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AMATEUR RADIO

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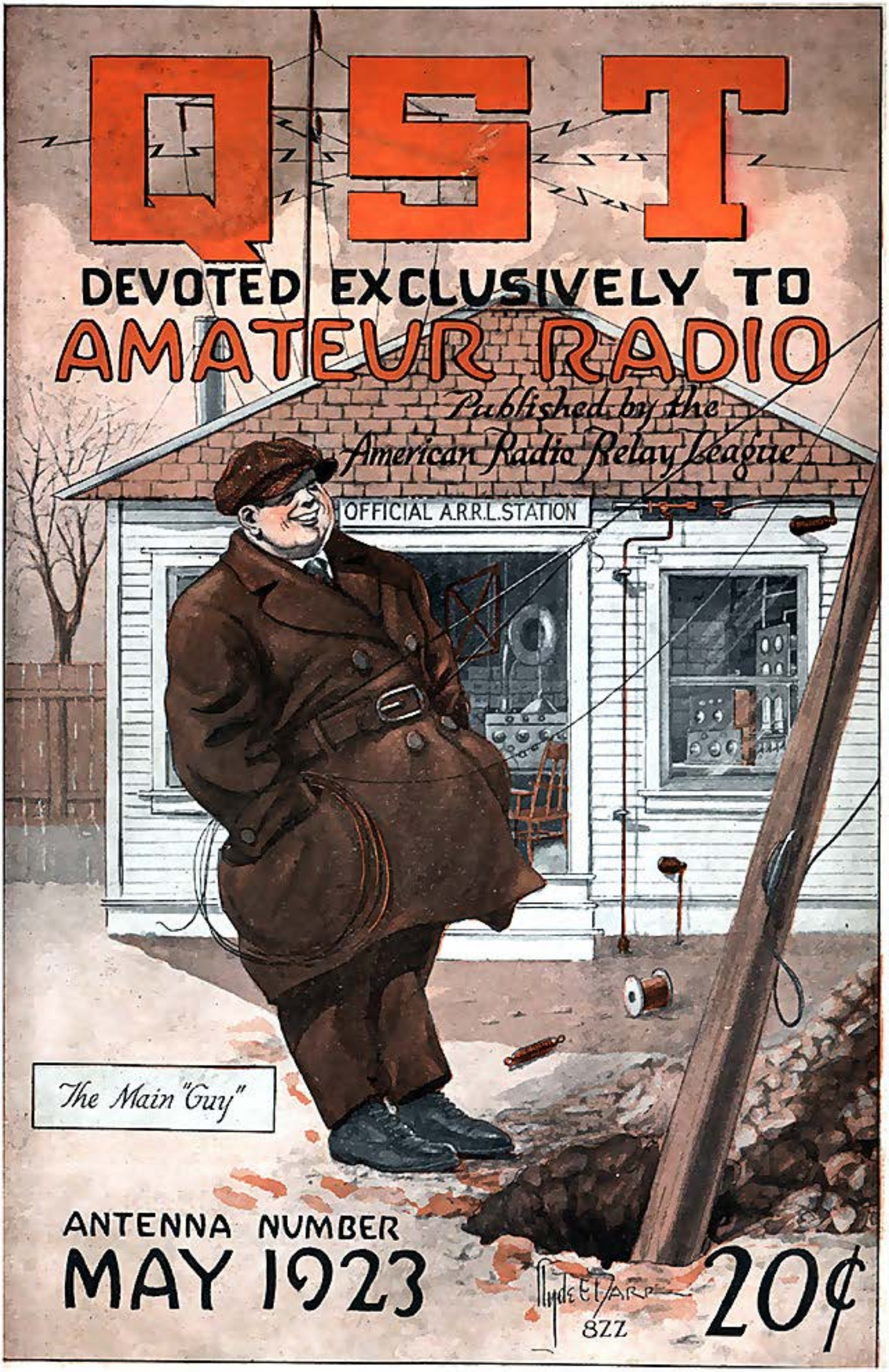

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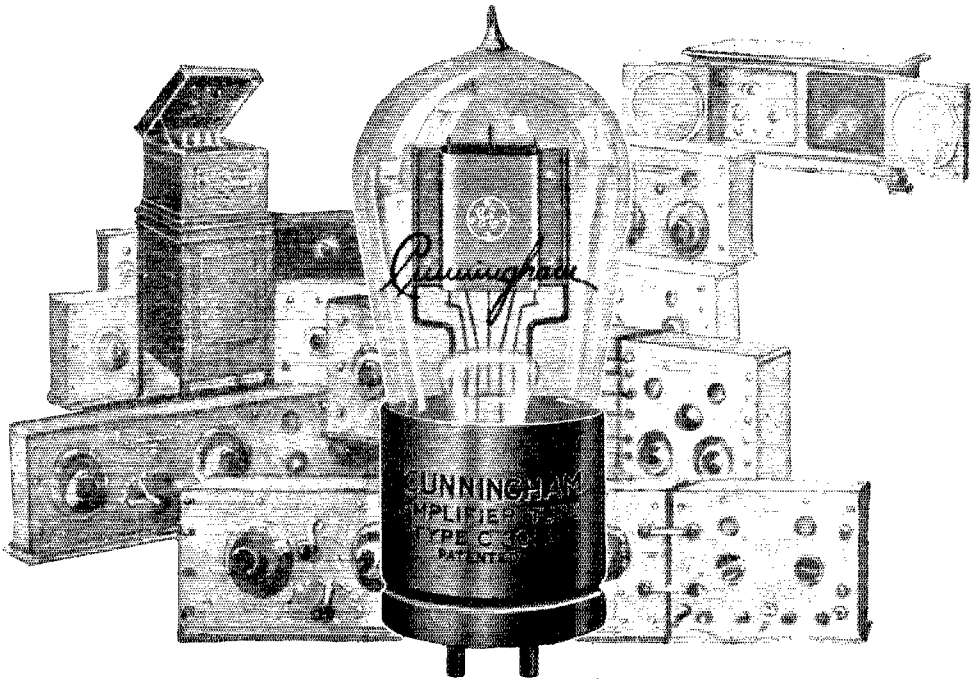

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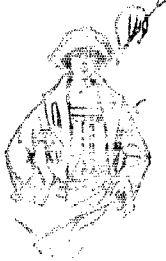

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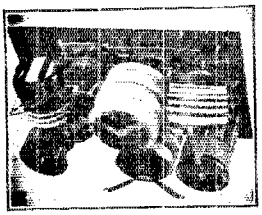

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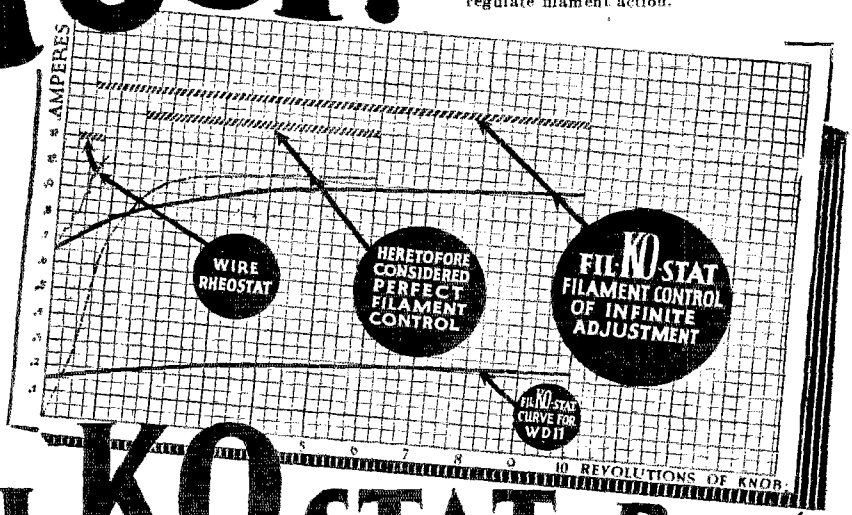

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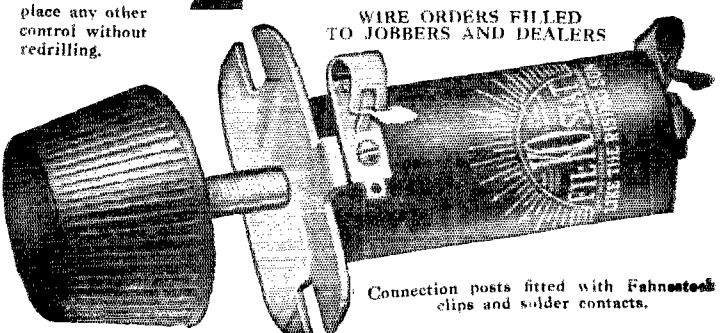

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A Magazine Devoted Exclusively to the Radio Amateur

The Losses of 200-Meter Antennas

*By Stuart Ballantine**

MY recent book, *Radio Telephony for Amateurs*, contains a discussion of short wave antennas which, altho received with much interest, does not do justice to this important subject. Accordingly when asked to contribute to the antenna number of *QST* I was glad of the opportunity to supplement this discussion. In the following article I shall undertake a calculation of everything about the antenna that may be usefully calculated. The exact calculation of the radiation and the losses in the earth will be left for a later paper, however.

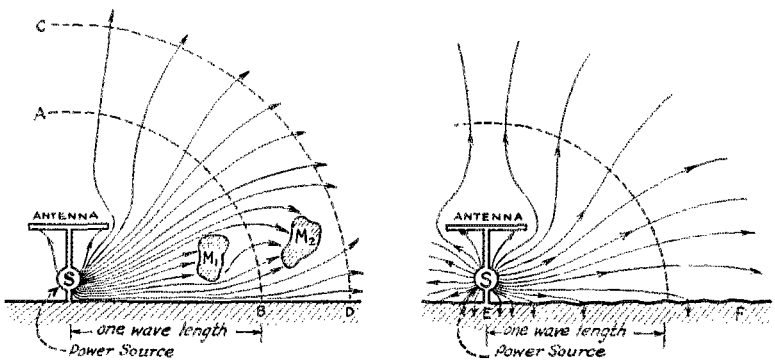


FIG. 1 – FLOW OF POWER FROM AN ANTENNA

To have something definite to talk about, the calculations will be carried thru for a 200 meter antenna having the following dimensions:

Specimen 200 Meter Antenna

Length.....100 feet.
Height.....60 feet.
Number of wires.....4.
Type.....Inverted L.
Top.....Flat or cage with 3 foot spacing between the four wires.
Downlead....4-wire cage tapering so that wires are 1" apart at the bottom.

When I shall have occasion to speak of the resistance corresponding to such-and-such a loss, this will mean the *lumped* resistance which, if inserted at the point where the power is applied and multiplied by the square of the current at that point will represent the loss in question.

Classification of Antenna Losses

The reader is undoubtedly familiar with the customary separation of the total antenna losses into radiation, dielectric losses, earthing losses, and losses in the insulators, the antenna wires and other nearby metallic objects. No radio book is considered complete without this analysis. It will be advisable to see if it is possible to define these various subdivisions so unmistakably that there will be no future chance of any misunderstanding.

In Fig. 1A I have shown the flow of power from an antenna which is assumed to be erected *over a perfectly conducting earth*. This representation is on the basis

*Radio Frequency Laboratories, Inc., Boonton, N. J.

of the Poynting idea and Maxwell's second expression for the distribution of the electro-kinetic energy, in terms of the magnetic force and induction. The sphere S at the base represents the source of power and the energy diverges from it and *not from the antenna wires.*

Conductor Resistance. The energy does not flow *away from the wires* but *into them.* By summing up this flow of energy into the wires we can find the total amount that goes into the wires and is lost as heat. We are justified in calling this loss the *conductor resistance loss.*

Dielectric and Induction (Eddy Current) Losses. Metal masts, wires, and roofs are also sinks of power, whether they are in the neighborhood of the antenna as in M_1, Fig. 1A or far away as M_2, Fig. 1A. Any receiving station is a power-sink of the second sort (M_2). Obviously the expression "losses in imperfect dielectrics or conductors in the field of the antenna" is of no use to us for the field of the antenna is without limit and we have information about only a very small part of the field.

Earth Resistance Losses. The same remark applies to the expression "earth resistance." The earth under an actual antenna is *not* perfectly conducting as at Fig. 1A but has resistance, and there must be a constant flow of power into it from the source S and the waves in the air as shown at Fig. 1B. This takes place everywhere, not only at the antenna. Of course, we will be justified in calling the loss in the earth at E Fig. 1B, underneath the antenna, "earth resistance loss" but what shall we call the loss in the earth further out at F?

Radiation Resistance. Radiation resistance is ordinarily defined as "the quantity which, multiplied by the square of the antenna current gives the total power radiated from the antenna." Now in the case of the perfectly conducting earth of Fig. 1A this was very nice; the amount of power radiated could be calculated as the total power flow outward thru a spherical surface surrounding the antenna. (Even this was not correct if there were any "energy sinks" like M_1 and M_2). But for the practical case of Fig. 1B where the earth is not perfectly conducting the entire concept of "radiation resistance" becomes of less importance as an index of the power reaching the receiving station. To see this let us for a moment agree with the quasi-logic of regarding all losses within a wave length of the antenna as "antenna losses" and all losses more than a wave length away as "radiation losses." On this basis radiation is the energy that flows out thru the sphere shown by the dotted line in Fig. 1B. Then the losses in a tree within a wave length of the antenna are "antenna losses" but the losses in another tree outside the dotted line are "radiation losses"!!! In view of these considerations I am inclined to argue that the popular respect for "radiation resistance" is very much misplaced and that more attention should be paid to the correct law of attenuation of electrical force with distance. I have succeeded in extending the mathematical theory to practical forms of antennas and

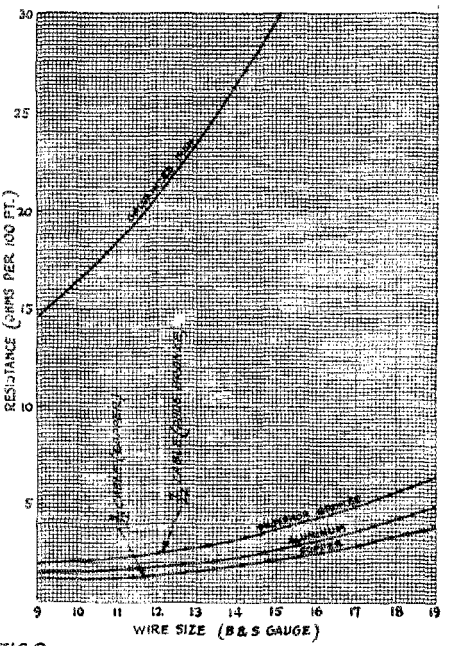


FIG. 2 RADIO FREQUENCY RESISTANCE OF WIRES AT 200 METERS

in a forthcoming *QST* article shall present such aspects of the newly completed theory as have application in amateur work.

