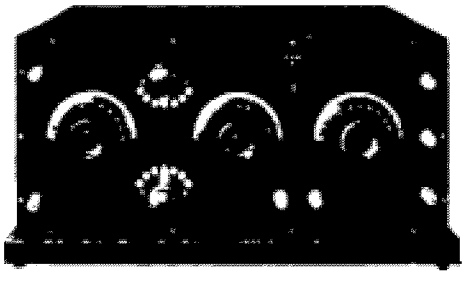
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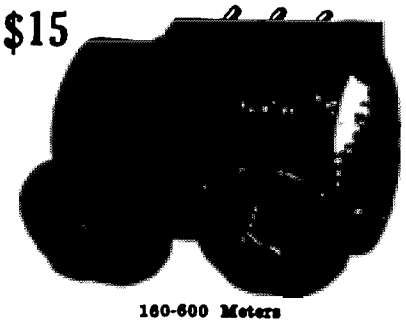
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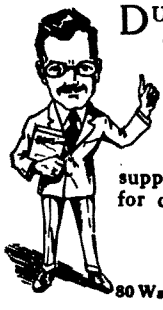
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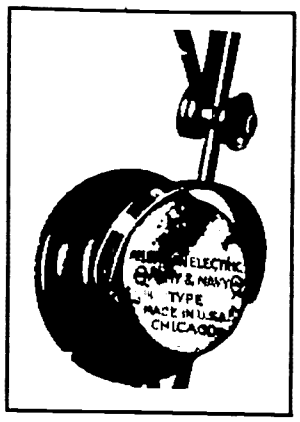


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Continued from page 70

The detectives looked at each other, at Madsen, the chief. The latter was in the act of raising a cigar to his mouth. His arm halted half-way and he stood in an attitude of close attention.

"This is your last warning, Homer Madsen! As I told you last night, your bank will be shattered Saturday night if you do not take steps to rectify the wrong you have done the stockholders of the Development Oil Company. Nothing can prevent it—not even Chief Brady or the central office men beside you. I mean business!"

The words ceased. Madsen, a picture of abject terror, stared at the chief with twitching face. The detectives shifted uneasily and peered around the room, seeking the source of the sound. Chief Brady pulled at his moustache and scowled at the walls, the ceiling. Abruptly he pivoted on his men.

"Get busy," he said. "Let's find this thing *now*. There is nothing supernatural here. There is an instrument of some kind working around here. The thing to do is locate it."

His words broke the tension. The men went to work with a will. They were of a different type from the agency man and plunged into the task at hand with a thoroughness that aroused Madsen's admiration, frightened as he was. They tore away tapestries, moved furniture, pulled up rugs and carpets and within a few minutes turned the place into complete disorder. Finally one of them knelt on the hearth of the fireplace and turned his flashlight up the chimney. He called out:

"There is something here!" he said.

Instantly Chief Brady was by his side with the other detective. Crouched in the broad open fireplace, they turned their lights up the broad-mouthed flue. In the augmented radiance they made out something that glittered with myriad knobs and switches.

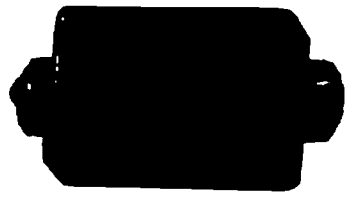
"At last!" breathed the chief. "Get me a pole, somebody."

One of the men ran down to the lower part of the house to return presently with a curtain pole. This he thrust up the chimney several times. Finally he broke one of the wires that suspended the instrument in place. The next instant there was a snap and a loud crash as a complicated mechanism of coils, switches and metal parts burst asunder at their feet and scattered numberless parts over the hearth and across the floor. The chief stood up with a smile.

"Well, Mr. Madsen," he said with a chuckle, "there is your mysterious voice. The remnants of a once good wireless telephone with a loud-speaking attachment!"

Continued on page 74

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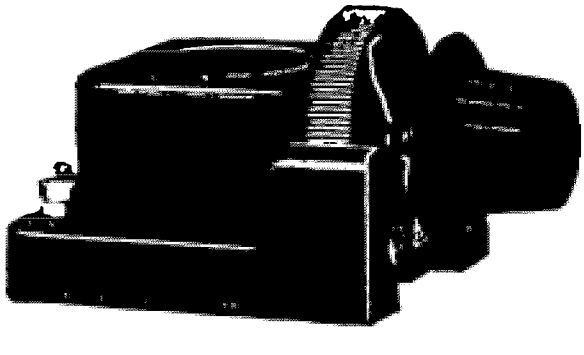
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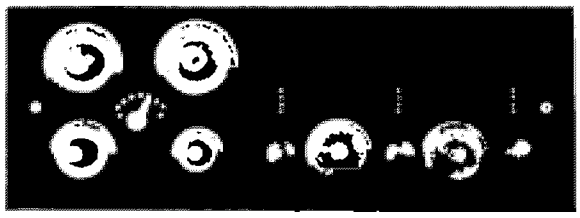
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521 Penn Ave. Wilkinsburg, Pa.

Continued from page 72

Madsen sank down in amazement—collapsed in a chair, a dazed look on his face. The detectives gathered up the parts and spread them out on the library table on a couch cover. There seemed an endless number of them.

"I guess this ends this part of the trail," said the chief. "Now for the man that did it!"

Madsen shook his head.

"There is something more important than that—his threat," said Madsen. "Do you think he will carry that out?"

Chief Brady half shut his eyes and considered.

"After seeing this I am inclined to believe he is very likely to have a try at it!" he said.

YOUNG Rivers closed his office for the week-end. With a small leather sack in his hand he went over to Madsen's bank, the Citizens Trust Company, where he carried a small account, and joined the long line of late hour depositors that reached from the entrance to the receiving teller's window.

It amused him, in the next few minutes, to notice that several heavy, red-faced men passed and repassed the spot where he stood subjecting all in the line to close scrutiny. He was surprised to find that he was not the least bit nervous over the circumstance, although he would have disliked to have been questioned or examined by any of them at that particular moment.

The line crawled along like a patient snake until it came Walter's turn at the window. The teller, a pleasant-faced young man with adept hands and an eye-shade, gave him a friendly nod and called him by name.

"I see you were not scared out," he remarked with a nod toward a newspaper which a man was reading avidly nearby.

"Not with my little acount," Walter laughed.

He opened the leather case and took out several rolls of money and some checks. The teller took Walter's bankbook, made the necessary entries, stamped in the date and passed it back. The money and checks he threw in receptacles behind him.

From the bank corridor an elevator went to the upper floor. Walter took one of the cages and stepped off on the upper level. There were few persons about. Walter walked rapidly along the hallway until he came to a door marked "stairway." He turned the knob and stepped out on the roof. The building overtopped most of its neighbors and those that were higher were too far away for anyone looking from the windows to determine what he did.

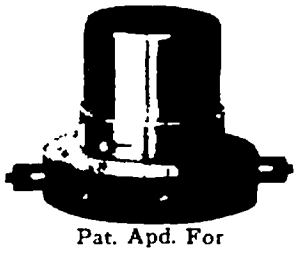
From his little satchel he took a small instrument to which he attached

Continued on page 76

RHAMSTINE*

Announces a

RADIO FREQUENCY TRANSFORMER



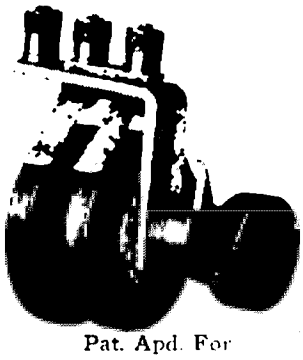
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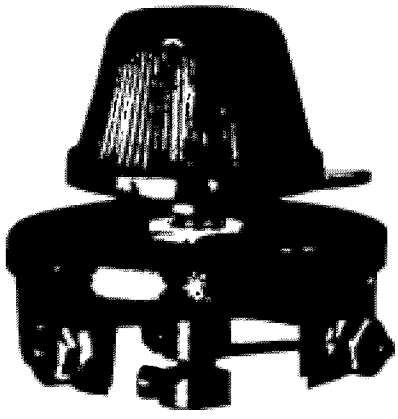
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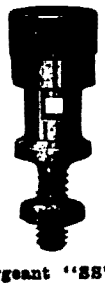
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THE H. H. EBY MFG. CO., PHILADELPHIA, PA.

Continued from page 74

a wire which he carried across the roof and looped to a corner of a ventilator pipe, fifty feet distant. Beside the instrument he hung a second wire to which he fastened a small round object which resembled a large metal lemon. The object was familiar in the trenches as a hand grenade and the instrument to which it was attached was a portable wireless receiving instrument.

Walter hung the grenade so that it would swing clear of the roof and safe from casual observance. Stepping back, he surveyed his work. Satisfied that the stage was set, he smiled grimly and went back down the stairway to the upper floor corridor. No one saw him close the door behind him, and the elevator operator, when he stepped into the down cage, merely favored him with a casual glance.

As Walter left the bank a watchman was hanging a "Bank Closed" sign in the front doors. He glanced back at it and mentally ran over the bank processes for the next few hours. Within a few minutes the clerks would settle down to their regular Saturday afternoon grind. The coin would be taken from the various cages, placed in racks and carted into the vaults on small, rubber-wheeled wagons. At 4 o'clock the huge vault would be closed. The time-lock clock would throw the tumblers on the four doors fifteen minutes later by automatic action, locking them until 8 o'clock the following Monday morning.

That afternoon Madsen called on Chief Brady, accompanied by Waterford. Together they went over the police arrangements for the night defense.

"When the police lines are out tonight," said the chief, "no one can get through without a personal pass from me. We will establish a deadline from 11 o'clock tonight until tomorrow morning at 1 o'clock. Nothing moves within that district during those hours. The rest is waiting."

"I suppose so," said Madsen. "I have doubled our own guards with agency men that can be depended upon. That is all I can do."

"That is all," said the chief. "To wait and hope for the best."

Madsen arose.

"I shall be at the Papyrus Club," he said. "There is nothing I can do at the bank."

"I agree with you," the chief replied. "I am really glad you are going to stay away. It will be better all around."

By 11:55 the whole downtown district of the city was tense with electrical expectancy. A revolver shot would have produced a panic. Afternoon extras had fanned popular excitement until the streets leading toward the financial center were thronged with

hundreds of persons who normally would have been in bed at that hour. The district immediately surrounding the bank was roped off and a "deadline" established by scores of uniformed and plain-clothes detectives. Inside the restricted area machines, filled with detectives, cruised slowly up and down the streets.

On the roofs of buildings adjoining the Citizens Trust Company police armed with rifles paced to and fro in ready expectancy. Armed men loitered in doorways or peered occasionally from alleys in the middle of adjacent blocks. Directly across the street from the bank a shotgun squad stood well back in the shadows of a big office building, where from an advantageous position they could sweep the opposite side of the street with their deadly weapons if the occasion demanded.