Resistance of the Antenna Wires. The discussion will be confined to 4 materials, copper, aluminum, phosphor bronze, and galvanized iron. Their conductivities are as follows:

Table 1—Wire Conductivities

	Conductivity in Mhos/cm.	Conductivity compared with annealed copper
Soft-drawn copper	5.71×10^5	98%
Hard-drawn copper	5.57×10^5	96%
Hard-drawn aluminum	3.54×10^5	61%
Phosphor bronze	2.03×10^5	30%
Galvanized iron	$.96 \times 10^5$	16%

High Frequency Resistance of the Wires. Data on the h.f. resistance of round wires have been collected at the Radio Frequency Laboratory at Boonton, N. J. At the frequencies we are considering, that is 1,500,000 cycles (200 meters), 99% of the cur-

rent is carried, in the case of copper, by a surface layer .009" thick, and the most economical way to use the copper is as a strip .02" thick and perhaps ¾" wide. Such a conductor might be useful in constructing an exceptionally good antenna *after* the reduction of other losses had made it worth while to reduce the conductor resistance. The properties of the materials at 200 meters are shown in the curves of Fig. 2.

Increase of Resistance Because of the Radial Currents. All along the antenna, current is flowing to the surface of the wire and leaving as capacity current thru the ether. See Fig. 3. Thus there is a radial

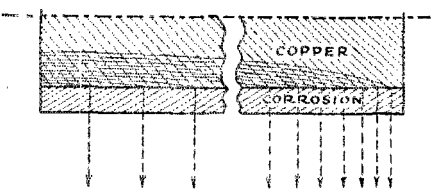


FIG. 3 LONGITUDINAL AND RADIAL FLOW OF CURRENT IN A CORRODED ANTENNA WIRE

flow in addition to the lengthwise flow and this should be taken into account, but for the materials under discussion the penetration is so small that the radial resistance is negligible.

Effect of Parallel Wires—the "Proximity Effect." The current in a single round wire tends to distribute symmetrically, but if other conductors are present and carrying currents of the same frequency (whether they are part of the antenna or not) the distribution is not symmetrical and the resistance is still further increased. When two wires are parallel in an antenna the current concentrates on the sides furthest from each other. The effect may be serious in a bunched downlead or a stranded cable such as 7 strands of No. 22 B.&S.

Table 2—Percentage Increase Due to the "Proximity Effect" of Two Parallel No. 10 Copper Wires.

Spacing	Increase in resistance over that of one wire alone
3 feet	negligible
1 in.	0.5%
½ in.	4.0%
¼ in.	6.0%

This table shows that the proximity effect is negligible for the spacings used in flat tops and in cage downleads. The *resistance* is not much improved by putting the wires farther than 1 inch apart. The table also shows the very bad effect of a bunched downlead.

The Edge Effect. Up to this point we have been considering the effect of non-uniform distribution of the current in a wire. We now come to the effect of uneven division of the current between several wires. In the cage arrangement the current divides equally between wires *provided that the cage is far from anything.* When the wires are arranged in a plane (flat top) the current crowds to the outer wires with the result that the resistance is a trifle higher. This is the "edge effect." I do not think that the mathematical details are of any interest but shall be glad to give the formulae to anyone who will communicate with me privately. The effect is shown in Table 3.

Table 3—Percent Excess of Current in the Outer Wires of the Specimen Antenna Described at the Start of This Paper

Wire sizes B.&S. gage	Excess	Dividing factor N
10	17.0%	3.970
12	16.5%	3.975
14	15.9%	3.980
18	15.0%	3.990

Note: $N = \frac{(1+R)^2}{1+R^2}$

While the excess of current is 16% the increased resistance amounts to only 1%.

Cage Versus Flat Construction. The advantage of cage construction over flat construction can be estimated for our particular specimen antenna (wires 3 feet apart) by comparing the figures (i.e., factor N) in the last column of Table 3 with the figure 4. In this case the resistance of a four-wire cage would be *less than 1% lower* than that of a four-wire flat-top. The comparison becomes a little more sensible in the case of a downlead where the wires are close together. If the downlead wires were No. 14 and separated 2 inches the advantage of the cage construction would be about 3% as far as resistance is concerned. Observable differences between cage and flat-tops are probably due to the differences in their capacities and their surrounding fields. (The difference in the field is that the field of each wire does not influence the other wires so much; hence the inductance of the downlead is less than if bunched and a little less than if flat.—Tech. Ed.)

Effect of Current Distribution Along the Antenna. We now have an idea of the high frequency resistance of a four-wire antenna taking into account (1) the unequal distribution of current among the wires; (2) the proximity effect; (3) the skin effect. In calculating the last we found that (4) the radial resistance was negligible. It remains to correct our results for the un-even distribution of current along the wire. When oscillating at its fundamental the current distribution of the antenna is very nearly sinusoidal as in Fig. 4A and when oscillating far above

the fundamental the distribution is very nearly linear as in Fig. 4B. We can calculate the effect of this distribution upon the total resistance and find that when working at the fundamental the antenna resistance is ½ that calculated above, and when working far above the fundamental

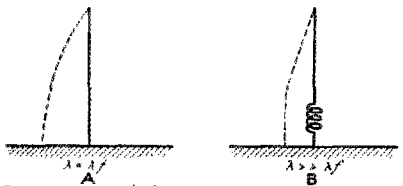


FIG. 4. *Current distribution in an antenna, A-when oscillating at fundamental (sinusoidal), B-when considerably above the fundamental (linear).*

the resistance is ⅛ of that calculated. (It is evident that the resistance of the antenna will depend on the point at which the e.m.f. is applied. An antenna which has a resistance of one ohm at the base may have a resistance of 4 ohms at a point half way up and still behave the same way when the same amount of power is introduced.)

Finishing the Calculations on Resistance of Wires. It will be assumed that the antenna is to be operated at the fundamental. The correction factor will then be ½.

Table 4—Total Conductor Resistance of the Specimen Antenna, described at the First of This Article.

Wire size B.&S.	Copper	Aluminum	Phosphor bronze	Galvanized iron
10	.265	.327	.450	3.45
12	.287	.422	.563	4.38
14	.380	.510	.595	5.58
18	.690	.885	1.200	9.05

Note:—7-strand-22 is about equal to No. 12 solid for copper and bronze. Galvanized iron is bad at 200 meters but for a zinc layer of .02" will still be as good as bronze. A copper-clad wire with a copper coating .01" thick will be as good as solid copper and stronger besides. However, there is no doubt at all about No. 10 or No. 12 solid hard-drawn copper; it has the mechanical strength and will make a very satisfactory antenna.

Effects of Corrosion. A corroded wire consists of a solid copper core with a thin coating of poor conductivity. If the thickness of the wire and the coating are known the current distribution can be calculated from the conductivity of the two materials. I made a diligent search of the literature for information regarding the resistivity of corrosion-coating but without any success. Messrs. Reinartz and Kruse then measured some samples of copper wire that had become oxidized in a non-smoky atmosphere. (Hartford and S. Manchester, Conn.) (There are omitted here, for lack of space, Mr. Ballantine's calculations on these wires.) The resistance of a layer of corrosion .001" thick on a No. 18 wire turned out to be .037 ohm for the whole antenna. This leaves unexplained the miscellaneous reports that improvement was made by simply substituting new wire for old in an antenna. These cases were probably due to another kind of corrosion entirely, that due to acid, sulphurous fumes, or smoke. We must not overlook the possibility that a particular kind of corrosion might raise the antenna resistance as much as 1.5 to 15 ohms. Soot would not account for it; even a heavy layer of it would be comparatively innocuous. More experimental data are required. In the meantime the use of a proper protective material such as enamel or tin plating may be resorted to in smoky environs. In the case of aluminum it is fortunate that the corrosion is of such a nature that it soon ceases.

Metal Plated Wires. It has often been stated that the high frequency current is bound to travel in the surface, no matter how poor a conductor the surface layer may be. *The current will not forsake a core of high conductivity to travel on a surface of low conductivity.* An interesting application of this fact is the much-discussed effect of nickel-plating on radio conductors. The current distribution for such a wire is shown in Fig. 5. It is seen that the nickel carries only a small part of the current; consequently the nickel plating increases the resistance only about 9%. For plated wires the h.f. resistance increases as the conductivity of the plating

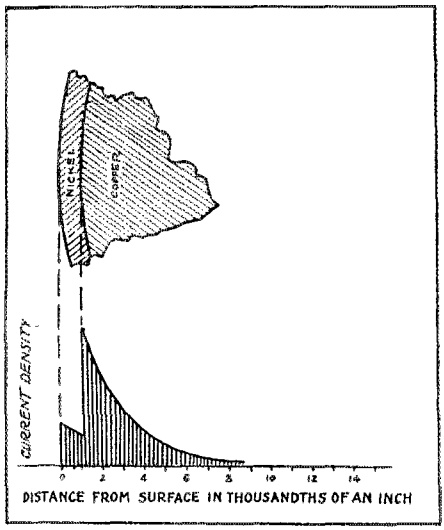


FIG. 5 SHOWING CURRENT DISTRIBUTION IN A NO 18 B.&S. COPPER WIRE WITH A NICKEL-PLATED SURFACE – (200 METERS)

material is lowered, reaches a maximum, and then slowly rises to the resistance of the core material as the coating is made still poorer. Consequently *if a radio conductor must be coated it should be with a material whose conductivity is much more or much less than that of the core.* In the case of tin-plated wire the increase of resistance for a coating like that of Fig. 5 would be 3% and for the usual thin coating of about .0002" would be only about ½%. (Note.—However, there has been some trouble with "tinned" wire that was really covered with lead and with lead-and-tin alloy.—Tech. Ed.)

Strength of Wires. The average strength and densities of the 4 materials are as follows:

Table 5—Strength and Density of Metals

	Tensile strength pounds per square inch	Density Grams per cubic cm
Soft-drawn copper	34,000	8.9
Hard-drawn copper	50,000	8.9
Hard-drawn Aluminum	30,000	2.7
Phosphor bronze	90,000	8.8
Galvanized Iron	50,000	7.8

Aluminum, while a weak metal, is light and so may be thought of as stronger than copper.

Sleet Formation. The behaviour of wires in sleety weather depends on their ability to adjust themselves to temperature changes of the air. The material having the least heat capacity will be least subject to sleet formation. The heat capacity of copper and bronze is 1.133 calories per degree per cubic centimeter while that of aluminum is 9.826, only 73% as great.

General Regarding Aluminum. The properties of copper wire are generally known, those of aluminum wires are not current in radio literature but may be found in the "Standard Handbook for Electrical Engineers," 4th edition, p. 78, section 4 (McGraw-Hill, 1915); and in Perrine's "Conductor's for Electrical Distribution," p. 15, (Van Nostrand, 1903.)

A good grade of aluminum is permissible, providing that proper care is taken in joining it to other metals. The rapid corrosion of a joint between aluminum and copper may rapidly increase the resistance and in time open the joint. This corrosion is electrolytic and unavoidable, hence the aluminum should be used for the entire antenna right down to the station window so that the connection with the copper can be inspected and cleaned from time to time. (Note—"A good grade of aluminum" is an important phrase. Poor aluminum wire whose impurities caused it to corrode and to become brittle was widely sold ten years ago and gave aluminum the bad name that GOOD aluminum does not deserve.—Tech. Ed.)

Topics in Brief

IN this issue of *QST*, our antenna number, we are endeavoring to present as much information and data on aerials and related matters as we can make room for. As a result our usual departments either have been omitted entirely or have been scaled down to a minimum; they will be resumed next month as usual. As a further result, there are many topics which we cannot present in any form this month. Detailed reports from the British and French transatlantic committees have now been received, and Mr. Coursey has sent us an interesting description of 5WS, illustrated with photographs and hook-ups, and this we will present as early as possible. With the same idea in mind we hope we may be pardoned for treating with great brevity the following items, which are of high amateur interest but for which our Antenna Number plans do not permit greater space.

Canadian Relay Fails—The first attempt at a trans-Canadian relay, undertaken on March 24, 25 and 26, was a complete failure because of freak atmospheric conditions, accompanied by aurora. Signals were not heard from greater than daylight distances. Canadian General Manager Duncan has arranged for a repetition of the tests on April 13, 14 and 15, and success is expected.

A two-way relay across the greater part of the continent was successfully put over an All-Canadian route on Feb. 20th when 5GO, Vancouver, B. C., started a message to Toronto which was relayed via 4BV in Loreburn, Sask., and 3NI in Ft. William, Ont., to 3DE in Toronto, and the answer returned to Vancouver in a total elapsed time of one hour and ten minutes. Most of the time was consumed at the Toronto end. FB, OM.

Short Wave Tests—The short-wave CQ Party was a decided success and the large volume of logs received attest a spontaneous and whole-hearted interest. Surprising distances on surprisingly-low waves were recorded. The short waves are the coming thing. Some of the reception is reported in "Calls Heard" this month, which see.

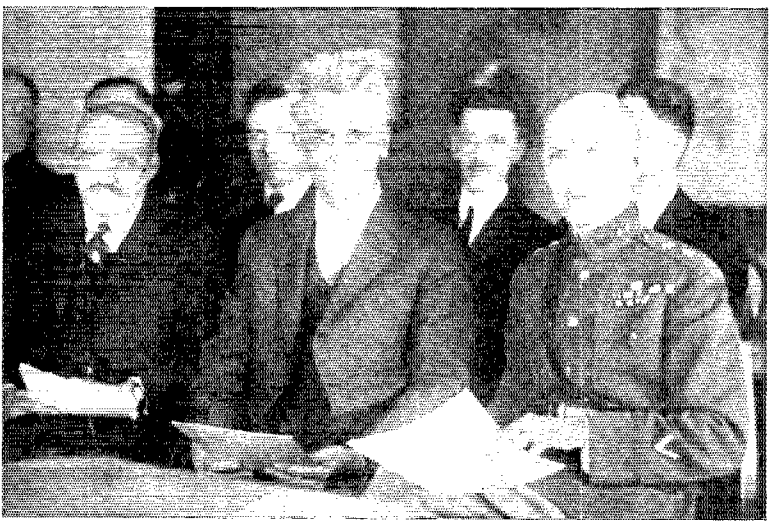
New England Convention—The M.I.T. Radio Society was host to the New England amateurs in their annual session at Cambridge on March 31st. Several hundred amateurs were present and attended an A.R.R.L. traffic session in the afternoon and a humdinger of a banquet in the beautiful Walker Memorial that night. Plans were made for reorganization of the New England Executive Radio Council, a matter so important that we will pass it until we can treat it adequately.

Amateurs Serve in Emergency—Amateur stations had another opportunity to demonstrate their value to the community when on March 12th a terrific storm destroyed all wire communication in the upper Mississippi Valley. The C.G.W. railroad in particular was without means of learning conditions on various parts of their lines nor what had happened to certain trains. Broadcasting stations failed in their attempt to connect and obtain information. 9ZN, Chicago, was called upon and jumped right into the job, calling up every possible amateur station in the storm area and obtaining reports, which were phoned to the general manager of the C.G.W. By this service the trains were located and complete reports obtained on conditions, which was of great assistance to the railroad. Among the stations assisting 9ZN in this work were 9APW, 9AZA, 9ZAA, 9BHD, and 9ALG.

The Second National Radio Conference

ABOUT this writing there is many an editorial typewriter clicking out an account of the doings at the Department of Commerce's Second Telephony Conference, which was held in Washington from March 20th to 24th at the call of Secretary Hoover to consider what could be done from an administrative point of view to lessen the amount of interference in radio broadcasting. Our space in this issue of *QST* is so limited that at best we can but summarize the recommendations of the conference. We can say, however, that we feel that from the standpoint of the broadcast interests and fans great progress was made and a really admirable broadcast system arranged for —so satisfactory a thing, on paper at least, that it may be wondered why this was not done a year ago instead of seeking new legislation.