Chief Brady made a personal inspection of the district during the last minutes of the evening. After assuring himself that everything that was mortally possible to police efficiency had been done to effect the safety of the bank, he took up his station a short distance from the bank to await results. The last minute of the hour shortened to seconds and these in turn to incalculable fractions. For a short fragment of time the minute and hour hands of the clock overlapped.

Suddenly there came a short, sharp jar, followed by the roar of an explosion. The sound of the detonation echoed and re-echoed down the long canyon of tall buildings. A puff of white smoke poured from the top of the building.

Into the silence that followed a police whistle shrilled sharply.

From every quarter the police closed in. Singly and in squads they plunged toward the spot—from doorways, alleys and around the corners of buildings. They came on the run, jerking at their revolvers. Here and there a uniformed man grabbed at a moving plain-clothesman, seen dimly in the half-light, thrust a revolver in his stomach and dragged him under a light. A coat would be thrown back to disclose a star—and they would run on together, cursing.

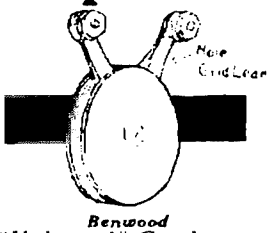
Madsen was sitting with his watch in his hand at the Papyrus Club when the detonation came. His watch was a minute slow, so that he was caught unexpectedly. With the jar he arose unsteadily, a queer, twisted expression on his face, and staggered toward the telephone exchange. The operator saw him coming and plugged in a call for the bank. Waterford slid down in his chair, letting the glass in his hand smash upon the marble floor.

"My God!" he muttered thickly. "They've done it!"

Madsen began clawing wildly at the receiver in the booth. The bank did

Continued on page 78

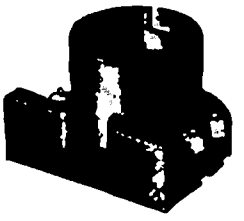
Dependable Radio Products



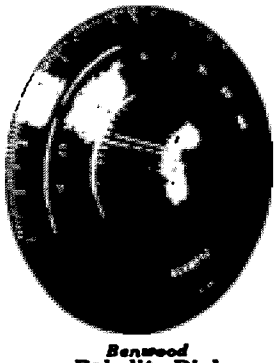
Benwood
"Universal" Condenser
An assembly of mica washers and thin copper plates. Can be used for grid, phone, filter, antenna, tapped or variable condenser. Standard set of six plates and ten washers, capacity .0005 mfd., per set 75c
Extra set of ten plates and ten washers, giving additional capacity of approximately .0005 mfd., per set $ .40

Ask for "Benwood" Parts

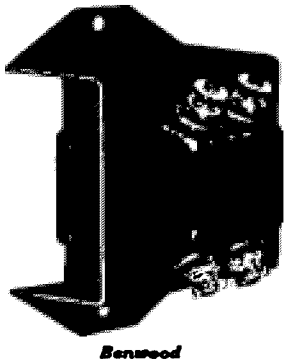
IT pays to be careful in the selection of every part that goes to make up your set—a few cents saved on mediocre parts may completely ruin the operation of the best set made. You can depend on "Benwood" products a few are shown on this page ask your dealer to show them to you, or if he cannot supply you, order direct by mail.



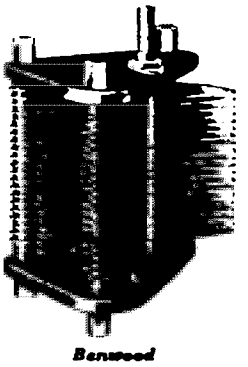
Benwood
V. T. Socket
Solid, highly polished, molded Bakelite. For either base or panel mounting. Firmly holds any standard four-prong vacuum tube. Eliminates ground hum and noises in operation of amplifiers. Terminal posts plainly marked. A good buy... $1.00



Benwood
Bakelite Dial
Solid Bakelite throughout—highly polished. Has extra large, tapered knob which fits the fingers perfectly. The knurling is particularly fine and sharp. Graduated 0° to 100° all markings clearly defined in white and stamped into the solid Bakelite—won't wear off. Stops on reverse side prevent turning too far.
BC-7—Control, 4" diam., each..... $1.75
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Audio Transformer
Completely sheathed in metal—gives full 4 to 1 amplification without howling or squealing. Base is 2½"x3½", height only 2 inches—ideal for either base or panel mounting. Core is best laminated steel giving highest transference of energy. Each..... $4.50

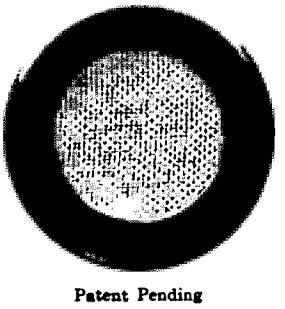


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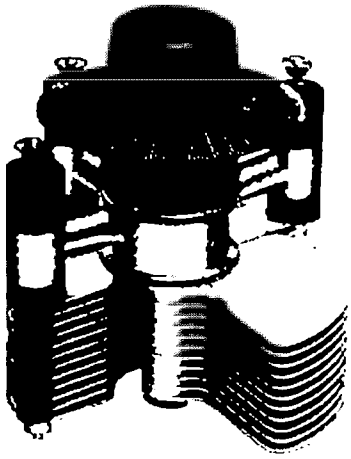
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SPECIAL—We are ready now to make arrangements with dealers throughout Illinois, Iowa and Wisconsin. Write for information.

Continued from page 77

not answer. Finally he gave it up and stumbled out, leaving the receiver dangling on the cord.

"Get me a taxi!" he commanded hoarsely.

At No. 52 Tenant Street Katie was sobbing on Walter's shoulder, unnerved, hysterical. The young engineer sat white-faced and haggard, a strange fire burning in the depths of his eyes.

"The last lesson!" he said grimly to himself. "I wonder——"

SUNDAY morning!

Homer Madsen, president of the Citizens Trust Company, and Marcus Waterford, president of the Development Oil Company, faced each other across a table in the latter's office with drawn, haggard faces. Beside them lay the oil company's stock books.

"Did you get Ruggles & Company on the telephone?" Madsen asked, looking up.

"He'll start shoving that stock up bright and early Monday morning," said Waterford wearily. "I hope that is satisfactory."

Madsen shook his head.

"We can only hope," he said. "Heaven knows I'd like to know what is expected of me."

Waterford lighted a cigar with hands that shook unsteadily.

"What does the chief think?" he asked.

"He says a bomb went off on the roof—probably clockwork, and that it was evidently intended to scare."

"All right, all right," Waterford replied impatiently. "I don't care how it was done. It was done, wasn't it? That's enough for me."

He pulled the books toward him and opened to the memorandum of transfers. Madsen stared out of the window.

"You know, Marcus," he said, "we *did* slump that stock at an awful rate, didn't we?"

Waterford scowled at him, fatly.

"I told you to let it alone, didn't I?" he demanded with sudden heat. "No, you wouldn't do it. Well, look what happened. If you had——"

The telephone bell jangled suddenly. The eyes of the two men met. Waterford grew a sickly yellow.

"Who the devil knows we are here?" he asked.

"Answer it and find out!" Madsen commanded.

Waterford shook his head and backed away from the table.

"Not me," he said.

Madsen picked up the receiver.

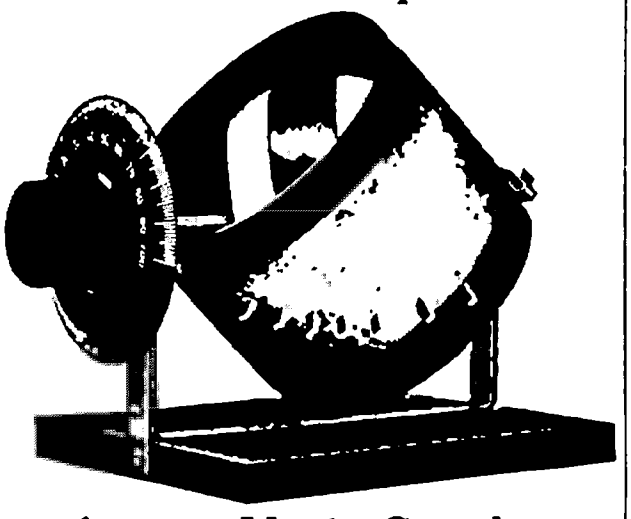
"Hello!"

"Hello, Madsen!"

Madsen felt the hair on the back of his neck stand up. It was The Voice—the one that had spoken to him out of

Continued on page 80

Variometers Specialties



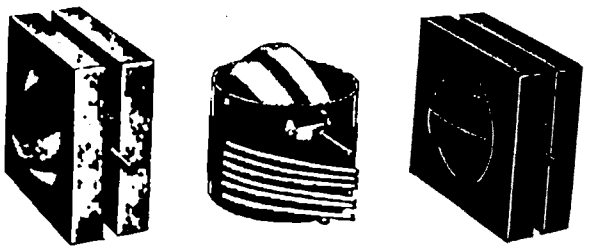
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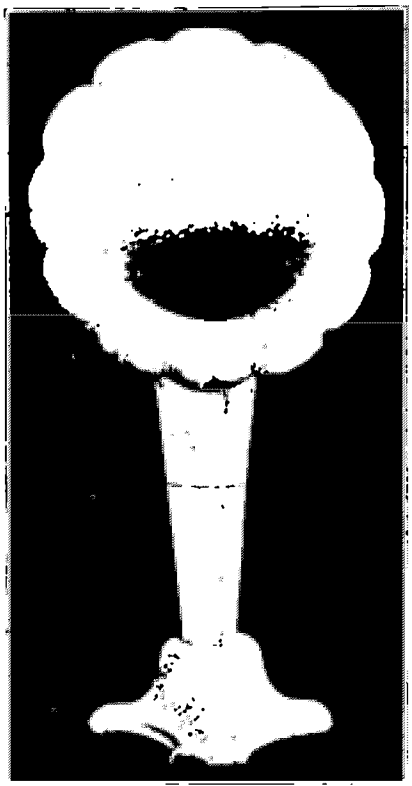
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No. 801



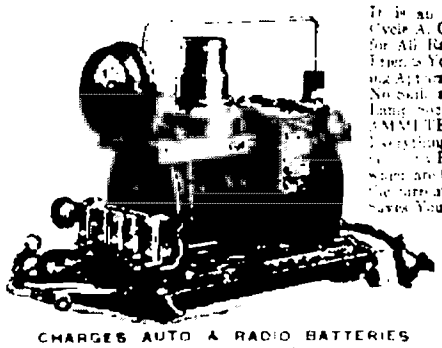
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FRANCE MFG. CO. General OFFICES & WORKS: CLEVELAND, OHIO, U. S. A. Canadian Rep.: Battery Service & Sales Co., Hamilton, Ontario, Canada.

Tell them that you saw it in RADIO

Continued from page 78

nowhere on three successive nights in his apartment—the voice he feared more than any one thing that had ever come into his life. He braced himself against the table.

"Hello, Madsen!" the Voice went on. "Have you made up your mind yet?"

The banker steadied his nerves.

"Merciful heavens—yes!" he gurgled.

The Voice chuckled.

"All right, Madsen," it said. "If you keep your word you have nothing more to fear."

Things in the room swam dizzily for Madsen. Waterford's drawn, concentrated face seemed to dissolve in a mist. After a bit he came back to himself.

"You mean that?" he asked faintly.

"Absolutely."

The banker took a long breath. Then he gave a short laugh.

"You win," he said. "The stock goes back to normal Monday. If it's not too personal, I'd like to know where you learned your trade?"

A long, hearty laugh—a rather pleasant, well-bred laugh—came over the telephone wire.

"In the Conscience Shop!" was the answer, as a distant receiver clicked into place.

"Well, I'm damned!" said Madsen as the other's meaning reached him.

A block away from the Development Oil Company's office Walter Rivers stepped out of a telephone booth, a whimsical smile on his face. Katie Ferguson was waiting for him with a tender, wonder-light burning in her eyes.

"Is it finished, Walter?" she asked softly.

"Practically," he replied. "Madsen has agreed to run the stock back to its original valuation on Monday. That will rehabilitate the investors. There still remains one problem——"

Katie's face grew serious.

"And that is?" she asked.

"My own."

"Yours?"

"Yes--you see, my stock has all been cornered by one little speculator who, like Madsen, is without a conscience—"

He broke off and glanced down at her. Katie flashed him a dazzling smile and slipped one small hand through his arm.

"Perhaps that stock will go up too—on Monday!" she said, her eyes very bright.

The End.

C W The C. W. MANUAL; only book of its kind on the market; tells you everything about C. W. and how to construct many types of radio telephone and telegraph Vacuum Tube Transmitters. Price, $1.00 per copy, postpaid. 112 PAGES.

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Better Radio Equipment

First—A Short Talk on Kellogg Head Set Superiority

Kellogg head sets are the lightest on the market which is a prime requisite for comfort in any Radio receiving. They are built of highest quality material and their design is based on 25 years' engineering experience in telephone receiver construction. Kellogg head sets are supplied under the following codes and resistances: No. 69A, 2400 ohms, including head band and 6 foot cord; No. 69C, 2000 ohms, including head band and 5 foot cord; No. 74A, 1000 ohms single receiver with head band and 5 foot cord. Kellogg head sets are adapted for use by campers with portable receivers.

Second—A Brief Description of Kellogg Jacks and Plugs

Kellogg Radio jacks likewise are a standard product, once installed in your set, will give service and last indefinitely. Hundreds of thousands of Kellogg jacks and plugs in telephone work are in service the world over. They are designed for all standard Radio practice with the following codes: No. 501 is a four-conductor, two break type; No. 502 is a two-conductor open circuit type; No. 503 is a three-conductor, single break type; No. 504 is a four conductor, single make contact type; No. 505 is a six-conductor, one make, two break type.

Third—Why You Should Use Kellogg Grid Leaks and Condensers

Because first of all, they are accurate—no variation, regardless of atmospheric conditions, insuring uniform receiving.

Fourth—The Reliability of Kellogg Transmitters

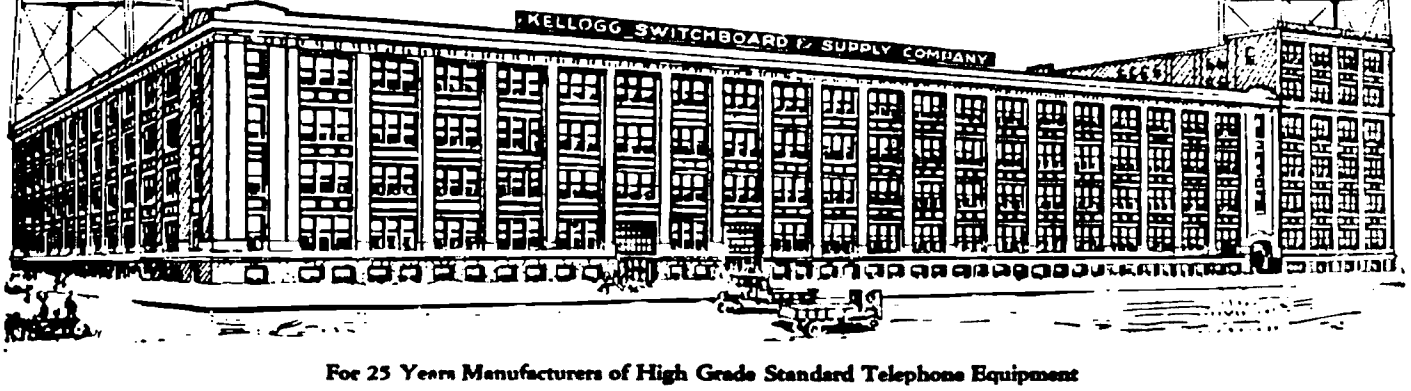
Kellogg Company transmitter or microphone is proving exceptionally reliable in Radio work. Today there are over three million Kellogg telephone transmitters in service, and their record is unsurpassed.

Fifth—Kellogg tube sockets are built of Kellogg Bakelite, and a standard product easily installed.

Write us today for our Kellogg Radio bulletin, completely listing our supplies, which include insulators, batteries, arresters, etc.; and investigate the latest Kellogg Radio products, every one of which is designed and built on the basis that—Use, is the Test.

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Two-Stage Amplifier $35.00
Detector and One-Stage Amplifier....$35.00
Detector and Two-Stage Amplifier....$45.00
Detector and Two-Stage Amplifier, Automatic Filament Control.....$55.00

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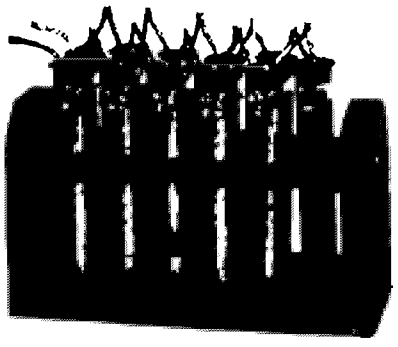
Audio Frequency Transformers.....$6.00
Proudfoot Automatic Filament Control Jacks—set of 3 with Wiring Blueprint, $3.00
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No battery noise in your V. T.
Easily recharged at home.
A life of from 3 to 5 years.
Jelly electrolyte, no spillage.
Clip on for any required voltage.

—A FEW OF THE REASONS WHY

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Storage "B" Battery



should be on YOUR set.

At your Radio Dealer, or

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22 v., 11 cells.....$ 6.50
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Chemical Rectifier 1.25
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BRONX RADIO EQUIPMENT CO.
687 Courtlandt Avenue Bronx, N. Y. C.
MANUFACTURERS OF QUALITY

LETTERS TO THE EDITOR

Continued from page 31

Los Angeles and vicinity and broadcasting stations are weaker than they should be for this distance of 74 or less miles air line, Denver stations coming up much stronger, and I presume, using no more power than Los Angeles broadcasting stations.

Why the Riverside and San Diego fellows come up stronger here I do not see, unless for Cajon Pass to east of me allowing an etheral air strata on a level to this elevation, while high mountains rise in continuity between here and Fullerton and Los Angeles.

With my transmitting, tests show, I am able to get out, north and east with comparative ease with my 15-watt I. C. W., having reached Canada on north and Fort Worth, Texas, east, but am not getting through to stations in Fullerton, San Diego, Los Angeles and Riverside with much kick. In fact, very unsatisfactorily for the distances of 60-120 miles air line.

I might add that my reception from north, east, northeast and southeast are all good here in Antelope Valley.

Anyone having any data on similar tests in this district, I should be pleased to learn your results.

LEE ROY POTTER.
Route No. 1,
Lancaster, Calif.



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950 So. Flower Street, Los Angeles, Cal.

LOW POWERED CIRCUIT

Continued from page 11

which is liable to decrease the life of, or totally destroy the filaments.

15. In operating vacuum tube transmitters, always heat the filaments to the proper brilliancy first, then cut in the plate supply voltage. When shutting down a tube transmitter cut out the plate supply voltage first.

16. When employing the Heising system of modulation, wherein control is obtained by variations in the grid potential of the modulator tubes, a C battery must be used. If the plates of the modulator tubes become red, the grid potential may not be sufficiently negative and more C battery should be used.

STATION 3BV

Continued from page 19

lead-in. It has an average height of 40 ft.

This station has been in operation, with the exception of the war period, since 1912, when licenses were a novelty. On the night of June 1 of this year I heard 6XAD very plainly. I have a letter from Major Mott confirming the signals. I hear 5ZA fairly regularly in the winter time, and occasionally in the summer when static permits. The old 9ZN spark used to roll in here in the wee hours. This station is located 25 miles northwest of Philadelphia, Pa.

The Standard Idea

Assembled—But Not Wired

THE STANDARD IDEA permits you to purchase radio equipment in a new way—**a cheaper way.** We manufacture a full line of instruments—including a Detector and Two-Stage Amplifier and a Multiple Wave Tuner—that embody the latest and most successful developments in radio. These instruments are shipped to you—complete assembled—**but not wired.** You do the wiring yourself with the diagrams and instructions furnished with each machine or using your own ideas if you prefer.

The STANDARD IDEA enables you to effect a saving of **20% or more** when you buy your instruments, for the wiring, being hand-work exclusively, is the most expensive operation in radio manufacture. By eliminating this costly item you save money and have the fun of doing all your own wiring.

Write today for literature descriptive of the STANDARD IDEA and prices and descriptions of the various machines we make. You will be interested in our offer to ship any machine for inspection on receipt of ⅓ the purchase price **which is cheerfully refunded if you are not satisfied.**

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VARIOMETERS COUPLERS

$3.75 Each

Wound but unassembled

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Hook it up as desired
Use the circuit you like

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PATRONIZE an organization for radio men, rendering personal, intimate and harmonized service with every article it sells.

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Tell them that you saw it in RADIO

GETTING RESULTS WITH SUPER-REGENERATION

Continued from page 15

condensers in parallel, or the Dubilier Model 577, furnished in the .0025 mf. value, will serve the purpose.

The filter, to prevent the 15,000 cycles from interfering with the operation of the audio frequency amplifier, is shown in the dotted lines and consists of two 12,000 ohm non-inductively wound resistances, a condenser of about .005 mf., and a 1 henry choke coil. Western Electric No. 38-B Lavite resistances are the best 12,000 ohm resistances on the market, and one of the ordinary choke coils used in transmitting sets will do for the 1 henry choke. A Radio Corporation Model UP-415 was used in the writer's installation.

The audio frequency transformer should be a Radio Corporation Model UV-712, where Western Electric "E" tubes are used, since it is the only transformer sold to the general public that has a primary impedance that is anywhere near the plate impedance of the "E" tube. If the ordinary tungsten filament receiving tubes are used, other types of transformers may be employed, but it is important when using "E" tubes to have a transformer that has a relatively low primary impedance.