The exponents of broadcasting were in a majority at the conference, and as the chief purpose of the meeting was to find ways to improve facilities for broadcasting it was natural that something should happen to some of the other services. It did. Very briefly summarized, the conference recommended the abandonment of the 450-meter ship wave during evening hours, the abandonment of the contemplated amateur extension to 275 meters, and the institution of broadcasting from 222 meters to 545 meters, with the "government reserve"



THE AMATEUR REPRESENTATIVE ON THE COMMISSION: Hiram Percy Maxim, President of the American Radio Relay League, representing the amateurs at the Second Hoover Telephony Conference. Mr. Maxim is in the center foreground, seated between Mr. C. F. Jenkins, inventor of radiotransmission of photographs, and Maj. Gen. G. O. Squier, Chief Signal Officer of the Army. Behind Mr. Maxim may be seen Paul F. Godley and K. B. Warner, who testified in behalf of the amateur at the hearings. *International Newsreel photo.*

above 600 meters opened up to take care of some of the displaced services, particularly the shipping formerly operating on 450 meters. It was recommended that broadcast stations be divided into two classes, "A" stations of high grade, considerable power, and continuous service, to operate in the band between 286 and 545 meters, and "B" stations, of restricted range and ability, between 222 and 286 meters, the assignment of wave lengths to be staggered geographically to minimize interference. For high-grade Class A broadcasting an exclusive wave length between 286 and 545 meters would be assigned, not to a particular station, but to a *geographical area*, and all Class A stations in that territory would use that wave length, dividing the operating hours. It is possible to provide 50 such non-interfering phone channels, so that if this plan be realized it would be possible for a good receiver to pick up any desired territory by tuning to the wave length assigned thereto, and to pass in turn to any other section of the country without interference and with a reasonable hope of successful reception.

There are many difficulties in the immediate application of this plan, and in order to develop a systemmatic assignment without hardship to existing stations the Department of Commerce proposes to establish temporary classifications similar to those now in effect but with expanded wave length assignments; stations not being required to change from their present assigned wave, however, unless they so elect. It is thot that thereby the stations will come into accord with the new plan without hardship, obtaining the benefit of lessened interference by accepting the offer of a new wave length.

As to the ham allocations, the spirit of the day was co-operation and the amateur co-operated. Last year's recommendations of an amateur extension to 275 meters were abandoned, and under the new plan general amateurs are given from 150 to 200 meters, and special amateurs from 200 to 222 meters, with a limited number of "extra-specials" on some quiet wave below 286 meters for use in the difficult Rocky Mountain region for the benefit of trans-continental relay work. Sparks are tentatively assigned the band 176 to 200 meters, and only straight C.W. can work between 200 and 220, but no other sub-divisions were made: However, the Department has invited the A.R.R.L. to study the situation and make recommendations for the subdivision of the amateur band by types of transmitters if desirable, and this is under way at this writing. Heretofore we amateurs have been assigned definite wave lengths, generally 200 meters and occasionally with one or more specified additional waves such as 175 or 150 meters. Under the new plan we would be permitted to operate anywhere within the amateur band. We will have more to say about this soon.

Personnel

The members of the conference were E. H. Armstrong, of New York; Com. D. C. Bingham, U. S. Navy; Hon. D. B. Carson, Commissioner of Navigation, Chairman; C. B. Cooper, New York; Dr. J. H. Dellinger, Bureau of Standards; Leo Fitzpatrick, Radio Editor, Kansas City *Star;* Dr. A. N. Goldsmith, secretary, I. R. E.; A. H. Griswold, vice-pres., A. T. & T. Co.; F. P. Guthrie, U. S. Shipping Board; Prof. L. A. Hazeltine, Stevens Institute; L. J. Heath, Treasury Dept.; John V. L. Hogan, New York; Prof. C. M. Jansky, Jr., Univ. of Minn.; Hiram Percy Maxim, president of our A.R.R.L.; Maj. Gen. G. O. Squier, War Dept.; Chief Radio Inspector W. D. Terrell; W. A. Wheeler, Dept. of Agriculture; and L. E. Whittemore, Bureau of Standards, secretary of the Conference.

Recommended Wave Allocations

The allocations of the Conference which are of interest to our readers are given below:

Below 130 m.	Reserved (See Note 1.)
130 meters	Government, CW, exclusive.
130—143 m.	Reserved (See Note 1.)
143 meters	Government, CW, exclusive.
143—150 m.	Reserved (See Note 1.)
150—176 m.	Amateur, CW, ICW, Ph., exclusive.
176—200 m.	Amateur, CW, ICW, Ph., Spk., exclusive.
200—222 m.	Special amateur, and technical and training schools, CW, exclusive.
222—231 m.	Aircraft, CW, ICW, Ph., non-exclusive.
222—286 m.	Class B broadcasting, Ph., non-exclusive. (See Note 2.)
286—288 m.	Reserved.
288—300 m.	Class A broadcasting, Ph., exclusive. (See Note 3.)
300 meters	Marine, CW, ICW Spk., non-exclusive. (See Note 4.)
300—450 m.	Class A Broadcasting, Ph., exclusive. (See Note 3.)
450 meters	Marine, CW, ICW, Spk., exclusive. (See Note 5.)
450—545 m.	Class A broadcasting, Ph., exclusive. (See Note 3.)
545—600 m.	Marine and aircraft, CW, ICW, Spk., exclusive.
600 meters	Marine and aircraft, CW, ICW, exclusive. (See Note 4.)
600—674 m.	Marine and aircraft, CW, ICW, Spk., exclusive.
674 meters	Government, CW, non-exclusive.
674—800 m.	Marine and aircraft, CW, ICW, Spk., exclusive.
800 meters	Radio compass, CW, ICW, Spk., exclusive.

Note 1.—Available for special licensing by the Department of Commerce.

Note 2.—Not more than six CW amateur stations to be licensed to use wave lengths below 286 meters for communication across natural barriers.

Note 3.—A class A broadcasting station is a station of sufficient power to serve an extensive territory. Fifty territorial wave frequencies approximately 10 kc/s apart are to be assigned by the Department of Commerce to local areas throughout the United States without duplication. The ten such areas within each of five national zones are to have wave frequencies separated by approximately 50 kc/s.

Note 4.—The 300 and 600 meter waves are for calling and distress purposes, with a minimum of traffic.

Note 5.—Mobile service on the 450 meter wave is to be stopped between 7 and 11 P.M. local standard time, and to be transferred in so far and as soon as practicable, to wave lengths above 600 meters.

Resolutions

Some of the more interesting and important resolutions adopted by the Conference are reported below:

That in assigning a wave band of 10,000 cycles to each Class A broadcasting station they be distributed over five zones throughout the country such that no stations in adjacent zones are closer together in frequency than 20 kilocycles, and that within each zone there be ten stations separated by 50 kilocycles.

That only one wave frequency be assigned to a Class A broadcasting station, which should transmit exclusively on the wave frequency designated and reserved exclusively for that station.

That every broadcasting station should be equipped with apparatus such as a tuned circuit coupled to the antenna and containing an indicating instrument or the equivalent for the purpose of maintaining the operating wave frequency within 2 kilocycles of the assigned wave frequency.

That the Department of Commerce estabished qualifications for Class A broadcasting stations, including a general minimum and locally suitable maximum power and a quality of program that will warrant assignment of a territorial wave frequency to each particular station, and that the qualifications be similar to those required of the present Class B broadcasting stations.

That the Department of Commerce in its discretion assign Class B broadcasting station licenses in which wave frequencies shall be specified and in which the power ratio between the Class A and B stations shall be at least 2 in so far as in practical for a given locality.

That reading of telegrams or letters by broadcasting stations be not construed as point to point communication so long as the signer is not addressed in person and so long as the text matter is of general interest.

That the Department of Commerce be requested to insist upon the suppression of harmonic and other parasitic radiation from all radio stations, as for example, by requiring the installation, if necessary, of coupled circuit transmitters at the earliest feasible date.

That spark transmitting apparatus be replaced as rapidly as practicable by apparatus which will produce a minimum of interference.

That the amateur organizations of the United States study the time requirements of the broadcasting of religious services on Sunday and by mutual arrangement with the broadcasters determine upon silent periods which will make possible the reception of such religious services in any given locality.

That, in the judgment of the Second National Radio Conference, the prevention of "wilful or malicious interference," as provided for by Section 5 of the Act of August 13, 1912, and the minimization of interference, as provided for by Article 8 of the International Convention, require that the Department of Commerce shall, in its discretion, withhold or rescind station licenses to transmit on specified wave frequencies, at certain times, and on definite powers, and with certain types of transmitters and when, in the judgment of the Department of Commerce such interference would result or does result; and that it is the clear and manifest intent of Section 1 through 4, and Regulations 10, 12 and 18 of Section 4 of the said Act to give the Department of Commerce such authority

Our Antenna Number

—An Appreciation—

This antenna number of *QST* is the work of many A.R.R.L. members. To all of them, whether authors of these articles or workers in laboratory and station, we give our hearty thanks.

With hardly more than a single exception textbooks have treated the short-wave antenna very slightingly; therefore this number of *QST* is presented as giving, directly or by reference, the best material on this subject. If any of our readers find themselves able to amend or improve upon this material, their writings will be welcome—even tho they have allowed them to lag past so many announcements of this Antenna Number.

The Technical Editor.

to withhold or rescind licenses which such interference will result or does result; and that the Second National Radio Conference believes that a decision by the Courts validating the above views will be greatly in the public interest; and that the Second National Radio Conference expresses its willingness to advise and assist the Department of Commerce in the support of the above resolutions in the event of litigation.

That the Second National Radio Conference desires to emphasize the limited facilities available for radio broadcasting, and the uneconomic and tentative basis of present-day broadcasting, and that the Conference urges the consolidation in each locality of those desiring the establishment or maintenance of broadcasting and those interested in broadcasting in that locality; to the end that broadcasting conducted in each neighborhood by such a local association will receive public support and be handled in an economic and permanent fashion.

[At this writing we have hardly got used to some of the new ideas introduced by the Conference. From the standpoint of the broadcasters it's FB but from that of the amateur—? It seems somebody else has their eye on the waves below 150 meters and we did not succeed in our effort to secure an amateur band around 100 meters, altho it is to be expected that amateur experimental licenses to operate anywhere below 150 meters can be obtained as heretofore. Nor can we count our waves in the neighborhood of 222 meters as worth much with nearby broadcasting on that wave. The majority sentiment on the Conference was to fix up the broadcasting business so it could succeed, and tribute was exacted from the government services, the amateur, the commercial, and even perhaps the facilities safeguarding life at sea, to make that possible. We'll have more to say after our Board of Direction has chewed over the matter.]

K.B.W.

Multiple-Tuned Antennas

A good ground connection is most important in building a good antenna, but some stations are located on the roofs of buildings or over high-resistance soil so that a low-resistance ground cannot be obtained. In such a case great improvement can often be made by combining several ground connections with a long antenna top to form an Alexanderson multiple-tuned antenna.

MULTIPLE TUNING THE LONG LOW ANTENNA

By L. C. Young, NSF-NOF

THE multiple tuned antenna is especially suitable where only a long low antenna can be used as the loss of height can be compensated for by use of the increased radiation due to multiple tuning. The scheme is to use a number of own-leads (from two to six) all tuned alike and each one operating with a portion of the top, exactly as if the antenna were independent T type antennas with short tops. (See Fig. 1). Accordingly the wave length of an antenna may be reduced by multiple tuning so that a very long antenna can be operated at 200 meters.

The following comparisons were made with a flat top antenna having a natural period of 415 meters. This antenna was first operated as a single T antenna and then two down-leads were added, one at each end, converting it into a three-lead multiple tuned antenna. During the tests reception was accomplished on an antenna several wave lengths distant from the transmitter. The received signals were measured with a rectifying tube and a galvanometer. This receiving set was first calibrated by operating the simple T an-

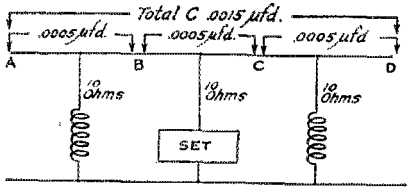


FIG. 1 - HOW THE MULTIPLE-TUNED ANTENNA OPERATES
NOTE. Sections A-B, B-C & C-D are equal; the leads are connected at the centers of these sections.

tenna with one ampere, then two amperes, three amperes, etc. To operate the antenna, when multiple tuned, on the same wave length it was necessary to use considerable loading. This reduced the radiation efficiency over that which would have been obtained when operating multiple tuned at a shorter wave. Nevertheless the comparison was in favor of the multiple-tuned antenna.

Comparison of Single and Multiple-Tuned Antennas

Input to tube plates 400 watts.
Wavelength 460 meters.

	Single tuned T	3-lead multiple tuned
Amperes per downlead	———	3.2
Total Amperes	4.5	9.6
Galvanometer deflection at receiving station	5.64	34.72

The deflection of 34.72 could also be produced with the single-tuned antenna by increasing the antenna current to 9.6 amperes but this took 1600 watts to the tube plates or 4 times as much power as with the multiple-tuned antenna.

One thing has to be remembered, the three down-leads *must* be adjusted so that

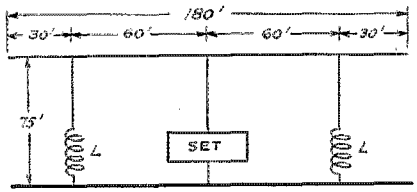


FIG. 2A "A" HIGH TYPE

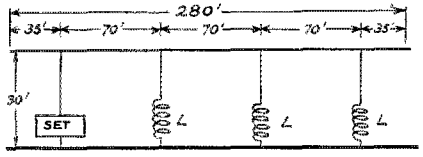


FIG. 2B "B" LONG LOW TYPE
200 METER MULTIPLE-TUNED ANTENNAS
NOTE: Flat-top of 4 wires spaced 2 feet or more. Downleads- Small cages 2¾" 6" in diameter L - 25 turns edgewise copper strip on 8" diameter

they are operating exactly in phase. This condition is shown by the appearance of the same current in all three down leads.

In designing the loading inductance to be put in the down-lead of a multiple-tuned antenna, one has to remember that each lead is handling only a portion of the antenna top. (See Fig. 1). Thus if we have an antenna top with a capacity of .0015 microfarads and use three down leads, including one to the set, each lead will be working with an antenna top having a capacity of .0005. Each inductance is required to tune only one-third of the flat top.

It is necessary to allow for very close plate and grid coupling because the resistance of the multiple antenna "looked into from the feed down-lead" is very much higher than that of a plain antenna. If each section of the antenna had a resistance of 10 ohms, then the apparent *feed resistance* would be 30 ohms or the sum of the three sections. However the sections radiate in parallel, hence the *ground resistance* will be only one-third and we have greatly reduced the worst resistance in the antenna.