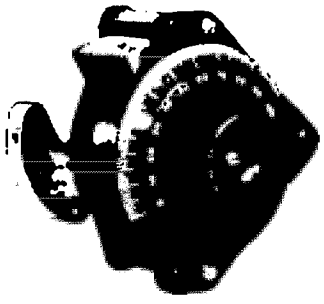
After setting up the circuit and making certain that the tickler coil of the super-regenerator tube is poled properly, and that the external oscillator is functioning, the signals may be tuned by varying condenser C-1 until the signals are audible. Then vary condenser C-2 until the signals are of greatest intensity, and then retune C-1 for maximum strength. Considerable trouble will be experienced by beginners in determining the proper adjustment of C-2 and the relative position of the tickler with respect to the primary inductance, but results will come in due time if the experimenter has the ability to stick to it and not give up at failure to get results the first time.

If a loop is not desired an antenna may be used, as is shown in the lower left-hand corner of the diagram, in dotted lines. The advantage of using the loop is increased selectivity and freedom from static and other interference, but it may be well for the experimenter to try the circuit with the antenna first, before using the loop, in case he is not familiar with the operation of the latter.

After duly considering the merits of the new circuit and comparing its operation with that of both the ordinary regenerative receiver and the so-called Super-Heterodyne type, the writer has come to the conclusion that where reception of broadcasting only is desired, and the receiving station is located in the midst of a group of broadcasting stations, as is the case in nearly every

CHELSEA

VARIABLE CONDENSERS (Die-Cast Type)



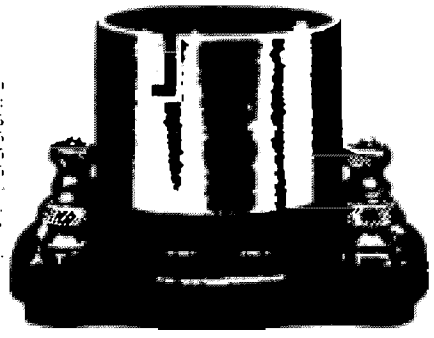
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Guaranteed for circuits up to 1,000 volts

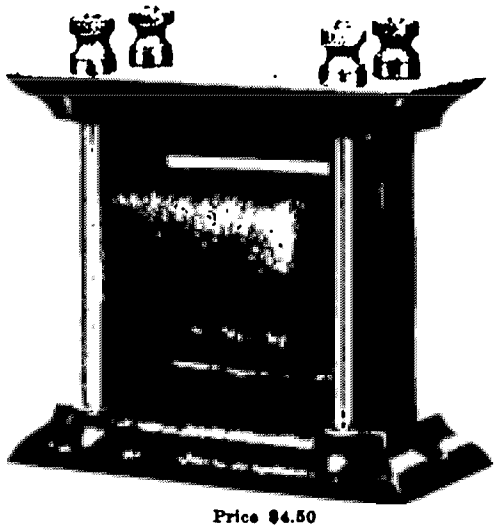


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This socket includes a bakelite base supporting four external readily accessible binding posts. The tube receptacle is highly polished nickel and will take any standard detector or amplifying tube as well as the smaller size power tubes. Although primarily intended for receiving circuits it will operate satisfactorily on any circuit up to 1,000 volts. It may be mounted either on table or panel. Positive contact springs

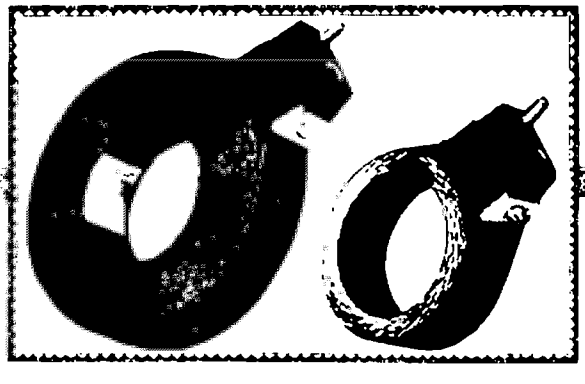
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Honeycomb coils were used by Armstrong as he threaded the circuit, and the convenience and efficiency of the De Forest method of mounting with the new spring plugs, greatly facilitate the adjustments which are necessary before this circuit can be made to operate. Insist on De Forest DL Coils and be sure of dependability.

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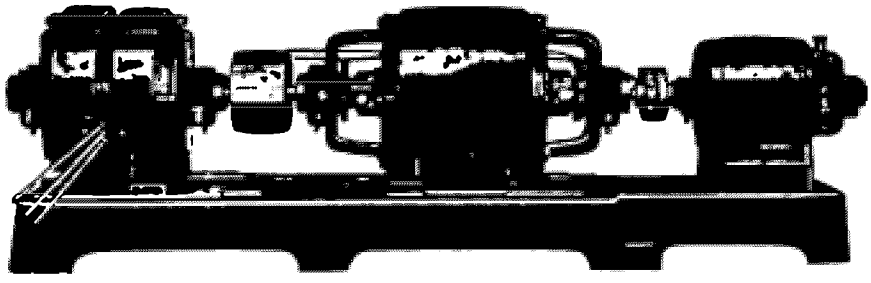
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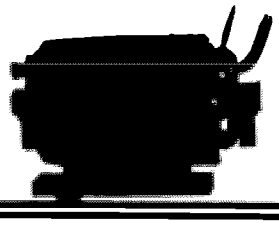
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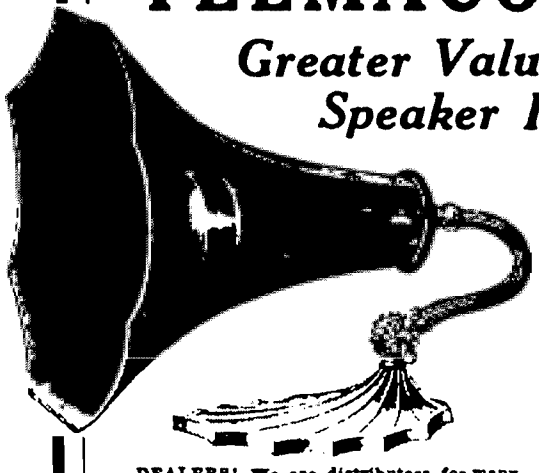
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large city, a super-regenerative circuit is not necessary. It has already been proved that a loud speaker can be operated satisfactorily from the ordinary detector and two stage amplifier, where the broadcasting station is not more than 25 miles away. Such a set will consume 3 amperes of filament current at six volts and the plate battery of 40 to 80 volts will last a considerable length of time. If a super-regenerator using Radiotron or Cunningham 5 watt tubes is employed, the filament current will be 7.5 amperes at 10 volts, or about three times the power consumed by the ordinary receiver. The plate battery would have to be much larger and should be either of the storage type or of large dry cells. Hence, where expense must be considered the ordinary regenerative receiver wins on all counts.

For the amateur who is some distance from the broadcasting centers the new circuit is a great benefit and will doubtless come into general use in the rural districts of the country. For amateur C. W. telegraphy the new circuit will prove of immense value, as it will permit of greater selectivity, the use of a loop, the ability to receive well on the very short wavelengths (since the efficiency of the new circuit increases as the wavelength decreases), and increased signal strength.

However, the Armstrong Super-Heterodyne, or double detection and amplification at a relatively low frequency by a number of amplifiers still remains the most sensitive of radio receiving circuits and will probably come into more general use with the advent of better tubes and more efficient apparatus. As the Super-Heterodyne is rather expensive to construct, it has been stated that the latter is the Rolls-Royce of the radio world, and the Super-Regenerator the Ford, which gets there just the same. The reader is asked to draw his own conclusion after trying out the new circuit.

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Also a complete line of high grade separate parts guaranteed unconditionally as best

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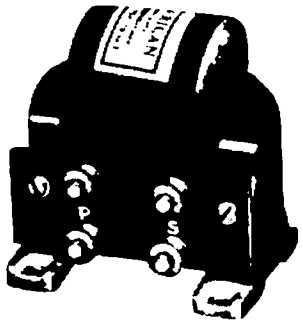
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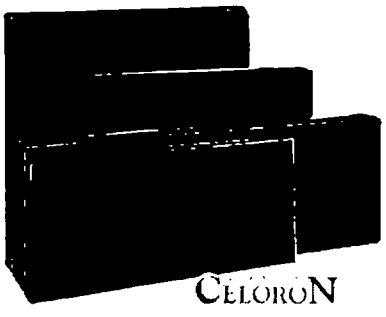
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KDKA

Continued from page 30

between 70 and 80 per cent. Piano solos average about 30 per cent, violin solos, 20 to 30 per cent, and vocal numbers, 40 to 50 per cent, with maximum of 100 per cent. Of course, the modulation meter indicates only the average volume of sound. While the meter may read only 30 per cent in case of piano music, the individual notes at the instant of striking may reach 80 to 90 per cent. Allowing for the kind of sound being transmitted, that is, piano, speaking voice, solo, etc., the modulation meter provides a convenient means of finding the correct distance to place the artist from the pick-up transmitter and accounts to a large extent for the uniform volume of sound received from KDKA. The instruments at the top of the transmitter panel, Fig. 2, are from left to right: filament volt meter, ground current meter, plate ammeter, modulation meter and plate volt meter. The antenna current meter is mounted on the wall with a series condenser and discharge resistance and is not shown in the picture.

The antenna at KDKA consists of 6 wires, 190 feet in length on 20-foot spreaders. This antenna is supported 210 feet above the ground by a brick smoke stack at one end and by a 100-foot pipe mast on a nine-story building at the other end. The operating room

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Price $20
Complete with 5 ft. flexible cord

The Standard of the World



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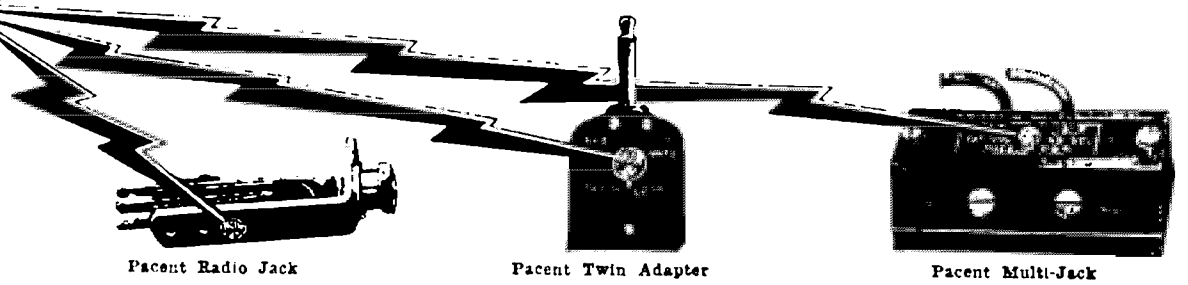
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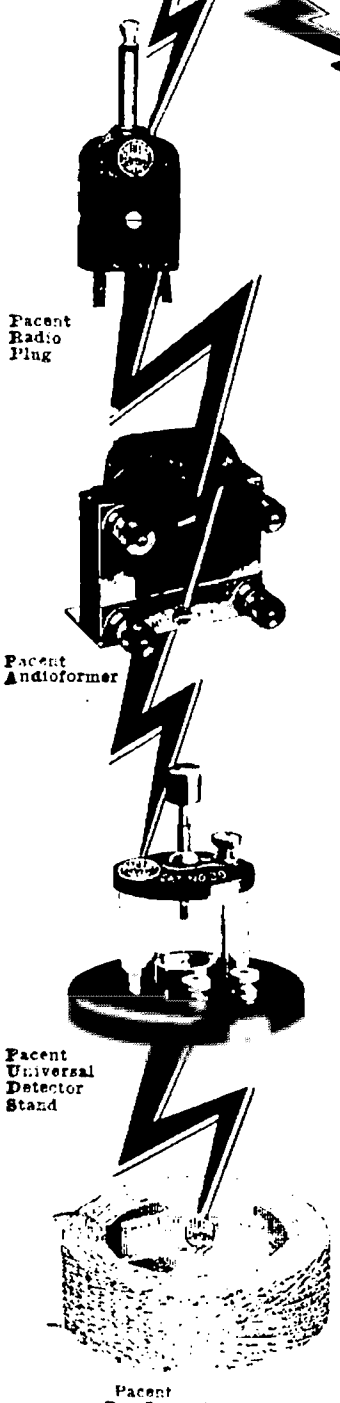
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PACENT RADIO ESSENTIALS

PLAY SAFE! LOOK ~ FOR ~ THE PACENT TRADE MARK



Pacent Radio Jack — Pacent Twin Adapter — Pacent Multi-Jack



Pacent Radio Plug

Pacent Audioformer

Pacent Universal Detector Stand

Pacent Duo-Lateral Coil

WHY TAKE CHANCES?

THE PACENT TRADEMARK IS A SAFE BUYING GUIDE

It Is Your Guarantee of Quality, Satisfaction and Service

In the ordinary purchases which you make every day, you invariably depend upon some mark of quality as an assurance of value and satisfaction. In buying radio materials the average purchaser is a great deal more dependent upon the reputation of the manufacturer than in buying everyday commodities. A radio instrument may look good and act bad. How much more important it is in this case, therefore, to look for the trademark of a competent, dependable manufacturer. The Pacent trademark on any radio products is an absolute assurance of satisfaction.

WHAT THE PACENT TRADEMARK MEANS TO YOU

It means that the device bearing this trademark was made to fill a definite, important radio need: that is the meaning of PACENT RADIO ESSENTIALS. It means that the product was originated by a radio expert and has passed the acid test of experience. The Pacent Universal Plug was the *first* radio plug; the Pacent Jacks were the first radio jacks, and so with the Twin Adapter, Multi-jack and other PACENT RADIO ESSENTIALS. Every Pacent product is also backed up with Mr. Pacent's fifteen years personal experience in the radio industry.

The Pacent trademark means that the product is one of a group generally recognized by radio authorities as leaders in their line. Pacent jacks and plugs are standard with the largest radio manufacturers. Pacent Duo-lateral Coils, besides being used in standard sets of wide distribution, were approved and used by Major Armstrong as important elements in his new super-regenerative circuit, together with other Pacent products. ALL PACENT RADIO ESSENTIALS are also approved and sold by the leading radio distributors.

Therefore, when you buy PACENT RADIO ESSENTIALS bearing the Pacent trademark you are absolutely sure that you are getting the best for your money. You are playing *safe*. Don't accept substitutes, imitations or something "just as good." Insist on seeing the Pacent trademark.

DON'T IMPROVISE PACENTIZE

SEND FOR DESCRIPTIVE BULLETINS

DEALERS AND JOBBERS: The Pacent Sales Policy is to a great extent responsible for the popularity of Pacent products. Write for outline of our Sales Plan.

PACENT ELECTRIC COMPANY

INCORPORATED

Executive Offices
900 NASSAU STREET
NEW YORK, N. Y.

Branch Offices
PHILADELPHIA, PA. CHICAGO, ILL.
Bourse Bldg. 13 So. Clinton St.

WASHINGTON, D. C.
Munsey Bldg.

Member Radio Section, Associated Mfrs. Electrical Supplies

Kearney 2778

Pacific Radio School

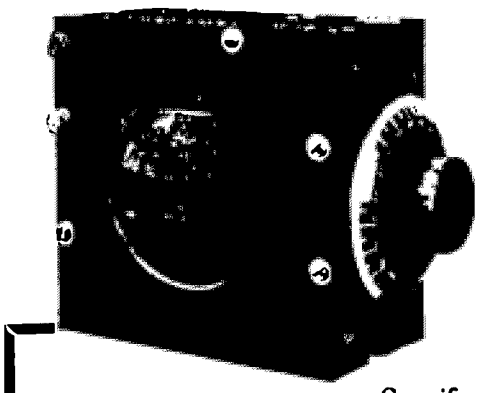
ARC AND SPARK SYSTEMS

Hours—10 to 12 noon
1 to 4 P. M.
7 to 9 P. M.

Send for descriptive circular

433 Call Bldg., San Francisco, Cal.

This school is equipped with KLEINSCHMIDT Automatic Telegraph System



"CYMO" Variometers

Price $5.00

(Without Dial)

Specifications:

Wood: Spanish Cedar
Wire: Double Silk Covered, Green
Metal Parts: Nickel Plated Brass
Finish: Rubbed Shellac over Mahogany Oil Stain
Range: 170 to 600 meters

General: Shafts absolutely true; no lost motion or rattle; smooth turning without backlash; perfect connections to rotor; absolute rigidity of stator; in a word, completely satisfactory.

At your dealer or write to

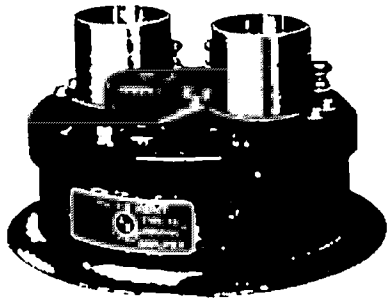
RADIO DEVICES COMPANY
693 MISSION STREET SAN FRANCISCO

The NEW

ATWATER KENT

2-STAGE AMPLIFIER

THE OUTSTANDING *Advantages* OF THIS INSTRUMENT *are*



- ¶ *Excellence of reproduction.*
- ¶ *Amplification regulation by small steps.*
- ¶ *A complete instrument in itself.*
- ¶ *Compactness.*
- ¶ *Regulation entirely by knob, no jacks to equip.*
- ¶ *Transformers protected by steel housing.*
- ¶ *Short wiring connections eliminate capacity effect.*
- ¶ *Hermetically sealed, absolutely no moisture troubles.*

THE LOW PRICE IS MADE POSSIBLE AS A RESULT OF 20 YEARS' EXPERIENCE IN QUANTITY MANUFACTURE OF SCIENTIFIC ELECTRICAL INSTRUMENTS

Price $16.00 *An Excellent Merchandising Proposition*

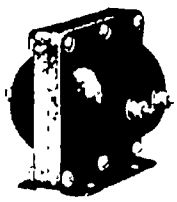
ATWATER KENT MANUFACTURING COMPANY
4947 STENTON AVENUE *Radio Dept.* PHILADELPHIA, PA.

and studio are located on the ninth floor of this building. Fig. 5 shows the mast end of the antenna with the operating room directly below. A counterpoise which is a duplicate of the antenna in construction is placed 110 feet beneath the antenna. This brings the counterpoise about 15 feet below the transmitting set. The down lead from the antenna and the counterpoise lead are made up of eight strands of No. 14 copper wire equally spaced around 1.5-in. diameter wooden spacers. The natural period of this aerial system is approximately 412 meters. A series condenser of 0.0005 mf. capacity is used in series with the antenna and sufficient loading inductance added to obtain the desired wavelength of 360 meters. The series condenser is shunted by a radio frequency choke coil of 10 millihenries inductance in series with a one megohm resistance, to drain off any static charge that might accumulate on the antenna when insulated from ground by the series condenser. The high frequency resistance of the antenna system at 360 meters wavelength is approximately 12 ohms, a large percentage of which is radiation resistance. The antenna current at 500 watts is 6.5 amperes; at one kilowatt it is 9 amperes.

The power equipment consists of two 2-kw. motor generator sets with 250-volt direct-current motors, the sets employing two armature windings and two commutators permanently connected in series. Normally, the motor generator sets are used with the generators paralleled. Either set may be used alone with the radio set at reduced power. There is also a third motor generator

CROSLEY RADIO Apparatus

BETTER—COSTS LESS



Crosley Sheltran

The Crosley Sheltran is designed to obtain the maximum amplification from the modern vacuum tubes used in radio work. Tests have shown that the design is correct to insure maximum efficiency. Completely shielded—9 to 1 ratio $4.00

Crosley Binding Posts

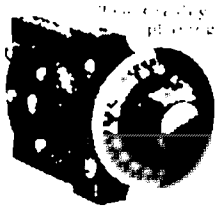
Made in three different sizes—7/16 in. and ½ in. These are all of the same design as illustrated.

No. 1 . . . $0.05 each
No. 2 . . . .07½ each
No. 3 . . . .10 each

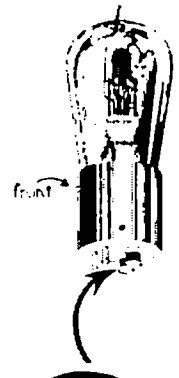


CROSLEY R. F. T. A.

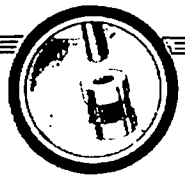
The Crosley Radio Frequency Amplifying Tuner is a new unit which replaces the Radio Frequency Amplifying Transformer in the receiving set. It is possible to obtain a broad band of wavelengths from 200 to 600 meters. With tubes $4.00



CROSLEY MFG. COMPANY
Dept. R-1 CINCINNATI, OHIO



Carrying Capacity ½, ¾, 1, 1¼, 1½, 2 and 3 amperes



Actually Worth More Than Its Weight In Gold!

Whenever one of these tiny patented fuses "blows" on your filament terminal it has saved you the cost of a new tube—which is more than the fuse's weight in gold.

Slipping directly on the filament terminals of any standard bulb used in any standard socket, the

RADECO Safety Fuse

FOR VACUUM TUBES

makes it impossible for any excessive amperage, even an accidental short, to "burn out" the filament. Positively does not affect the efficiency of your set.

The Radeco Safety Fuse is equally good for the protection of meters and other delicate Radio instruments.

Come only in boxes of four

Order by Mail **4 for $1** *Buy from Your Dealer*

Send money with order and state what tube fuses are wanted for

We carry a complete stock of standard Radio sets and parts at standard prices Order from any standard catalog.