Figures 2A and 2B make some suggestions for practical 200 meter multiple-tuned antennas. The one in Figure 2B is especially recommended for erection on a long house roof that is covered with tin or copper. Such a location is practically worthless for an ordinary antenna.

THE MULTIPLE-TUNED ROOF ANTENNA AT 1YK

By H. H. Newell, 1YK

THE antenna system at 1YK had to be constructed above a grounded copper roof. When worked as a plain L antenna (as shown in Fig. 3A) this thing had a natural wave length of nearly 300 meters. Taken all around it was very poor for 200 meter work. It was accordingly converted into a two-lead multiple-tuned antenna as shown in Figure 3B. This sort of a multiple-tuned antenna operates as two L antennas in parallel, each down-lead handling one-half of the antenna current.

The sending set uses two 50-watt tubes with 1000 volts direct current plate supply. The circuit is an ordinary Hartley. The helix has 55 turns of No. 14 A.W.G. (B&S) wire on a frame 4½" in diameter and 8" long. Twelve turns are used between the antenna and ground, ten between the filament and grid, and thirty-two between the filament and plate. The filament clip is four turns from the ground toward the antenna. All of this is left the same for multiple tuning or plain L operation but for the latter a .0003 microfarad condenser is put in series with the antenna lead. This arrangement (which was obtained with some difficulty) permits quick changes from the L to the multiple-tuned if someone with a good heavy overcoat stays on the cold roof to connect the second down-lead at the distant end. The loading coil on the roof is wound of 20 turns of No. 14 A.W.G.

(B&S) on a slotted hard rubber frame 5" in diameter and 10" long protected by a weatherproof box. All turns are in at 220 meters.

The adjustment of the multiple-tuned antenna is quite a job. Generally too many turns in the load coil means small

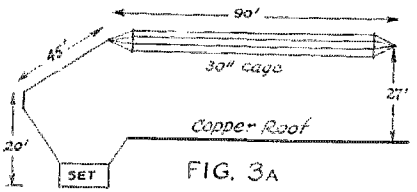


FIG. 3A

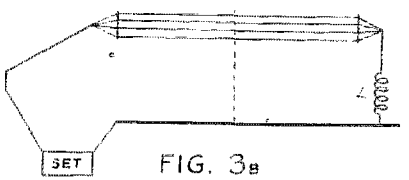


FIG. 3B

THE ANTENNA AT 1YB

current in it and too few turns the reverse. The currents should be equal. The first hundred years are the hardest.

Audibility measurements were made at various stations which did not use regeneration but used the shunt-telephone method of measuring the strength of I.C.W. signals from 1YK.

Comparison of Received Signals

Observers	Audibility L Antenna	Audibility Multiple-tuned Antenna
1XZ	70	160
Mr. Haigis (Shrewsbury, Mass.)	80 (8 tests)	160
1CMK (Mt. Holyoke, Mass.)	No meter available but signals much more intense on multiple tuned.	

Note: The set as operated at full power with the same input thruout all of these tests.

It is doubtful if those owning a very good simple antenna should try multiple tuning. However, in cases like ours where a simple antenna cannot possibly give results, multiple tuning may be used to secure them.

Curiously enough the utility of the antenna for reception was very little affected by the change from the L to the multiple-tuned form.

WORKING DOWN TO 100 METERS BY MULTIPLE TUNING

By Lynne C. Smeby, 9AUL

A PLAIN antenna suitable for 200 meter work can be very nicely worked down to 100 meters by use of multiple tuning.

At 9AUL the cage-type L antenna was 45 feet long and 60 feet high. The counterpoise was a fan 45 feet long and 120 feet wide. No ground connection was used.

First the antenna was tuned as a simple L and on 200 meters an antenna current of 3 amperes obtained. Then a second down lead was installed at the far end with an inductance of about the same size as the one on the set. Before any results at all were obtained it was found necessary to adjust the two coils so that the current in the two down leads was exactly the same. The wave length was then 100 meters, the current in each down lead 2 amperes, making a total of 4 amperes. There was no trouble whatever in making the tubes oscillate at 100 meters (not even when using a UV-204).

RECEIVING LOOP DESIGN

From Stuart Ballantine's "Radio Telephony for Amateurs."
Receiving Loops for Wave Lengths from 180 to 400 Meters

Side of square loop	Turns	Relative received voltage
35 feet	1	19.8
17	2	9.3
10	3	4.8
7	4	3.1
5	5	2.0
3	7	1.0
2½	10	1.0

The loops are to be used with a .0006 microfarad (max) variable condenser in shunt and are to be wound with No. 18 lamp cord with the turns spaced 2 inches. Copper strip ¼ inch by .005 or .001 inches is very good. See also "Principles Underlying Radio Communication," available from the Government Printing Office.

How to Measure Antenna Resistance and Capacity

By Albert F. Murray ★

WHY is it so desirable to know the resistance of your radiating circuit at different wave lengths? Because you cannot determine either your power output or transmitter efficiency unless you know R_o, the total antenna resistance. Only by examining a curve (such as shown in Fig. 1) of R_o vs. wavelength for an antenna system, can the ground resistance, dielectric loss (losses due to guy wires and nearby absorbers) be estimated. The question "How good is my antenna?" can then be answered. If it is a receiving antenna and the minimum resistance is more than 25 ohms, a redesigned aerial system will probably give you louder signals. All these points are fully discussed in radio books and magazines but the authors do not tell *just how* to measure the antenna resistance.

Method

Three points must be observed in order to measure the resistance of your antenna accurately. They are: (1) A METHOD that gives accurate results. (2) Suitable INSTRUCTIONS. (3) Skillful MANIPULATION.

The method which I have found most satisfactory is called the Substitution Method. The idea of this method is that

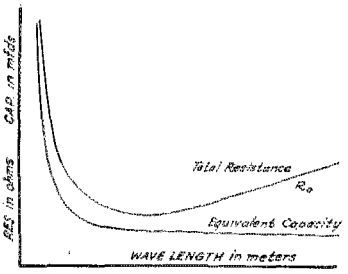


FIG. 1 *Curves of Total Resistance and Equivalent Capacity*

it is hard to measure directly the capacity and resistance of the antenna itself but it is not very hard to make up a "dummy antenna" that will have the same capacity and resistance as the real antenna. In other words the substitution method does not try to measure the antenna at all, but *substitutes* a "dummy antenna" which is made up of things that are easily measured or else are known to begin with. It is well known that an antenna has distributed capacitance, resistance and inductance. The "Phantom" Antenna, as the circuit which is substituted for the real antenna is called, has its capacity and resistance adjusted so that if you connected it to your transmitter in place of your antenna and ground, neither your wave length nor your antenna current would be changed.

[The substitution method can be understood from Figure 2. The antenna "A"

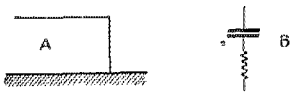


FIG. 2

may be looked at as being a condenser. Because it is not a very good condenser but has a lot of resistance it will have to be shown as at "B"—a condenser and a resistance. Now in Fig. 3 if we throw the switch S to the right we have the antenna (which is a condenser) connected across the helix. That gives a tuned circuit. Let up suppose that this tuned circuit has a wave length of 200 meters. If we then throw the switch to the left we have still another tuned circuit and by adjusting C_1 we can tune this new circuit to 200 meters. It is easy to see that when we have done this the capacity of C_1 is equal to the "equivalent capacity" of the antenna at 200 meters. All that remains is to adjust the resistance R until the dummy current (shown by A_1) is equal to the antenna current when the switch is the other way. When we have this adjustment the condenser C_2 shows the "equivalent capacity" of the antenna, and the resistance R shows the antenna resistance. This is only the general outline—several things have to be watched; these are explained in the article. —Ed.]

Arrangement of Apparatus

A source of undamped oscillations is needed, so use your C.W. transmitting set, with either D.C. or A.C. plate supply. Use all the power you have up to 50 watts. See Fig. 3. A single 5-watt tube often is not powerful enough to give accurate results. Leave the helix in the antenna circuit and make up a temporary helix L, with more turns so that your transmitter, working as a driver, will oscillate from the natural wave length of your antenna, to four times this wave length. The modified Hartley-circuit driver shown in Fig. 3 is good, but use the circuit with which you are most familiar. Put an antenna am-

★Engineering Dept. General Radio Co.

meter A1 in series with the variable condenser C_1. Shunt the meter with a short length of No. 14 copper wire, since the current is likely to be more than five times the usual antenna current. *Keep all this equipment six to ten feet from the apparatus shown on the left in Fig. 3.* Run the antenna lead directly to the *porcelain base*

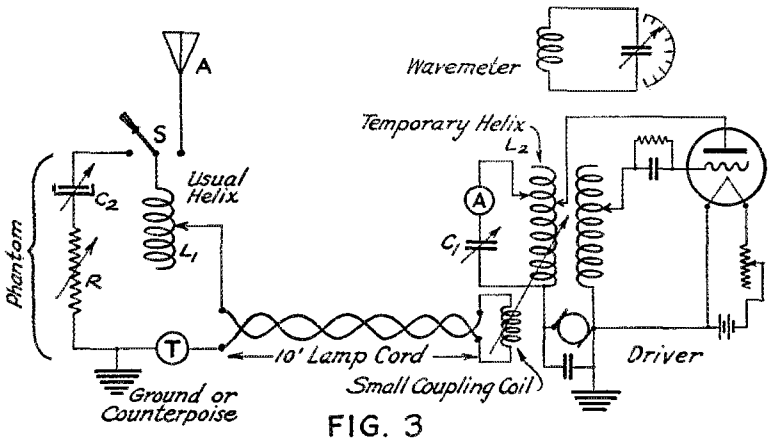


FIG. 3
CONNECTIONS FOR ANTENNA RESISTANCE MEASUREMENTS

S.P.D.T. switch S, the blade of which is connected to the regular helix L_1, with a sufficient number of turns added to load the antenna to the desired wave length. The coupling coil consists of from two to six turns (about 3" in diameter), coupled to the *grounded* end of the driver coil L_2. Connect the left-hand contact of the switch S to the *fixed* plates of the low-loss variable condenser C_2; the rotary plates and the metal case are connected to the decade resistance box, R, which is grounded. The leads should be very short and not smaller than No. 18. It is necessary that the relative position of the instruments be *exactly* as shown. There will then be no variations due to the capacity of the operator's body.

Instruments

During the past four years while employed as research engineer at the Hammond Radio Laboratory, I have had occasion to measure the resistance of a number of antennas, varying in size from a 150 meter natural to the 1250 meter natural of a large naval station antenna. I am giving the type numbers of the apparatus used in the set-up shown in Fig. 3, which proved satisfactory in these measurements.

1. DECADE RESISTANCE. 0-111 ohms. General Radio Type 102-F. See Fig. 4. Substitute: Resistance wire, No. 30 or smaller, stretched out straight on the table, with a variable clip. Measure its resistance with D.C.

2. CURRENT-INDICATING DEVICE. First choice: Weston Thermo-Galvanometer, Model 425, 115 M.A. Second choice: General Radio Co. Hot Wire Milli-Ammeter, 100 M.A., Type 127-A. Substitute: Crystal detector or thermo-couple with sensitive galvanometer.

3. A LOW-LOSS VARIABLE CONDENSER. (Note—*This is* C_1; anything will answer for C_1). First choice: General Radio Type 239-J Variable Condenser, with vernier, .002 MF. maximum. See Fig. 5. Effective resistance of this type is one half

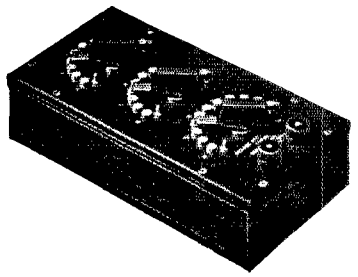


Fig. 4—Decade Resistance Box

of that shown in Appendix 2 for Type 247, so low that it may be neglected. Second choice: Type 247-C, .001 MF. condenser, with vernier. The resistance of this type of condenser, while much lower than the average of its class should be subtracted from the total measured resistance, as explained in Appendix 2. The experimenter is warned that if other makes of variable condensers of unknown resistance are substituted, the true resistance of the antenna cannot be ascertained.

4. A WAVE METER. First choice: A Kolster Decremeter, range 75-3300 M. Second choice: Type 174 General Radio Co. Wavemeter, range 150-3000 M. Third

choice: A General Radio Co. Type 247-W Amateur Wavemeter. Range 150-500 M., direct reading, accuracy 2%.

Procedure

Check your connections and arrangement with Fig. 3. Throw S.P. D.T. switch S to the right, and add turns enough in the helix L_1 to load the antenna to about twice its fundamental. Start your driver and tune it to the antenna by means of C_1. Have the small coupling coil only close enough to the driver to get a small deflection on the antenna galvanometer, T.

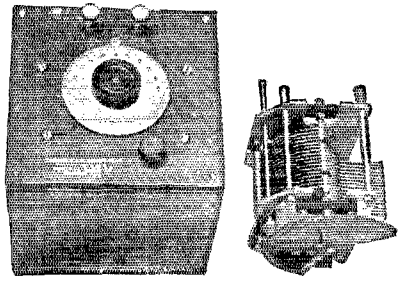


Fig. 5—Laboratory Type Variable Condenser

Now, loosen the coupling and adjust the driver for good current thru A_1 by varying plate and grid coupling only. Use the least possible grid coupling, to reduce harmonics. Carefully re-tune the driver to the antenna, and move coupling coil so as to get ½ to ¾ full scale deflection on T, then open switch S while you watch *closely* the ammeter, A_1. A slight change in its reading may be permitted, when using this Substitution Method (that is one of its advantages), because, when the phantom antenna is substituted, the amount of this reaction will be the same. However, check often to see that you are getting a reaction on the oscillator not greater than, say, .1 amp. change in 2 amps. To reduce reaction, decrease the coupling to the driver circuit; this unfortunately reduces the reading of T, which should be above 20 divisions to read accurately. A way around this difficulty is to use a more powerful driver.

To proceed, assuming zero or only slight reaction, insert about 20 ohms in the decade resistance box R and throw switch S to the left. Always insert sufficient resistance in R to prevent burning out the thermo-galvanometer T, BEFORE moving the switch to the left. Tune for maximum current in meter T, by adjusting the low-loss condenser C_2. Then leave C_2 at this setting and vary decade resistance R until T reads the same as when the antenna was in the circuit. (Re-tune the phantom circuit slightly, if necessary). Also make sure that the current thru A_1 in the driver circuit is exactly the same with the switch S in either position. If the current in A_1 does not remain steady, use more L and less C in the driver circuit. Of course, the plate and filament sources must be constant in voltage, whether A.C. or D.C. With S thrown to either the right or left bring the wavemeter near the oscillator (driver) coil and measure the wave length, using the reaction on the oscillating current meter A_1 as an indicator of resonance. Record wave length, decade resistance setting R, and the reading of the phantom circuit condenser C_2.

Precautions

Let me again emphasize the imperative need of painstaking and accurate TUNING. Each time make sure that you are on the top of the resonance peak.

To check measurement: Repeat above with three different values of antenna current, obtained by varying the distance between the coupling coil and the source. (While a measurement is in progress, this coupling of course should not be changed). If the three results vary by more than .2 ohms in 10 ohms (2%), look for and eliminate any or all of the following sources of error:

(A) Inaccurate tuning.