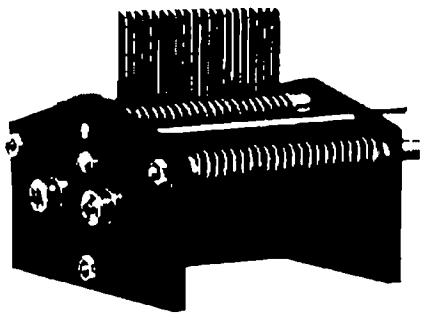
RADIO EQUIPMENT CO.

830 Washington Street

BOSTON, MASS.

Oldest Exclusive Radio Store in New England

Pen Brand Variable Condensers



Pen Brand 43 Plate Variable Condenser

Will Meet Your Requirements Regardless of What Circuit You Use.

For Telephone reception, a 3 plate vernier in parallel with a 23 or 43 plate variable is the only REAL vernier.

PEN BRAND PRODUCTS have enjoyed the reputation of being the STANDARD for three years, and are Quality instruments.

3 plate Vernier	Approx. .00005 mf		$2.10
7 plate Variable	Approx. .0001 mf		2.25
11 plate Variable	Approx. .0002 mf		2.60
17 plate Variable	Approx. .0003 mf		3.00
23 plate Variable	Approx. .0005 mf		3.60
33 plate Variable	Approx. .00075 mf		4.20
43 plate Variable	Approx. .001 mf		4.70
63 plate Variable	Approx. .0015 mf		7.20

MANUFACTURERS

We are in position to supply you with U and T punchings for transformer iron cores, also brackets. If you are contemplating manufacturing transformers, write us, stating your requirements, and let us quote you.

Attractive discounts to dealers and jobbers. Write for folder on PEN BRAND PRODUCTS

THE RADIO TELEPHONE SHOP

175 STEUART STREET SAN FRANCISCO, CAL.

★ ★ RADIOADS ★ ★

A CLASSIFIED ADVERTISING SECTION READ BY 60,000 BUYERS

The rate per word is five cents, net. Remittance must accompany all advertisements. Include name and address when counting words.

ADS FOR THE OCTOBER ISSUE MUST REACH US BY SEPTEMBER FIRST

RECEIVING APPARATUS

FOR RELIABLE BROADCAST RECEPTION buy a "Master Radio Broadcast Receiver." Write at once for complete circular. Master Engineering Company, Omaha, Nebr.

VARIABLE CONDENSERS. Buy them direct—save money. 23 plate, $2.25; 43 plate, $2.85. We pay the postage. Electrical Equipment Co., 118 N. Broad Street, Trenton, N. J.

FOR SALE—New Honeycomb Set: detector, two step, tubes, coils, phones and B battery, in one cabinet, $100. Write M. A. Hicks, 230 No. Eugene Street, Stockton, Calif.

FOR SALE—Reinartz C. W. Receiver, Detector and 3 step Amplifier. Hear 2ZI, 3FS, 4GL, 8AGZ, and 15 concert stations all over 400 miles distant, on detector alone. $80.00 without tubes. John Titcomb, Nogales, Ariz.

Switch Levers, $0.50; **Binding Posts**, $0.10; Switch Taps, $0.03. Remler, Murdock and Crosley radio apparatus on hand. Send stamp for list. Griewisch Radio Supplies, 301 So. Oakland, Green Bay, Wis.

RADIO. Our $15.00 (tube) detector sets selling like hot cakes. Big opportunity. Write today. Simplicity Radiophone Factories (6), Cincinnati, Ohio.

FOR SALE—2 Remler Variometers and 180° Coupler, mounted on new formica panel, complete, $20.00. Also 200 watt C. W. Power Transformer, new and completely mounted, $12.00. C. W. Park, Riverbank, Calif.

Variable Condenser parts: Plates, .03; **Rotary** washers, .10 doz.; Stationary, .05; Shafts for any number plates, .25; Supporting Rods, .05; Condensite top and bottom, .25. Gravenstede, 84 Hancock Ave., Jersey City, N. J.

BARGAINS. Variometers, $3.00; Variocouplers, $3.00; Two Variometers and Variocoupler, $8.00. Wound with silk wire. Unmounted tuning coils, beautifully finished, 95c. Dials only 55c while they last. Remit coin or money order. K. J. Morrison, P. O. Box 1896, Pittsburgh, Pa.

FOR SALE—Short Wave Regenerative Receiver, $15.00. E. Gassmann, R. R. B. Box 498, Fresno, Calif.

FOR SALE—New York Coil Variable Condensers, 11 plates, $2.50; 23 plates, $3.00; 43 plates, $3.75; Variometer, $5.00; Variocoupler, $5.00; Amplifying Transformer, $5.00; 3" Bakelite Dials, 95c; Switch Levers, 40c; Switch Points, per dozen, 20c; Switch stops, per dozen, 40c; large Rubber Binding Posts, 9c; Metal Binding Posts, 9c; Crystal Cups, 9c. Add postage. Wholesale and Retail. W. E. Roehl, 614½ Fannin, Houston, Tex.

200—20,000 **Meter Receiver, including Radiotron Detector**, $35.00. Box 205, Williamsport, Pa.

MISCELLANEOUS

AUDION RENEWALS—Tungsten filament Detectors renewed $3.00. **Tungsten filament Amplifiers** renewed $3.25. **Tungsten filament 5 watt Transmitters** renewed $5.00. We do not accept tubular Audiotrons, RAC-3 or other multibase tubes for renewal. W.E., V.T.1 with Oxide coated filaments renewed for $4.00. If in doubt write us, enclosing 2c stamp. Ten years experience, results guaranteed, safe delivery assured. TERMS, CASH WITH ORDER OR C. O. D., PLUS COLLECTION CHARGES. Trimount Laboratory, Milford, Mass. (Superseding all price lists prior to Aug. 1st, 1922.)

LIGHTNING. Wonderful new Electrolyte charges discharged batteries instantly. Eliminates old Sulphuric Acid method entirely. World has waited half a century for this invention. One gallon retails $10.00; free to agents. LIGHTNING CO., St. Paul, Minn.

FOR SALE—New set "Hawkins Electrical Guides," $7.50. Will trade for fones. Cessford Kerr, 627 N-2 E, Provo, Utah.

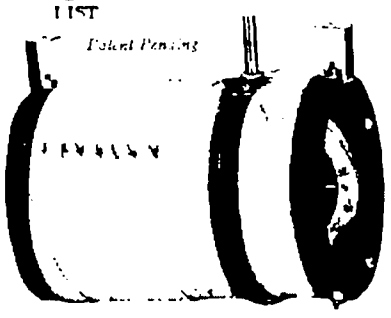
PERSONAL — Graphologist reads character from handwriting. Enclose 25c and sample of writing for trial. R. A. Williams, Box 63, Tucson, Arizona.

The New **"ALL WAVE"**

COMBINATION FLAT AND BANK WOUND

Coupler

PRICE $9.00 LIST



Guaranteed Wave Length 150 to 3000 Meters

Entirely eliminates the use of All Variometers, Variocouplers and Loading Coils.

Permits the building of the most compact and efficient receiver at a considerably lower cost.

We guarantee the "ALL WAVE" Coupler (with a money back guarantee) to give maximum results for long or short wave long distance *selective reception*.

Six efficient Hook ups are included FREE with each genuine WAVE COUPLER. Don't be persuaded to accept any inferior coupler offered you as "just as good."

If your dealer cannot supply you, send us his name and your order; we will supply you direct or through him.

Manufactured by

Capitol Phonolier Corporation

54-56 Lafayette St. **NEW YORK, N. Y.**

MUSIC - SPEECHES - SIGNALS

Received from Any Lamp Socket

NO WIRES NECESSARY

The "Super-Antenna" unit eliminates all lightning hazards—does away with outside antenna. Designed by one of the country's foremost radio engineers.



SAVES EXPENSE OF ANTENNA AND LIGHTNING ARRESTERS

Why use outside aerial? Save expense and trouble. The "Super-Antenna" unit is shock-proof—will not blow fuses or damage a set in any way. Just insert plug in any light socket and you get perfect results.

TESTED & APPROVED

The "Super-Antenna" unit is so made to conform with the requirements of the Nat'l Board of Underwriters. Has been tested and approved by leading electrical institutions throughout the country.

Super-Antenna

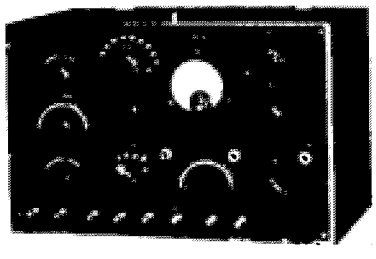
This unit is the only safe plug to use and get full satisfaction. It also eliminates the alternating current hum. **If your dealer cannot supply you send his name enclosing check or money order.**

PRICE **$2.80**

West of Rockies, $3.00
Canada $3.70

F-R-L SUPER RECEIVER—Radio Frequency

This is the most perfect operating Set offered to the Radio Public and six months ahead of any other unit. Made of quality material—tested by skilled engineers, gives perfect modulation of sound without distortion. Three Stage Radio Frequency and Two Stage Audio Frequency, having several unique features making it the most sensitive and efficient set on the market.



Price, including Tubes.....$240.00

Dealers, Jobbers—Wire or Write for Discounts

SUPER-ANTENNA Co.

Dept. 129 **QUINCY, ILL.**

You Can Do It

Make Money in your spare time by securing subscriptions to "RADIO"

Write for Particulars

SUNBEAM

RADIO "B" BATTERIES

Long life—strength—freshness and in any quantity

Western Electric Novelty Co.

1250 E. Sixth St. **Los Angeles**

Tell them that you saw it in RADIO

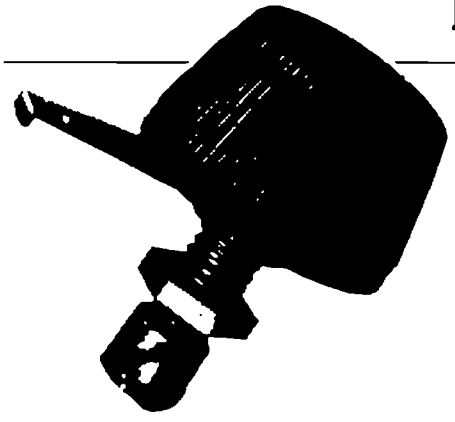
set with a 220-volt 25-cycle motor, which can be connected to the radio set in case of failure of the direct-current supply. This set is provided with an exciter to supply the field of the high voltage generator. A filter consisting of a 50-henry inductance and 32-microfarad condenser reduces the generator hum to a negligible amount. The panel beneath the speech amplifier on the right in Fig. 1 controls the power equipment. Here are mounted generator field switches and rheostats, generator paralleling switches, generator voltmeter and ammeters, voltmeter switch, antenna switch control and studio signal light button to show the announcer in the studio when the transmitting set is in operation.