(B) Too much reaction.

(C) Magnetic coupling between helix and driver—use greater separation between L_1 and L_2; rotate either L_1 or L_2 to obtain zero mutual.

(D) Electrostatic coupling—move driver farther away from phantom circuit. Place

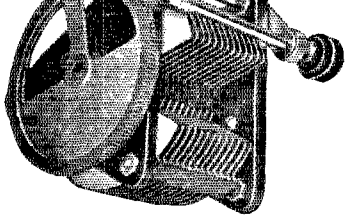


Fig. 6—Amateur Type 247 Condenser

a grounded static shield between driver and coupling coil.

(E) Momentary variations in driver output—provide steadier filament and plate sources, or wait until line voltage is steady.

Plotting the Resistance Curve

Having measured one point and made sure that everything is working well one is now ready to proceed rapidly. Measure R_0 as described above, for, say every 10 meters, from as near the fundamental as

you can, (adjustments get more difficult here and more capacity is needed in the phantom antenna) to about 4 times the fundamental. As soon as you get each point plot it on the resistance-vs.-wave length curve (Fig. 1) on a piece of cross section paper; then if a point is far off the curve you can at once re-measure. Nearby absorbers, such as guy wires, metal towers, etc., *may* cause peculiar variation in the smooth curve; but many of the irregularities attributed to such things are due to errors in measurements.

After you have plotted your resistance-wave length curve, you can analyze it and determine your dielectric losses also your combined ground and conductor losses, as shown in Figure 7. In the chapter on

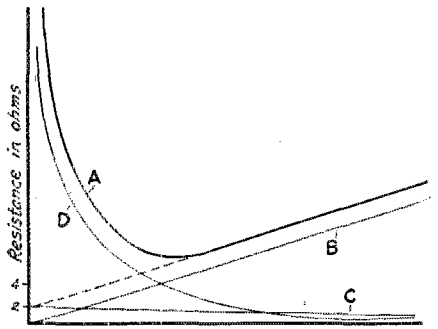


FIG. 7

Curve A Total Antenna Resistance
Curve D Radiation Resistance
Curve B Dielectric loss Resistance
Curve C Ground and Conductor Resistance

Antennas in Dr. G. W. Pierce's "Electrical Oscillations," you can easily take from the curves shown, the various values of radiation resistance calculated for an antenna having the same dimensions as yours. The resulting curve of radiation resistance vs. wavelength should, of course, lie beneath your curve of total resistance. If it does—fine, you have checked the theory! If it does not—well, maybe those calculations were not for just your kind of aerial, and maybe your resistance measurements were slightly off.

The resistance R_o, is that of the antenna and ground, exclusive of the helix.

Accuracy

The method outlined, with proper instruments and manipulation will give, I believe, the greatest accuracy obtainable. In measuring the resistance of an 80 foot vertical cage antenna at Cruft Laboratory, Harvard University, I was able to repeat resistance measurements to within 0.1 ohms on three consecutive days. It will be, however, a great help to the amateur using C.W. to know approximately what resistance his set is working into, even if it is not more accurate than 1 ohm in 15 ohms or 6.7%.

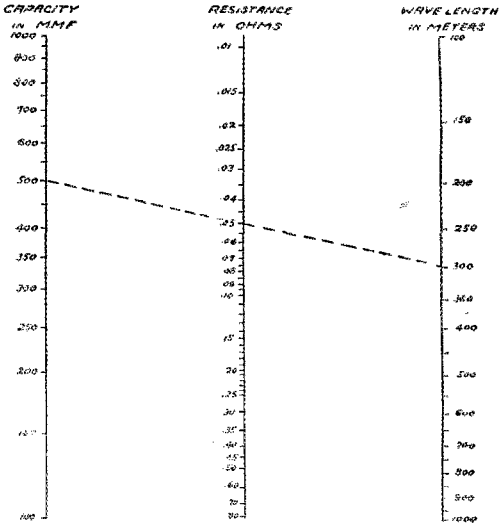
Antenna Capacity

The equivalent capacity of the antenna at any wave length, (the capacity, which connected to the antenna inductance L_1 will give the same wave length that is given by the antenna similarly connected), is given by the capacity setting of the phantom antenna condenser. The low-loss condenser C_2 should therefore be calibrated. The Type 247-C and -E mounted condensers mentioned above have a scale directly calibrated in MMF., accuracy 2%. A knowledge of your equivalent antenna capacity allows you to design loading coils for receivers, etc. It is not the same as the D.C. capacity of the antenna. An equivalent capacity-wave length curve for a typical amateur antenna is shown in Fig. 1.

APPENDIX 1

The curve R_o is not strictly correct as we have drawn it. So far it has been assumed that all of the resistance in the dummy circuit is in the decade resistance R. This is not entirely correct—the low-loss condenser C_2 even though it is much better than most variable condensers still has some resistance and, if one wishes to be accurate, this resistance should be added to the reading of R for each point along the R_o curve of Figure 1. This will raise the curve a trifle.

Ordinarily this business of correcting the curve is quite a job but the author has been



ALIGNMENT CHART
GIVING RESISTANCE OF
GENERAL RADIO CO TYPE 247 CONDENSER

Fig. 8

worked out especially for this article a chart, Fig. 8, by which the resistances of General Radio Type 247 variable condensers can be read off without any equipment but a ruler. The chart is based on bridge measurements at audio frequency. Such calculations are simple as there is a straight-line relation between condenser resistance at audio and at radio frequencies. The power factor remains constant.

The resistance of two condensers in parallel (R_p) can be obtained from the chart easily if one of the condensers is set at maximum while the other varies.

$$R_p = R_1\left(\frac{C_o}{C_1}\right)$$

Where

R_1 = resistance in ohms shown by the chart for the condenser C_1 (which is set at maximum)

$C_o = C_1 + C_2$ total capacity of the two condensers as they are set (found by reading the condenser scales)

C_1 = the capacity of the condenser which is set at maximum.

APPENDIX 2
The Resistance Variation Method

The Technical Editor of *QST* has pointed out to the writer the fact that the average amateur may not have the instruments necessary for the Substitution Method. Therefore the fairly accurate Resistance-Variation method will be described. This simpler, but less accurate, method does not require a low-loss variable condenser. The connections are made as in Figure 9.

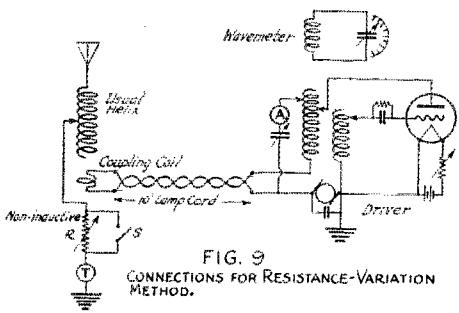


FIG. 9
CONNECTIONS FOR RESISTANCE-VARIATION METHOD.

The thermo-galvanometer is the same sort of an instrument as before, the resistance R may be a decade resistance or simply a ten-foot length of No. 30 B.&S. gage resistance wire with a sliding contact, such as a clip. If a powerful driver (over 20 watts) is used a less sensitive instrument may be used at T. Keep the driver *at least ten feet from the helix* and insert the *small* coupling coil in series with the *ground* side of the oscillating circuit.

PROCEDURE: Start the driver, short the resistance R with the switch S, and tune the driver to the antenna which has been set to the desired wave length by moving the helix clip. Then vary the coupling between the small coupling coil and the helix until the meter T gives a half-scale deflection. Before starting to measure, test the set for reaction of the antenna on the driver by suddenly opening S. If the driver current as shown by A_1 changes, the coupling between the helix and the small coil must be loosened or the power of the driver increased until there is *absolutely no reaction* indicated by the meter A_1.

When reaction has been done away with, insert resistance by opening S and moving the slider on the resistance wire (or turning the dials of the decade box if one is used) until T shows that half as much current is flowing in the antenna. Now the antenna circuit must have twice as much resistance as before and the series resistance must be equal to the antenna resistance.

Remember that if the meter T reads current (ammeter or milli-ammeter) decrease deflection to ½; if it reads current squared (Thermo-galvanometer) decrease deflection to ¼.

Look out for this. The resistance curve obtained by this method is for the *entire* radiating system, i.e., antenna, *helix*, and ground, just as usually used.

APPENDIX 3

(When a resistance curve has been drawn as at R_o in Fig. 1 or curve A in Fig. 7, it is possible to tell something about the antenna even before the curve is analyzed. If the curve goes up very steeply to the right, the antenna has high dielectric losses—look around for masts, houses, and trees that are too close to the antenna, for a down-lead that hugs the house wall or for bad lead-in bushings and antenna insulators. If the lowest part of the curve is not below 5 ohms the antenna has probably a good deal of ground resistance. If the curve has "humps" (and you are dead sure they are not mistakes in measurement) there are resonant circuits in the neighborhood. This does no great harm unless the humps are on your working wave; if that is the case they must be eliminated. Screw down the key and start out with a wavemeter to find the gutter-pipe, 110 volt line, tin roof, or wire fence that shows radio energy at this wave length. After that, use your ingenuity to de-tune the absorbing circuit by the use of radio chokes, condensers, and ground conections.

To find out definitely what ails the antenna the R_o curve should be broken up into its separate parts as shown in Fig. 7. The curve R_o must be measured up far enough (4 times the fundamental) so that it has become a straight line. A ruler is laid along the straight part of the curve

and a line drawn back as shown in Fig. 7 (dotted line). This dotted line crossed the resistance scale at 2 ohms—this antenna has a low ground resistance. Now if we start at the O point and draw a straight line B parallel to the dotted line and the straight part of A, we will have a line showing the Dielectric Loss resistance in the surrounding houses, masts, etc. Also we can start where the dotted line crosses the resistance scale and draw a line off horizontally to show that the ground-and-wire resistance is the same for all wave lengths. (Not strictly correct; line really slopes a trifle as shown as C). Finally we can substract curves B and C from curve A and get a fourth curve, D, which gives an approximation of the Radiation Resistance.

The best sending antenna is one in which both B and C are low while D is fairly high. —Tech. Ed.)

APPENDIX 4

See also the following references:

"Calculation for Antenna Capacity," L. W. Austin, Proc. I.R.E., April, 1920.
"Electrical Oscillations," G. W. Pierce.

Also the following Bureau of Standards (Radio) publications:

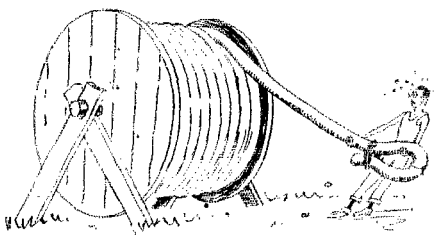
S.P.269, "Effect of Imperfect Dielectrics in the Field of an Antenna," J. M. Miller.
Circular 74, "Radio Instruments and Measurements."
R-240-G, "Notes Regarding Antenna Resistance," J. M. Miller.
CR-126-A, "Ground Resistance Measurements," H. M. Freeman.
CR-127-A, "Measurements of Antenna Constants," John C. Warner.

The Perfect Aerial

By M. Adaire Garmhausen, 3BCK

THIS is a very technical article. It is so technical that anyone with less than three degrees shouldn't even read the title. It is the result of two long weeks of spare time research, and so I feel perfectly fitted to discourse intelligently upon the subject of aerials.

The first point to be made is *selectivity* If you wish to get the very best results you must be sure that your aerial is super-selective. A number of experiments have proved that the most selective wire available is the No. 0000 B&S, but as this is



a trifle awkward to handle, the average amateur will have to use whatever he can get, and add *artificial selectivity*. This is comparatively easy if you have on hand a little savoir faire. In buying your wire ask to see all the kinds in stock, and examine them closely—under a microscope if possible. Bend them, twist them, burn them with a lighted match, break off bits of them, rub them with a bit of ice. On the strength of these experiments you can select the one you like best, and thereby add selectivity.

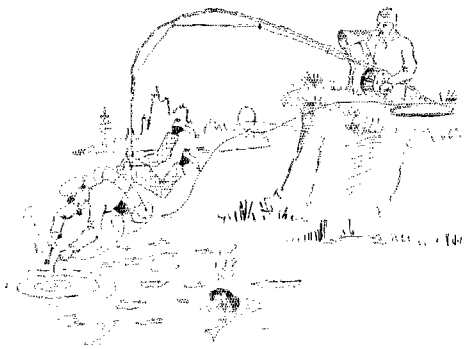
Before constructing the aerial itself, rub the wire with 3-in-1 oil. The instructions which come with each bottle of this oil, say that if a drop of it is put on a crystal detector the crystal becomes more sensitive. This principle was extended to include aerials. I found that altho it did not increase sensitivity to any great extent, it caused the signals to slide in easier, and kept them from getting wet in bad weather. If the wire is well oiled the first time it will not have to be done again for several years.

The next subject in this connection is insulators, and I cannot be too emphatic in insisting that they be multi-tuned. Without tuned insulators the aerial loses a good bit of its selectivity, but with them multi-tuned its efficiency increases almost 100%. A good insulator of this type is the ordinary building brick, but as one eminent Kansas authority prefers bottle necks, we will devote the space to them. Bottle necks are excellent insulators, provided the bottle contained the real stuff. Those which have contained White Mule or Gentle Annie absolutely will not give the same results. The best way to obtain these bottles is to write to your Senator, telling him just what you want them for, and he will understand and be glad to send you any number of them free of charge or in exchange for a few cigarette coupons.

As long as our wire is super-selective and our insulators multi-tuned, the shape of the aerial makes very little difference. Here is a field for the amateur to show his individuality. By building a frame work for support all sorts of figures or pic-

tures could be formed—stars, pretzels, animals, or even call letters.

The ground system should be regenerative if possible but this is not imperative, provided it is properly heterodyned. Be *sure* to select a ground system that will not squeal or hiss. The best results are obtained if the ground lead be connected



directly to a large pond of still water—the larger the better—but failing this, a large brook or small river will do very well. A number of amateurs will not know how to solder a wire on to a lake, but this is a technical article and you cannot expect to understand everything you read in technical articles

The business of connecting the aerial to the receiver is comparatively simple. It is an accepted fact that if the positive side of the aerial be connected to the binding post marked "ground," interference will be greatly reduced. The positive side of an aerial is the side you are positive is the negative. The negative, or wattless current side, is then connected to the depolarizer of the storage battery thru the wave strainer. If WD11 tubes are used, this lead will have to be connected in shunt with the logarithmic decrement as no storage battery is necessary. The results are practically the same.

Dr Einstein and I have worked out formulae covering each of these principles, but as they are very complicated, and only twelve of us scientists understand them, there is no use setting them down here. This aerial is strongly recommended to all those striving for maximum efficiency, and anyone wishing to try it out can be assured of my willing assistance

Some Tests of Amateur Antenna Insulators

BECAUSE C.W. sets do not need the same sort of insulation that used to be satisfactory for spark work and also because no one seemed to know what insulators are good for C.W. work, these tests were made.

The work itself was done by Messrs. L. C. Young, John Reinartz, H. F. Mason, and S. Kruse.

Method of Testing

The insulators were bought in batches, 6 of each kind, excepting only Nos. 4 and 5, which were presented by the makers. Three of each batch were sent to one test station (M) and the other three of the same batch to another test station (W), the two

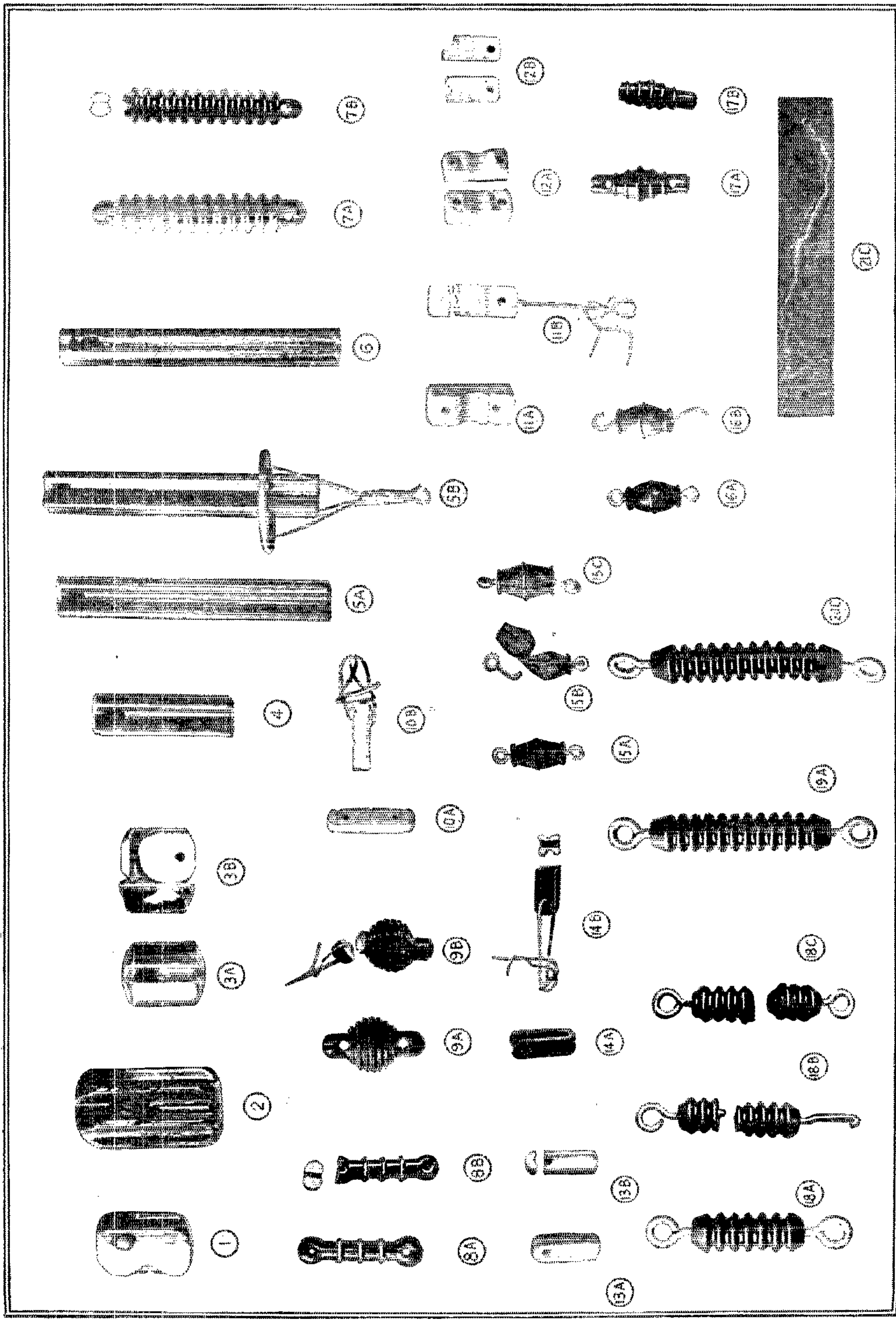
(Continued on page 26)

Table 1—Description of the Insulators

Number

1—Wet process brown glazed porcelain strain "egg" made by Locke for Westinghouse. Length about 3½", fairly fine grain.
2—Same as 1 but 7" long.
3—Greenish glazed egg—very poor—dry process. Same size as 1. Maker not known.
4—Short (5") wet process porcelain rod, maroon glaze, all but one end. Excellently vitrified body. Ohio Brass Co.
5—Same as 4 except 10" long.
6—Same as 5 but both ends unglazed. Parker & Son.
7—Dry process porcelain, black glazed *except* in suspension holes. Fleron.
8—? process porcelain, light brown glaze General Radio Co.
9—Same as 7 except for shape. Fleron.
10—Plain 110-v. unglazed wiring cleat. Dry process.
11—Heavy glazed cleat—large "bald" area Probably dry process.
12—Medium glazed cleat—large "bald" area. Dry process.
13—White porcelain, badly glazed.
14—Same as 13 except brown glaze.
15—Imitation Electrose—maker not known.
16—Black asphaltic composition—Woolworth's.
17—Pure Hard Rubber. Maker not known.
18—Imitation Electrose. Maker not known.
19—10" "Electrose" corrugated rod. Shellac-mica composition.
20—Black composition, imitation of No. 19, maker unknown.
21—10" Formica Bar, 2" x ½" section.
22—Same as 21 but 36" long.

Note:—In the photographs the "A" following the number shows the original insulator; "B" the result of mechanical tests; and "C" the result of electrical tests.



stations using their own methods and not comparing notes until afterward. The results compare very well, which gives one confidence that the tests really indicate the goodness of the insulators.

Important Note—The same number refers to the same type of insulator in every figure, picture, and table in this article.

Work at Test Station "W"

All tests made at 1,500,000 cycles (200 meters). The insulators were connected between a very small one-wire antenna (capacity 35 micro-microfarads) and ground. See Fig. 1. The ammeter was

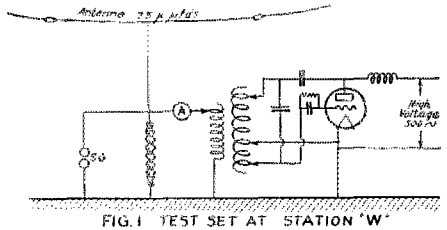


FIG. 1 TEST SET AT STATION "W"

connected to show input to both the insulator and the antenna. Each test was started at low voltage and the power increased until something happened or the limit of the test set was reached. As soon as each test was done the flashover voltage at the power used was measured by means of the calibrated ball spark gap SG.

Insulator Type	Remarks
2	Using ¼" rods thru holes. Broke down at 2.1 amps. and gap-flashover distance of 3.5 mm. or about 13,000 volts.
3	Using No. 14 wires thru holes. Broke down at 3.5 mm. and arced thru inside of insulator, which got white hot in one minute.
4 (1st sample)	Ammeter reading 2.5 amps. At 17,000 volts brushing into insulator begins; flashes over at 20,000 volts and burns a conducting streak along one side.
4 (2nd sample)	Using corona shield; flashes at 26,000 volts.
5 (1st sample)	Using ¼" rod thru hole. Ammeter 3.5, voltage about 26,600. Brushes slightly into insulator. No heating after several minutes.
5 (2nd sample)	Using ¼" rod thru hole and corona shield as shown in photo. No brushing or heating at all with 28,200 volts.
7 (1st sample)	Starts brushing at 3.5 amps. and 25,000 volts. Raised power to 3.8 amps. and 29,000 volts. Brushing fairly strong but did not break down.
7 (2nd sample)	Using corona shield. No brush or break at full power, 3.5 amps., 28,000 volts. No heating at all.
8 (1st sample)	Using No. 14 wires thru hole, starts brushing at 2.2 amps., 17,000 volts. Using ¼" rods thru holes flashes over at 3.2 amps., 26,250 volts.
8 (2nd sample)	3 amps., 24,600 volts, some brushing; nothing happened after two minutes.
9 (1st sample)	Using No. 14 wires thru the holes brushing starts at 2.5 amps., 18,000 volts. Using quarter inch rods thru holes brushing starts at 2.6 amps. and insulator heats badly in two minutes. Flashes over at 3 amps. and 24,250 volts.
9 (2nd sample)	2 amps., 14,200 volts, severe brushing thru center of insulator.
10	Ammeter reading 2.5, voltage 13,800. Flashes over outside.
11	Ammeter reading 3.2, voltage 22,000.
12	Breakdown too low to read meter and gap.
13 (1st sample)	Using ¼" rods thru holes; flashover at 2.5 amps. and 19,000 volts.
13 (2nd sample)	Flashes over at 2.3 amps. 14,300 volts.
14 (1st sample)	Flashes over at 2.7 amps. and 21,000 volts.
14 (2nd sample)	Flashes over at 2.9 amps. and 21,250 volts.
15 (1st sample)	Insulator heated inside and blew out in 30 seconds. Ammeter reading 3.4, voltage 25,600.
15 (2nd sample)	Insulator melted in two minutes at 3.2 amps.
16 (1st sample)	Ammeter reading 3.4, voltage 25,500; insulator heated but did not break down or flash over.
16 (2nd sample)	Ammeter reading 3.5, voltage 27,500; insulator heated but did not break down or flash over.
17 (1st sample)	No. 14 wire used thru holes. Ammeter 2.4, voltage 21,500. Brushed into insulator and burned within a few seconds.

17 (2nd sample)	Using ¼" tubing thru holes. Ammeter 3.5, voltage 27,500. No breakdown, flashover, or heating during 5 minutes.
18 (1st sample)	Insulator exploded with a loud report after one second. Ammeter 2.2, voltage 17,400.
18 (2nd sample)	Melted in two after 2 minutes at 2.5 amps.
19 (1st sample)	Ran 3 minutes at 3 amps. and heated but did not break or flash. Voltage 27,500.
19 (2nd sample)	Ran 5 minutes without break or flash and only slight warmth. 3.5 amps. voltage 27,500.
20	Ammeter reading 3.7, voltage 27,500. Did not break or flash. Dropped down to 3 amps. and ran for 3 mins. during which insulator heated badly; then went back up to 3.7 and melted insulator in one minute.
21 (1st sample)	Ammeter reading 3.8, voltage 29,000. No brushing when ¼" rods used thru holes, but when No. 14 wires used brushing began at 2.5 amps. (about 22,000) and charred a small part of the Bakelite which increased the brushing so that in a few seconds the entire insulator flashed from end to end and formed a conducting path.
21 (2nd sample)	Soaked in water for 45 minutes before test. Using corona shield no brushing or flashover. Using No. 14 wires thru holes and low power, brushing starts at 2.5 amps. as above and burns out entire insulator in 7 seconds.
22 (1st sample)	Using ¼" rods in holes no brush or break at 3.9 amps. and 29,000 volts. With No. 14 wires brushing starts at 26,000 volts and burns entire insulator in 10 seconds.
22 (2nd sample)	The same.

Conclusions of Mr. Young, of Station "W"

The two insulators that seemed to stand up best were Nos. 7 and 5. Neither of them broke down on full power nor did they heat up. No. 5 is the best mechanically. No. 8 showed up well but is a little small.

Of the composition insulators the only one that appears satisfactory is No. 19, which heats only a little on heavy load and does not break down. No. 1 held up wonderfully but is a little short. The Formica insulators are OK as long as they are worked well under the brushing point, but once a brush starts they are gone.

One precaution must be taken with all the insulators and that is NOT to use small wires thru the holes in the insulator but to use quarter-inch rods or else quarter-inch tubing with the wire run thru it.

When any considerable amount of power is used it is very much worth while to use a corona shield such as has been left on one of the long insulators tested. This should of course be on the "hot" end of the string of insulators, the end next the antenna. It is always best to use several insulators in series to reduce the capacity thru the string. The units too should be fastened together with quarter-inch stock, either by using U-shaped pieces of tubing thru the ends of the insulators and running wire thru them, or else by the use of some sort of clevis.

Tests at Station "M"

In the tests at this station the insulators were divided into 3 groups, one of each kind going into each group. The first group was tested as received, first dry and then under a spray, using the apparatus of Fig. 2 and keeping the voltage fixed

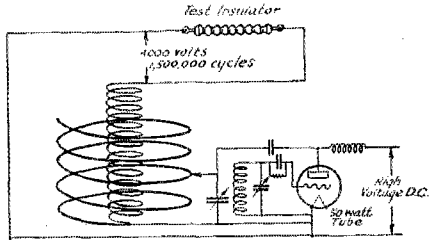


FIG. 2-TEST SET AT STATION "M"

at about 4,000 with a frequency of 1,500,000 cycles per second (200 meters). The second group was soaked in water for 24 hours and then run thru the same tests as the first group. The third group was soaked in a solution of eosin, a dye that penetrates wherever water will go. This group was then used for strength tests and those that did not pull in two were broken up with a hammer. It was then possible to see the pink dye marks that betrayed the porous places in the insulators. Notice that the porous ones were the ones that gave poor electrical tests.

Tests on the First Group of Insulators (tested as received) at Station "M"

Preliminary Test on Porcelain Eggs.—Several porcelain eggs that had laid in the snow during the winter were tested first. They all broke down within 4 minutes apiece—arcs bored thru the inside of the material. The energy consumed was about 50 watts average. Tests were then made with a single egg used as in Fig. 3A and then as in Fig. 3B. The losses when used as at A were about ⅛ as great. Tests were then made with two eggs in series. When they were connected with wire they consumed 1 watt when dry and 5 watts when wet but when connected with rope they consumed 19 watts when dry and 24 watts when wet. All this was with the insulators used as in Fig. 3A. Now they were turned as in Fig. 3B and the losses went to *30 watts when dry and 47 watts when wet.*

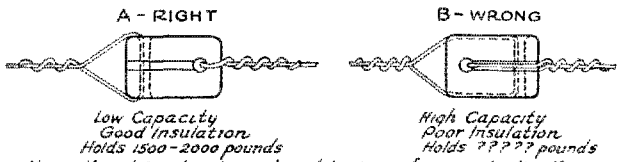


FIG 3 HOW TO USE PORCELAIN EGGS IN THE GUYS

Type Number	Watts Loss Wet	Watts Loss Dry	Remarks
1	44	50	Did not dry but broke down in 5 minutes.
2	44	75	Got very hot but tube set not powerful enuf to break down.
3	70	50	Dried off but was getting very hot.
4	50	10	Dried off in 3 mins. —no brush.
5	40	5	Dried off in 30 seconds—no brush.
6	40	5	Exactly the same as No. 5.
7	20	3	Started to dry off but arced thru and cracked.
8	25	10	Dried off several times without harm.
9	40	13	Dried off but became very hot and started to arc into the high voltage end.
10	25	17	Started to dry but broke down in one min. Several did this.
11	30	22	Cleared itself OK but very hot.
12	30	26	Cleared itself OK.
13	—	—	Broke down on dry test in 10 seconds.
14	30	21	Brushed violently and started to heat but was not run long enuf to break.
15	—	—	Started to melt at once and was done in 3 mins.
17	0	???	Burned the instant the spray hit it; best of all when dry, tho.
18	—	—	Started to smoke instantly — came apart of its own weight in 1 minute and 36 seconds.
19	—	30	Warmed slightly but OK after 5 mins.
20	—	30	Started to bend at once—all out of shape in 5 minutes—soft as putty after 1 min.