The engineer in charge of the station tests all filament and plate batteries before each program. He next starts the transmitting set and checks the wavelength by means of a wave meter. He then lights the signal light in the studio, notifying the announcer that the transmitter is in operation. The announcer turns on the studio amplifier which lights a signal light in the operating room, notifying the engineer that the audio circuits are in operation. The engineer then watches the modulation meter and adjusts the amplification of the speech amplifier to give the desired amount of modulation. A loud speaking receiver in the operating room serves as a check on the quality of the transmission. When programs from local churches or from the downtown studio are to be transmitted, the telephone line is tested before the program. Orders and any special arrangements are made over a supplementary order wire or phone line between the radio station and place of the performance.

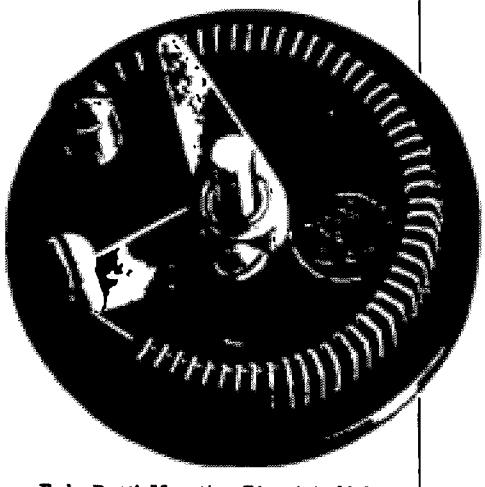
RADIO MINE EQUIPMENT

The Bureau of Mines is considering the problem of equipping mines with radio apparatus for use in the event of accident. The stringing of wired telephone is impossible, but officials state that it would be fairly simple to equip certain distant rooms or chambers with crystal receiving sets, so that rescue parties could communicate with imprisoned miners. The real problem, they say, is to find a simple and portable transmitting set by which the miners could communicate with the mouth of the mine or the outside world in the event of being injured in or imprisoned after an accident. There is no room for a large transmitting set, they point out, and the danger of a transmitting spark igniting gases or coal dust complicates the problem, although a tube set might be used if the necessary power could be supplied for its operation without lengthy power wires which would be in danger of being cut constantly, just as telephone lines would be cut or broken by the mining operations.

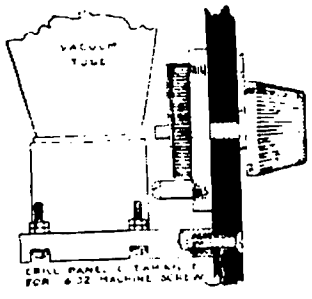
Buy Fada Equipment From Your Dealer

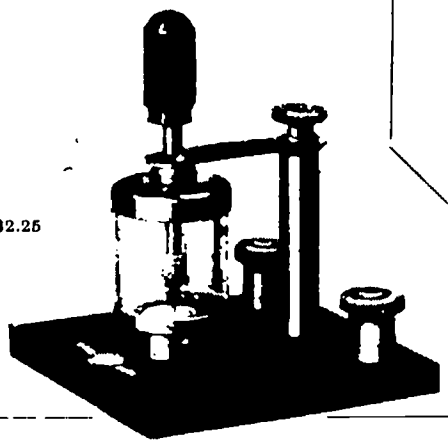


Fada Inductance Switch, 50c



Fada Panel Mounting Rheostat, $1.00





Fada Crystal Detector, $2.25

Fada Equipment Assures the Joy of Radio Reception

Don't fool around any longer with apparatus that is theoretically imperfect and miss all the good things that are broadcasted every day for your benefit. End all that trouble and worry by making your own receiver complete with FADA parts or demand FADA equipment when buying complete assembled sets.

Our aim, first and last, is user satisfaction. We design and build FADA products to give the greatest possible results.

If you would go through our plant and observe the care with which the proper materials are selected, the scientific exactness with which each piece is made, the precision in assembly and testing, the constant supervision of each step in the process of manufacture—you would realize that there could be no better equipment made. You would ever after, look for the FADA trademark when you buy.

The FADA Inductance Switch is a delight to use. It moves easily over the contact points and gives perfect electrical contact. It's so easy to fasten to your panel and the cost most reasonable.

The FADA Rheostat is mechanically and electrically perfect in design and free from the usual rheostat troubles. The wire is evenly wound so the contact lever passes smoothly over each turn of the resistor. The knob is secure on its shaft and "fits the fingers."

The FADA Detector has a supersensitive crystal. You marvel that such a small piece of crystal can capture words and music from the air. It always does its work faithfully, constantly receiving messages from miles around.

F. A. D. ANDREA

1581-F Jerome Ave.
New York City

The Mark of Scientifically Exact Radio Equipment



Type R Z Radak Receiving Set Clapp-Eastham's newest achievement (Licensed under Armstrong U. S. Patent 1,113,149)

Radak

Trade Mark Reg. U. S. Patent Office

Means Simplified Radio

CLAPP-EASTHAM'S long career in engineering and manufacturing has been devoted to Radio exclusively. Its constant aim has been to make Radio simple and easy for the novice. In the Type R Z Radak Receiving Set, shown above, the very highest development of this aim has been realized.

This new set brings in signals, messages and music with amazing clearness and loudness, responding to wave lengths as great as 3,000 meters. The effects obtained are unsurpassed by any set made today, whatever the price—especially when used with the Radak Electric Ampliphone.

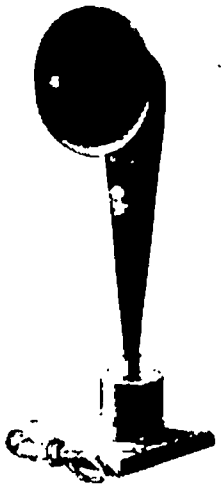
Combines features of Clapp-Eastham Type H R Regenerative Receiver, with two stages of amplification in one cabinet. Extremely simple to operate.

SPECIFICATIONS

Cabinet—Solid mahogany, dull finish. Hinged cover. Compartment for B battery.
Panel—Condensite, dull finish black; white lettering.
Dials—Indestructible metal, black with white lettering.
Binding Posts—Hard rubber composition.
Condensers—Balanced type, built as a Vernier; two rotary, three stationary plates.
Antenna Inductance—Wound on formica tube.
Plate Inductance—Wound on molded ball.
Switch—Fan blade.
Rheostat—Clapp-Eastham type H 400.
Circuit—Single circuit regenerative.
Price—$100, complete as above.

Ask to see this unusual set at the store where you usually buy electrical goods. If the dealer does not carry the Clapp-Eastham line he may obtain same through his jobber.

Newest catalogue complete with the most up-to-date sets as well as other radio equipment sent you for 6c.



Radak Electro Ampliphone. Does not distort the tone. Especially successful with type R Z Radak Set. Price, $28.

CLAPP-EASTHAM COMPANY
103 MAIN STREET CAMBRIDGE, MASS.
Oldest, Largest Manufacturers of Radio Equipment Exclusively. Established 1906.

It Is Time to Think of Service

It is time to look further than the mere equipment when you buy radio supplies, whether you're in Radio for profit or pleasure.

SIGNAL

When you see this name "SIGNAL" on wireless and radio equipment, you may confidently expect real radio service on your problems.

SIGNAL Radio Apparatus is built entirely in SIGNAL factories, from improved designs, by our own radio engineers, working in our own laboratories.

Bear in mind that SIGNAL Equipment is not, nor will it ever be **"side-line" material.**

Back of every SIGNAL Product is a reputable company, with a record of years of successful development in Radio.

As a part of the Service offered beginners, advanced amateurs and serious experimenters on Radio, we maintain a complete engineering service department, upon which our friends are at liberty to call, at any time, regarding their Radio problems, and to aid them in getting the best results at all times from their apparatus.

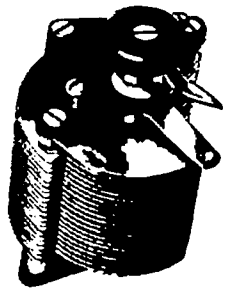
When you specify "SIGNAL" you specify "SERVICE"

SIGNAL ELECTRIC MANUFACTURING COMPANY

Menominee, Michigan

709 Mission St., San Francisco

SIGNAL BACK MOUNTED VARIABLE CONDENSER



One of the SIGNAL line, produced to meet the demand for a condenser for panel mounting. Comes in three models, so built as to permit mounting on panels from ⅛ to ⅜" in thickness. Machine screws are furnished for fastening the instrument to the panel; it is only necessary to drill three holes. Each instrument furnished with metal scale calibrated to 180 deg. Knob and pointer are removable. Construction is very rigid, the material in the aluminum plates being .026". The bearing plates are 3/16" black Formica.

This request-coupon makes it easy to secure all "SIGNAL" latest Wireless Bulletins, without any obligation. Simply fill out and mail now.

CUT OUT AND MAIL COUPON NOW

COUPON

Send me the new Signal Wireless Bulletin W.

Name .....

Company .....

City .....

State .....

RADIO

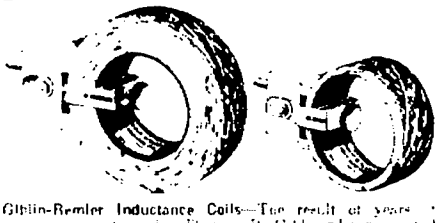


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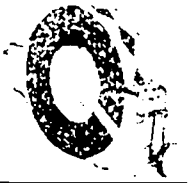
R532 Remler Bakelite Dial—With knob and bushing. A true micrometer. Metal Base. Dial 3" diameter, ⅛" thick, with ¼" bevelled tapering to ⅛". Can mark at edge of dial especially ¼" or ½" off. **Price** 75c



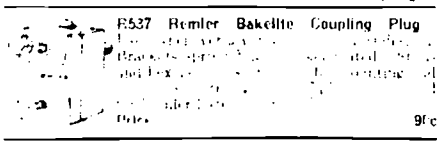
Giblin-Remler Inductance Coils—The result of years of experimenting by Thomas P. Giblin who originated Honeycomb and Duolateral Coils. They have MORE INDUCTANCE LESS DISTRIBUTED CAPACITY and LOWER HIGH FREQUENCY RESISTANCE than any other coils of same number of turns on the market.