21 and 22—No use to give figures, as all bakelite and formica, etc., flared up instantly when the voltage was applied.

Tests on the Second Group of Insulators

The second group of insulators that had been soaked in water did not develop anything new—the insulators in Group 1 that had been poor were still poorer and the good ones were not harmed by the water.

Dye Tests on the Third Group of Insulators

Type Number	Mechanical strength (Pounds)	Remarks on dye and mechanical strength
1	1500 (as at Fig. 3A)	Dye soaked in at the white "tests" for ⅛".
2	Too large—over 3000	Same as 1.
3	1500 (as at Fig. 3A)	Dye soaked in thru cracks in the eye for over half an inch.
4	Over 3000—no break	No penetration at any point.
5	Over 3000—no break	No penetration at any point.

6	Not on hand at the time of this test; hence not logged.	
7	120 pounds	Eye pulled off, some pink in.
8	400 pounds	Eye pulled off, dye penetrated $\frac{3}{16}$".
9	200 pounds	Broke in eye — very badly colored.
10	75 pounds	Pink clear thru — mere sponge.
11	600	Broke thru eye, dyed for about $\frac{1}{8}$".
12	300	Broke thru eye, dyed clear thru.
13	240	Dye in for $\frac{1}{8}$".
14	Not tested at all as white one was so poor.	
15	200	Hook pulled out — dye in about $\frac{1}{4}$".
16	300	Hook opened — no dye soaked in at all.
17	600	Eye pulled off —no dye absorption at all.
18	900	Eye straightened and insulator parted — its proportioning is the only good thing about it.
19	3500 and no break	No mechanical damage and when broken with hammer no electrical damage.
20	Not on hand as these were all burned up in the electrical tests.	
21 & 22	Too poor electrically to excuse any other tests.	

Conclusions from the Work at Station "M"

The best sending insulator was No. 5 very closely followed by No. 6. The other good ones were Nos. 7, 4, and 8. None of the composition insulators were nearly as good as porcelain but the best of them was genuine Electrose. Imitation electrose was very poor. The little No. 16 insulator (purchased at a 10¢ store) held up wonderfully but was not strong mechanically. It should be f.b. for receiving antennas, tho.

The best receiving insulators were Nos. 16, 17, 8, and 19.

The rest of the insulators tested were good for nothing.

Use of porcelain eggs in the guys.

The special test on porcelain eggs showed that they can be used as tension insulators (See Fig. 3) with great improvement in insulation and are still plenty strong enuf. This refers to really good eggs such as the Locke-Westinghouse type, not to the sort shown at 3. Strings of eggs should be connected with wire—NOT WITH ROPE.

The importance of GOOD glazing and GOOD porcelain is greater than was thought. Rods 5, 6, and 4 were so close-grained and well vitrified that the dye did not soak in at all, even where there was no glazing.

Thick insulators are all poor—the right shape is the "long and skinny." The big eggs were much poorer than the little ones.

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What I Found Out About Sending Aerials

By John L. Reinartz, 1QP.

IN most cases the erection of an aerial means only the erection of some type in popular use in the home town. Having a desire to find out just how much there is to the report that the cage is the best type. I tried out 26 different aerials. The results were worth the work.

A single wire antenna was used as a base and all others compared with it. This antenna is shown in the figure. All the other antennas were tested at the same wave length (230 meters) and not a thing about the grounding system or the antenna downlead was changed until the antenna-top-tests were over. The input to the sending tube was kept constant, 50 mils at 800 volts, and it is safe to assume that the efficiency did not change. To keep from moving the antenna clips on the helix (and changing the current distribution) *it was necessary to adjust the wave by cutting successive pieces off the free end of the antenna top*, the antenna being let down for each "pruning" until the wave dropped to 230 meters.

With all of these precautions it seems fair to say that the current thru the antenna ammeter was a good test of the various antenna tops.

Here then, are the results of one month's work. (This took teamwork; Mrs. Q P provided it.—Ed.)

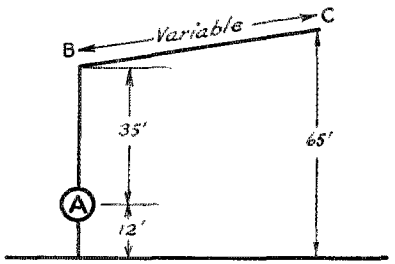
By the end of Table 2 we are back to a flat-top again, only now the flat-top uses *cages* instead of *single wires*.

And here is what I now think about aerials.

1—The D.C. resistance plays a small part.
2—The H.F. resistance plays a greater part.
3—The flat-top is the best form to use.
4—The cage is of use where the available space permits no flat-top. The cage does little except reduce inductance and skin effect; the flat-top is much better for increasing the antenna capacity.

Table 1—Tests of Flat-Tops

No. of Wires	Width of Antenna Top at B	at C	Amperes at A
1, No. 6 Solid Bare			2.4
20 No. 21, paper, bunched in cable			2.8
2	8 ft.	16 ft.	2.8
3	8 ft.	16 ft.	3.0
6	8 ft.	16 ft.	3.4
25	8 ft.	16 ft.	3.6



The test antenna at 1XT-1QP

Table 2—Tests of Cage Tops

No. of Wires per Cage	No. of Cages	Size of Cage	Spacing of Cages at C	D	Amperes at A
6	1	12"	—	—	3.10
6	1	24"	—	—	3.10
6	1	30"	—	—	3.10
6	1	60"	—	—	3.10
12	1	30"	—	—	3.39
6	2	12"	8'	16'	3.7
6	2	12"	4'	16'	3.41
6	2	12"	4'	4'	3.12
6	3	12"	4'+4'	8'+8'	3.5

Table 3—Antenna Lead Test

Same wave as before—Top—6 wires in 12" cage

Downlead	Current at A
6 wires bunched	3.1
6 wires in tapered cage 12" at top 9" at A	3.72

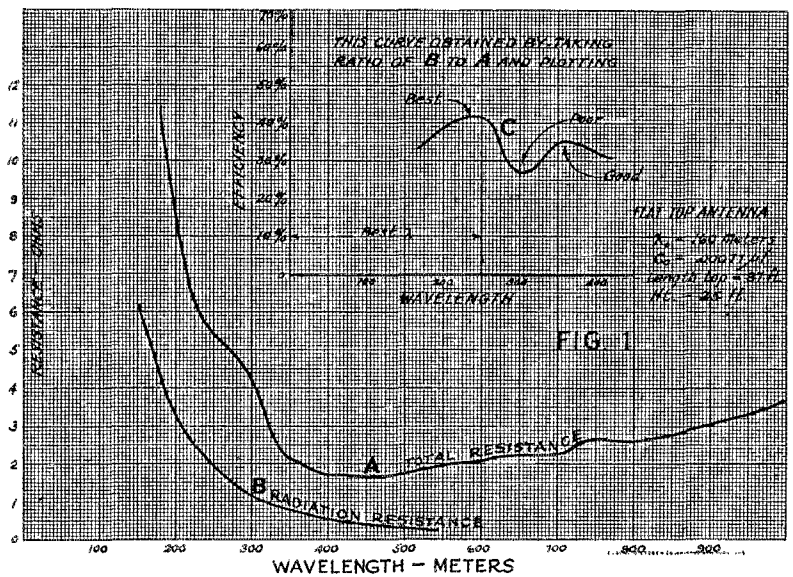
Table 4—Ground Lead Test

Ground Lead	Current at A
Cable of 20 No. 21 paper covered	3.72
6 wires in tapered cage 9" at A 12" at Ground	4.47

How Long Shall We Make Our Antennas?

THE answer to the question "How large shall we make our antennas?" is, of course, "As large as possible for best transmission." The next question is "How large can we make them? Can we make them so large that we are working on the fundamental or even below it?" That is the question discussed in the articles below.

tion (that is, the radiation resistance.—Ed.) varies inversely as the square of the wavelength and directly as the *effective height.* In a well designed antenna the undesirable losses* remain practically constant from the fundamental wavelength to a wavelength two or three times this and the ratio of useful loss (radiation) to the total power supplied is greatest at the



Operate at the Fundamental

In favor of operating right at the fundamental wave of the antenna we quote from Stuart Ballantine's "Radio Telephony for Amateurs" as follows (1st Edition, p. 67.):

"Best Operating Wavelength in Transmitting.—The resistance which represents the useful loss from an antenna by radiation (that is, the radiation resistance.—Ed.) varies inversely as the square of the wavelength and directly as the *effective height.* In a well designed antenna the undesirable losses* remain practically constant from the fundamental wavelength to a wavelength two or three times this and the ratio of useful loss (radiation) to the total power supplied is greatest at the fundamental wave length. Hence this is the wavelength at which best radiation takes place and should be selected for transmitting. It will usually be necessary to insert in the antenna a.....coil for the purpose of coupling (to the sending set—Ed.)....but this should be kept as small as possible and its effect in raising the wavelength above the fundamental may be compensated for by inserting a series condenser having low losses. The fundamental wavelength is not the wavelength at which maximum antenna current will be secured,

*—1—Loss in the antenna wires.
2—Loss in the tuning apparatus.
3—Loss in the earth connection.
4—Loss due to dielectrics (house, trees, etc.)
5—Loss thru the insulators.
6—Loss by induction in neighboring wires etc.

but at which maximum I^2R_{rad} is obtained. The operator is therefore warned not to be deceived by the antenna ammeter reading—this tells only part of the story."

A Method of Determining the Best Wave For an Antenna

By Ross Gunn, Pre-war 8ZO

The duty of an antenna is to radiate energy into space. We cannot expect an antenna to radiate all the energy that is supplied to it; there are bound to be losses of various sorts—ground resistance, dielectric losses, etc. Now as a rule we are able to supply to the antenna about the same power at any wave we may happen to use. (We are speaking of amateur conditions only.) It follows then that if the input to the antenna is the same at different waves and the efficiency is *not* the same we are vitally interested in antenna efficiency as that is what determines our output.

Efficiency is usually defined as the *ratio* of the power gotten out of a device to the power put into it—or, more simply, as the percentage of the input that can be gotten out.

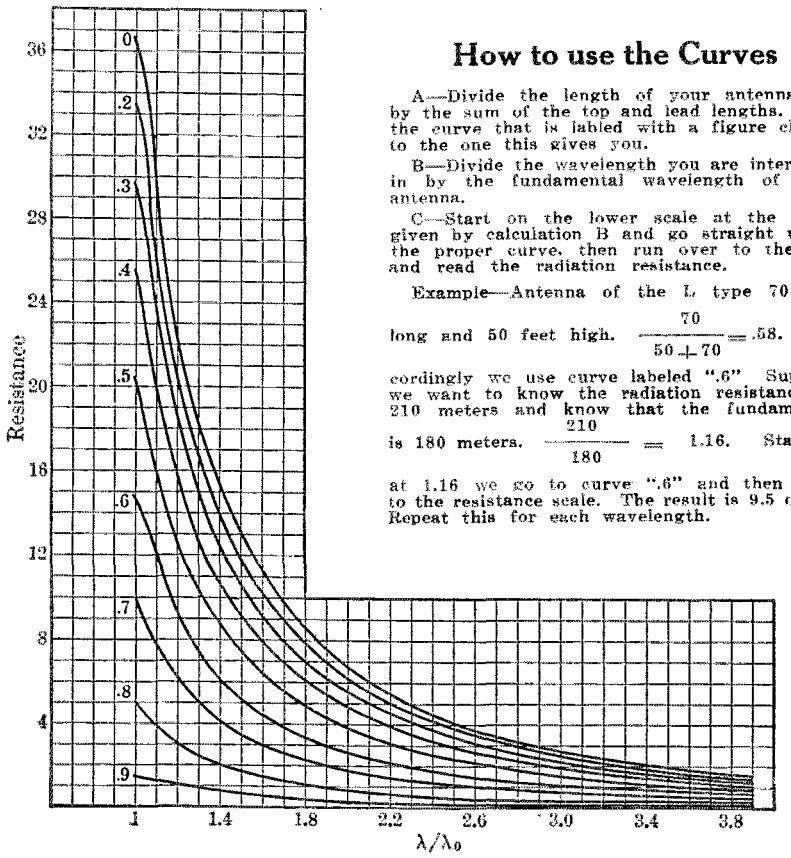
Before applying this to an antenna let us define a few terms. The "effective resistance" of an antenna is the resistance that we usually measure. It is defined as:

$$R_{eff} = \frac{\text{watts put into the } \textit{antenna}}{(\text{antenna amperes})^2}$$

"Radiation resistance" is defined as:

$$R_{rad} = \frac{\text{watts from the antenna to the ether}}{(\text{antenna amperes})^2}$$

Let us review; if we multiply both R_{eff} and R_{rad} by I^2 we will get respectively the *power into the antenna* and the *power out of the antenna*. Quite obviously the difference is left in the antenna and goes to make up the various losses—heating the wires, the nearby walls, the ground connection, etc.



How to use the Curves

A—Divide the length of your antenna top by the sum of the top and lead lengths. Use the curve that is labled with a figure closest to the one this gives you.

B—Divide the wavelength you are interested in by the fundamental wavelength of your antenna.

C—Start on the lower scale at the value given by calculation B and go straight up to the proper curve, then run over to the left and read the radiation resistance.

Example—Antenna of the L type 70 feet long and 50 feet high. $\frac{70}{50+70} = .58$. Accordingly we use curve labeled ".6" Suppose we want to know the radiation resistance at 210 meters and know that the fundamental is 180 meters. $\frac{210}{180} = 1.16$. Starting at 1.16 we go to curve ".6" and then over to the resistance scale. The result is 9.5 ohms. Repeat this for each wavelength.

Figure 2 Radiation Resistance Curves for Reading Radiation Resistance Offhand
(From Pierce's "Electrical Oscillations and Electric Waves.")

Now we started by saying that the power to the antenna is about the same at all waves so that the efficiency of the *antenna* is a measure of the goodness of the whole station. As we said the efficiency of a device is the output over the input this means that the efficiency of an antenna is:

$$\text{Antenna efficiency} = \frac{\text{watts radiated}}{\text{watts put into antenna}} = \frac{R_{rad}(I)^2}{R_{eff}(I)^2} = \frac{R_{rad}}{R_{eff}}$$

It is easy to see that the greater we get R_{rad} in proportion to R_{eff} the oetter will be the performance of the antenna. The popular belief is that it is best to work the antenna at the fundamental where the radiation resistance is greatest. This is probably correct for the case of the ideal antenna in which the resistance curve has no humps due to resonance with nearby wires or tinwork and the losses due to dielectrics and eddy currents are low. Practically, however, this does not always hold true and the only way to make sure of the best wave for a particular antenna is to make measurements. A simple graphical method is here suggested. It is to be considered only an approximation but is worth the trouble required to carry it through.

The first step necessary is to make a resistance curve for the antenna. Circular 74 of the Bureau of Standards describes the standard method of doing this. (See also in this issue the article "How to Measure Antenna resistance and Capacity." —Tech. Ed.)