R533	35M turns	Price, mounted	$1.50
R534	50M turns	Price, mounted	1.60
R535	75M turns	Price, mounted	1.65

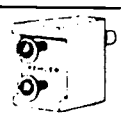
All sizes from 20 to 1500 turns



R536 Remler Q. S. A. Inductance Unit [illegible] Q. S. A. 550 Remler Inductance Coil Unit $6.00



R537 Remler Bakelite Coupling Plug [illegible] Price 95c



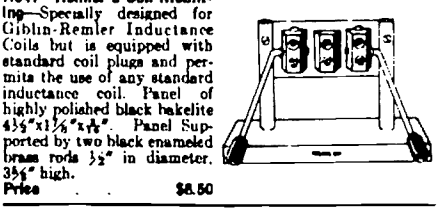
R538 Remler Bakelite Panel Plug. The Brass Terminals are tapped and provided with two nickel plated screws to serve both for mounting and connections. **Price** 60c



R539—Remler Bakelite Coil Plug—Provided with two N. P. metal clamps and screws for securing fiberoid straps. Terminals of brass and extend through plugs for making soldered contact to coil leads. **Price** 70c



R540—Remler Bakelite Coupling Plug—Same as R539 but provided with No. 85 polished nickel binding posts instead of hexagon nuts. Drilling centers ¾". Cross drilled for Remler Extension Handle. Price $1.65



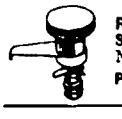
R541—Remler 3 Coil Mounting—Specially designed for Giblin-Remler Inductance Coils but is equipped with standard coil plugs and permits the use of any standard inductance coil. Panel of highly polished black bakelite 4½"x1⅛"x⅛". Panel Supported by two black enameled brass rods ½" in diameter, 3⅝" high. **Price** $8.50



R543—Remler Bearing Type Rotary Lever Switch—1" radius lever. Knurled insulating knob. Ideal for coupler control switches. **Price** 60c



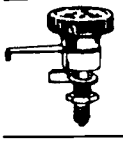
R544—Remler Plain Type Rotary Lever Switch—Knurled insulating knob. Polished N. P. washer ⅛" collar, ½" in diameter. **Price** 40c



R545—Remler Plain Type Rotary Lever Switch—Knurled insulating knob. Polished N. P. Washer ¼" collar, ½" in diameter. **Price** 40c



R546—Remler Plain Type Rotary Switch—1½" radius with Remler Polished Bakelite Knob 1⅜" diameter. Polished N. P. washer ⅛"x¼". **Price** 50c



R547—Remler Bearing Type Rotary Lever Switch—Finest switch manufactured. When MOUNTING IT NEED NOT BE DISASSEMBLED AS THE LOCK NUT CLEARS THE SPRING. Radius 1¾" Remler Bakelite Knob 1¾" diameter. **Price** $1.00

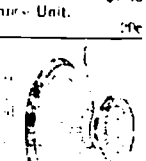


R546 Remler Plain Type Rotary Lever Switch [illegible] Price 50c

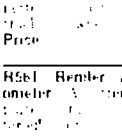


R549 Remler Junior Rheostat [illegible] Price $1.00

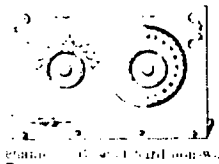
R550 Renewal Resistance Unit. Price 50c



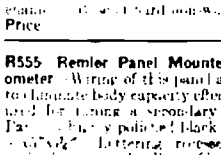
R551 Remler Heavy Duty Rheostat [illegible] Price $1.75



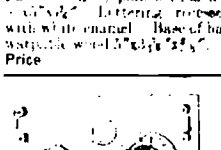
R561 Remler A-Battery Potentiometer [illegible] Price 75c



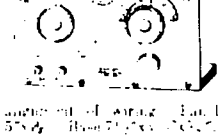
R554 Remler Panel Mounted 180 Vario-Coupler [illegible] Price $12.00



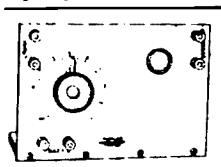
R555 Remler Panel Mounted Variometer—Winding of this instrument arranged to eliminate body capacity effects when used for tuning a secondary circuit. Panel highly polished black bakelite [illegible] Lettering recessed filled with white enamel. Base of hard, non-[illegible] wood 3"x3⅛"x2½". **Price** $9.75



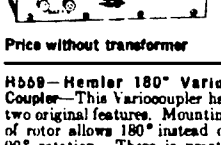
R556—Remler Detector Panel with A-Battery Potentiometer for Plate Voltage Control—Designed to give maximum efficiency. Panel [illegible] wiring makes it impossible to control [illegible] with Remler Vario-Coupler and Variometer panels. Short bakelite [illegible] connections [illegible] Price $8.50



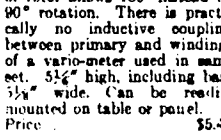
R557—Remler Amplifier Control Panel with Rotary Cam Switch—For long distance work—clear reception of broadcasting—operation of loud speakers, an amplifier is a necessity. Rotary Cam Switch is exclusive feature of this panel; does work of two jacks and plug. Panel 7½"x 5"x⅛". Six Remler nickel plated binding posts. Base 7½"x3½"x¾" **Price without transformer** $9.00



R558—Remler Amplifier Panel Without Transformer—Designed to give maximum efficiency—necessary for long distance work—operation of loud speakers, etc. Panel highly polished black bakelite 7½"x5"x⅛". Remler Rheostat, Tube Socket, six binding posts. Base 7½"x3½"x¾". **Price without transformer** $8.00

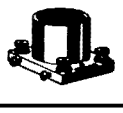


R559—Remler 180° Vario-Coupler—This Vario-coupler has two original features. Mounting of rotor allows 180° instead of 90° rotation. There is practically no inductive coupling between primary and windings of a vario-meter used in same set. 5½" high, including base 5⅛" wide. Can be readily mounted on table or panel. Price $5.40



R560—Remler Molded Bakelite Variometer—In electrical and mechanical design—in accurate construction—in uniform appearance, these Remler Variometers are without equal. Wave length range 100 to 600 meters. Stator 4½" diam. Rotor 3¾" diameter. For panel or table mounting. **Price** $6.50

R542—Remler Bakelite Socket—For Panel or Table Mounting. Molded in one piece, insures perfect alignment. Base 2⅛" x 2¾". Overall height 1½". **Price** $1.00



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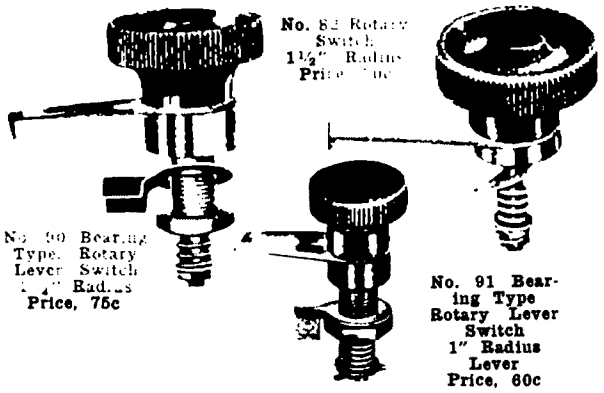
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681 MARKET STREET **SAN FRANCISCO, CALIF.**

R563—Remler ¼" One Piece Slider—Stamped from one piece of spring brass completely in compound die. Lever is 1" and length of slider ¾". **Price** 25c

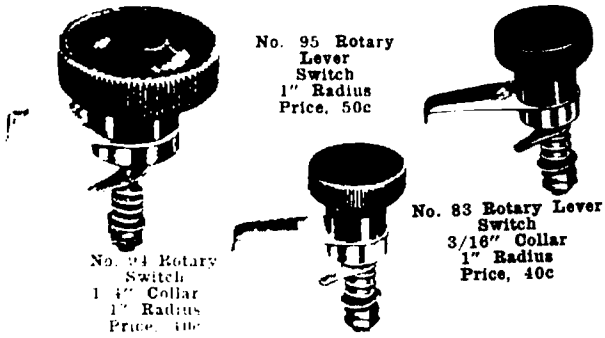


REMLER Cunningham



No. 90 Bearing Type Rotary Lever Switch 1" Radius Price, 75c

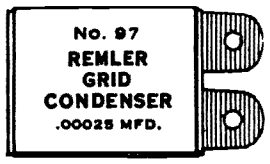
No. 91 Bearing Type Rotary Lever Switch 1" Radius Lever Price, 60c



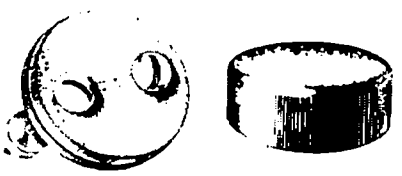
No. 94 Rotary Switch 1/4" Collar 1" Radius Price, 40c

No. 95 Rotary Lever Switch 1" Radius Price, 50c

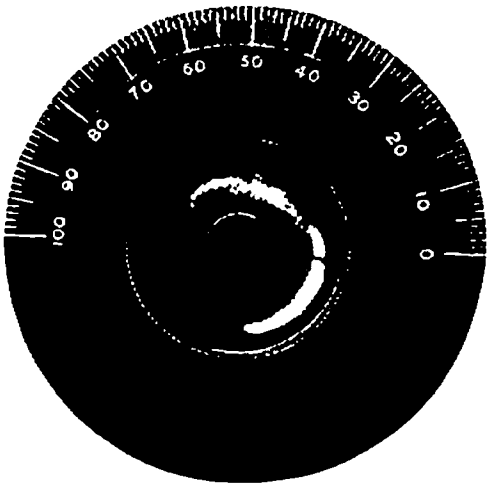
No. 83 Rotary Lever Switch 3/16" Collar 1" Radius Price, 40c



No. 97 Fixed Grid Condenser Price, 20c



No. 96 Variable Grid Leak Price, 40c



Type No. 100
3-inch Bakelite Dial with Knob and Bushing 75c

On this page are shown the popular line of Remler switches, the Remler Fixed Grid Condenser, the Remler Variable Grid Leak and the famous Remler Dial.

This represents but a small fraction of the Quality Radio Apparatus that has put Remler in the leading position it holds today. This small fraction, however, is built with the same care, accuracy and precision that has made the entire Remler line universally known as Quality Radio Apparatus.

It is becoming more and more apparent that Remler Apparatus is preferred in the building of sets because of its uniformity of construction—the well balanced proportion of each item giving an accurate and a pleasing appearance to the finished set.

Insist on Remler parts. If your dealer cannot supply you, write us direct for the name of a Radio dealer who can.

Built To Give Maximum Efficiency

VACUUM tubes are used for two distinct individual purposes in a receiving set—as DETECTORS and as AMPLIFIERS. The qualifications of a tube for these two uses are so different that for maximum efficiency tubes of entirely different design must be used.

This point was one of the chief considerations of the research engineers who designed Cunningham tubes in the great laboratories of the General Electric Company. After years of research and experimental work, the Cunningham C-300, a SUPER-SENSITIVE DETECTOR, and the Cunningham C-301, a DISTORTIONLESS AMPLIFIER, were developed. These two tubes, now nationally recognized as standards for all types of receiving sets, are responsible for the highly perfected results obtainable in radio phone reception.

Amplifies As It Detects

TYPE C-300 GAS CONTENT DETECTOR $5.00	TYPE C-301 HIGH VACUUM AMPLIFIER $6.50

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Cunningham tubes are covered by patents dated 11-7-05, 2-13-08 and others issued and pending. Licensed only for amateur or experimental uses in radio communication. Any other use will be [illegible]