Supposing that we get a curve like that shown in Figure 1A. We can see that this curve either has some mistakes in it or else shows resonance with something else nearby. If we are able to make sure that the curve is correct, that there is really something resonant nearby, but we either cannot find the resonant object or else cannot remove it, we are entirely in the air as to the best wave. We know the total resistance but cannot in the ordinary way (described in the article, "How to Measure Antenna Resistance") find out what the radiation resistance is. The best thing is to turn to calculations that were made for an ideal antenna having the dimensions of the antenna we are using. In Figure 2 (taken from Prof. G. W. Pierce's "Electric Oscillations and Electric Waves") we have curves from which radiation resistances can be taken rather easily and with as great accuracy as by any available method. For the particular antenna of Figure 1 the curve of radiation resistance comes out as shown at B.

Now we have curves for the *input* and the *output;* we are ready to find out the efficiency at different waves. The easiest way is to plot point-by-point an efficiency curve such as that shown at C, Fig. 1. The points are gotten by referring to A and B for the *same* wavelengths and dividing the value of B by the value of A.

Curve C will look nice to the average man as it can be seen that there is quite a nice wide region where the efficiency is about the same—if one happens to guess badly the result will not be disastrous. One thing that stands out very prominently is that the best point is *not* the one where the resistance is lowest and the antenna current biggest. There is a strange fascination about seeing the antenna ammeter flop clear over but there are hundreds of amateurs who will tell you that they do better work on a shorter wave with less current.

The writer has had some opportunity to check the above experimentally and now feels perfectly safe in saying to the amateur: "Stay away from the point of minimum resistance with its misleading antenna amperes." Work well down toward the fundamental but first make sure by the above method just where the best wavelength really is.

The Best Operating Wave

From a conversation with Dr. A. N. Goldsmith.

The fundamental is probably a point of excessive radiation resistance. For 100 meters (330 feet) a vertical antenna would have a length of approximately 70 feet. For a 50 meter fundamental the antenna would be about 36 feet high. Actually an antenna like that shown in Fig. 3 should be O.K.

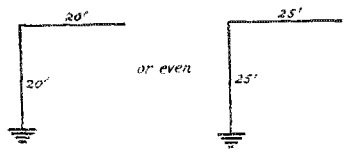


FIG. 3

In reply to a statement to the effect that amateur experience seemed to show that the "excessive" radiation obtained at the fundamental was desirable and that best ranges seemed to be obtained there or near there, Dr. Goldsmith gave the following explanation:

The distance effect of a station is proportional to the meter-amperes (the product of the effective height in meters times the antenna current in amperes). The effective height does not change very much with the wavelength while the current in the antenna will go down markedly near the fundamental. It therefore may be more desirable to operate at a wave length 1.5 to 2 times the fundamental, or, conversely, to make the antenna shorter and load it.

The Murphys Build a Mast

By F. M. J. Murphy, 8ML.

FROM making masts that used to *fall* down I have come to ones that have to be *taken* down. Last autumn one of the guy anchors pulled out and my 110 foot mast stood all night without a support on the west side; not straight, but it stood.

I wanted to be prepared for a break in the guy wires, so I sunk the foundation pit good and deep. When I got down where I couldn't throw the dirt out without most of it sliding back down my neck I rigged up a tackle and bucket. Mrs. 8ML acted as the engineer and dump superintendent. I had to lay off when I got down to 9 feet, as she threatened to go away and leave me down in the hole without a chance of getting out.

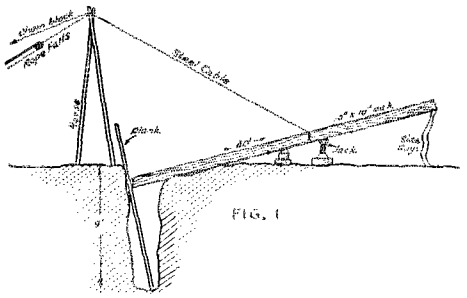


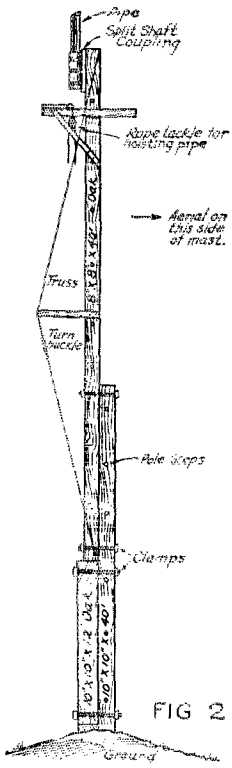
Figure 1 shows how the first section was raised in place. Visitors flock to a radio station when it is in operation, but during the construction period they are conspicuously absent. I took this well known phenomenon into account in arranging the hoisting party, which consisted of Mr. and Mrs. F. M. J. Murphy. A crow-bar raised one end of the heavy 10"x10"x40' timber until Mrs. 8ML could slip a block under and I could get another "bite." By this preliminary raising it was possible to use a much shorter horse to support the hoisting cable. Once the lower mast section was in the hole alongside a short 10"x10"x 12' timber it was kept standing upright by filling the hole with concrete and rocks.

In a week the concrete had set and I had gotten rested up. Another 12-foot stick was set on top of the first short one, and clamped to the lower mast section with U-bolts as shown in Figure 2. Then an oak piece 8"x8"x40' was placed on this second short piece, using the 40-foot stick already in place as a boom. This second 40-footer was raised without assistance, one half of the crew having mutinied and departed with the remark that dishwashing was preferable to radio.

Four deadmen were set in the ground 100 feet out from the base of the mast, and the mast was guyed to them with ⅜" messenger cable broken at 40-foot intervals with wooden trolley insulators. Figure 3 shows that these anchors were calculated to hang on for a while—and also shows the advantage of living near the railroad tracks.

Using three sets of guys is the best possible way to get experience in masts. You'll be as busy setting 'em up as the kid in the bowling alley. Use four sets of guys and a fifth guy at the mast top straight away from the direction of the aerial—that's the idea. It is a good idea to fasten a couple of extra guys to the top, and one at each joint because some day you may come out and find one of the regular ones has resigned.

Nothing smaller than 1½" pipe is worth using in a mast and even this is good only for the top section. Screw couplings are condemned — use a sleeve of pipe large enough to slip tightly over the joint and fasten it in place with ⅜" thru bolts. If the size reduces at the joints put the upper one down inside the lower one and fasten with thru bolts.



For my pipe topmast I used a 20' length of 2" and a 20' length of 1½" galvanized steel pipe. A secure support for the topmast was provided by bolting to the top of the wooden mainmast a steel plate to which had been welded a split shaft coupling. The pipe was hoisted up *thru this coupling* as shown in Figure 2, guys being hitched on as the joints came above the clamp. The hoisting hook was caught in

the lower end of the pipe and wired into place. To couple on another section of pipe the clamp at the top of the wooden mast was tightened, the rope slacked off and the pulley lowered to pick up the new section.

Almost all of this work was done with practically no assistance. This was not so bad at first but after the pipe was up a ways and there were 12 wires to look after I was a busy guy. The distance around the anchor posts was 700 feet; a well-worn path could be seen when all was done. Every few feet a fellow has to take a chase up and down the mast and in passing the couplings thru the clamp there is need for more hoisting power at the base while your attention is concentrated at the top. The gang came over and helped for a few hours, each man holding a wire in the regulation way so

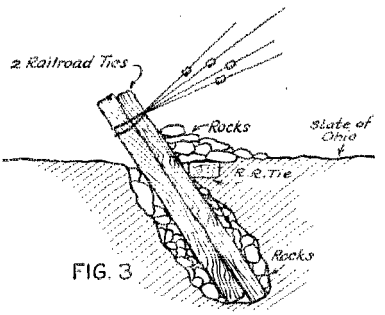


FIG. 3

often described in *QST*. This was better, but if you try it, be careful—especially if one of 'em is a guy you once sold a crummy storage battery to.

For the guys on the pipe topmast 3 strands of No. 14 double galvanized telephone wire were used. Steel is stronger but more brittle and inclined to go away and leave the mast all by itself. Strain insulators may be ordinary porcelain knobs, of which 200 cost 8ML just $2.

But it does not pay to save on the guy wire—nor on the joints to the insulators; make the twist 10" or a foot long.

Raising an aerial of any size on a pretentious pole requires a vocabulary. There seems to be a natural born tendency for the spreader or top hoop, to commit polygamy with all the guys it meets on the way up. Then a lot of height is lost because of the string of insulators that must intervene between the aerial and hoist rope. By making up a trussed spreader and raising it to the mast head as suggested in Figure 4, a lot of eloquence is conserved, and an otherwise ordinary aerial may be expanded at the top into a large cone with increased efficiency. *Note the strain guy down the center of the cage.* This takes the pull off the hoop.

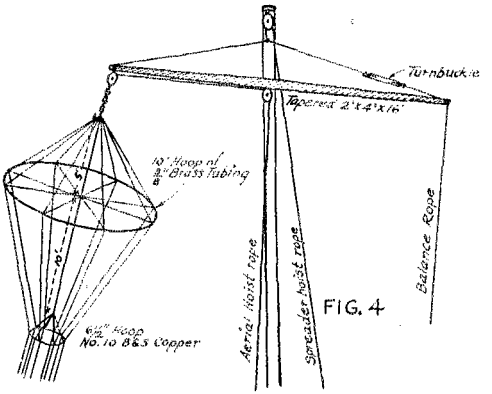


FIG. 4

The down-lead cage was made small in size to concentrate the capacity at the top. Hoops of No. 10 hard drawn copper were used, spaced, 6 feet apart. The top was assembled first, then a 10 foot hoop and a 6½" hoop were soldered in position as shown in Figures 4 and 5, this being done with the whole hanging vertically.

The counterpoise is a big radial affair covering ⅝ of a circle. It is 15 feet off the ground, has a rim of ⅜" steel messenger cable and a filling of 40 wires each 90 feet long. They are bunched more closely under the antenna where the electrostatic field is densest. The radial wires were tightened by leaning a ladder against the messenger cable rim and then pulling

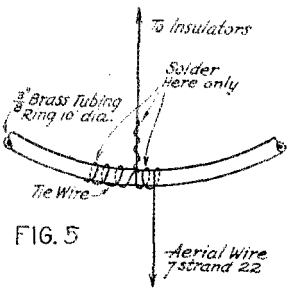


FIG. 5

by hand on the radial wire. Once the wire snapped and the messenger cable, freed suddenly of the strain, became a greatly amplified slingshot. The flight lasted 7 seconds; with a pair of shingle wings I could have stayed up longer.

The present layout will work on 200 meters with 5 turns 7" in diameter between antenna and counterpoise. It has worked on 130, 140, 160, and 170 meters with ease and good radiation.

(This is the antenna system that put such excellent signals across in the T.A. tests with only a pair of "fifty watters." 8ML has been heard in all states so often that we suspect F. J. M. has lost count. In addition it has been heard in a whole flock of European and American countries. An antenna pays.—Ed.)

References

"A 122 Foot Tower," LeRoy Moffitt, Jr., 5ZAK ex 5HK, *QST*, October, 1922, page 19.

9AUU,'s Tower, *QST*, October, 1922, page 64.

"Some Good Dope on Mast Construction," L. A. Bartholemew, 6LC, *QST*, September, 1922, page 32.

"Saving Your Neck," Norman R. Hood, 7ZO, *QST*, December, 1922, page 25.

The Antenna Circuit

By Parker Wiggin, 8ZD

THE purpose of the following discussion is to point out in an elementary way the properties of antennas and the way they influence efficient design.

Purpose

The purpose of the antenna is to transfer energy from an oscillating circuit to a medium (the ether) in which it will travel to great distances in the form of electromagnetic waves.

Types of Antennas

Antennas are constructed in three important shapes:

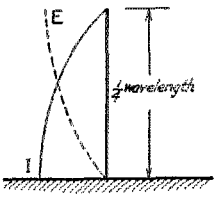


FIG. 1 VERTICAL ANTENNA

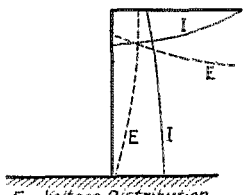


FIG. 2—ANTENNA WITH A TOP

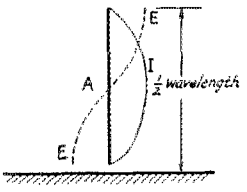


FIG. 3 ANTENNA WITHOUT EARTH CONNECTION

(1) *The open type or elevated antenna* that everyone is familiar with.
(2) *The loop type* in which one or more turns of wire are wound on a frame which may or may not be able to rotate.
(3) *The condenser type* in which two conducting surfaces (of wire mesh, usually) are supported parallel and not far apart.

The open antenna is usually used for sending; the loop is used for receiving only and the condenser type is very little known.

Radiation Efficiency

The three antennas differ in their ability to radiate, that is to transfer energy to the ether. This ability is generally expressed as "radiation resistance." The reason for speaking of it in this fashion is as follows. When current goes thru an ordinary resistance (made of German silver for instance) some energy is used up in the resistance and shows up as heat. By experiment it has been found that the number of watts used up in the resistance may be found by multiplying the resistance by the *square* of the current thru it. For instance if we have 5 amperes going thru a 12 ohm resistance the watts consumed in that resistance will be

$$\text{Watts used up} = (12)\ (5)^2 = 300 \text{ watts}$$

If we know how many watts go into the resistance and how much current flows thru it we can also calculate the resistance that *must* be in the circuit. Taking the same example again,—we know that 300 watts are being used up and that 5 amperes are flowing; then the resistance must be

$$\text{Resistance} = \frac{300}{(5)^2} = 12 \qquad (1)$$

Now in the case of the antenna we have a current flowing in the antenna and energy is used up by ordinary resistances that we can measure. But some of the energy is not used up *in* the antenna; it is radiated, and we think of this as being used up by the "etheric resistance" or the "radiation

resistance." We write an equation much like Equation 1—

$$\text{Radiation resistance} = \frac{\text{watts radiated}}{(\text{antenna current})^2} \quad (2)$$

Radiation Resistance for Various Types of Antennas

The radiation resistance for an *open antenna* is

$$R_{rad} = (39.7\frac{h}{\lambda})^2 F \quad (3)$$

Where H is the effective height of the antenna in meters
λ is the working wave in meters
F is a "form factor" that depends on the distribution of the current in the antenna.
The radiation resistance of a *loop* is

$$R_{rad} = (13.3\frac{A}{\lambda})^4 N^2 \quad (4)$$

Where A is the length of one side of the square coil in meters
λ is the working wave in meters
N is the number of turns on the loop.

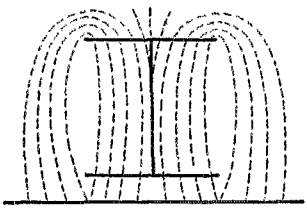


FIG. 4 – ANTENNA WITH COUNTERPOISE

While the first of these formulas is not very useful for getting at the value of the radiation resistances as it uses the "form factor" (which we generally do not know), still it is useful to compare the loop with the antenna. It can be seen that the radiation from the open antenna is inversely proportional to the *square of the wavelength* while that from the loop is inversely proportional to the *fourth power of the wavelength.* This means that that loop will be a very poor radiator except at very short waves; for ordinary waves it is good for receiving only.

The Reason for Antenna Tops and the Form Factor

The earliest form of elevated antenna was the single vertical wire; the next was the vertical "harp." The few vertical antennas now in use have the wires arranged in cage form. In a vertical antenna the current distribution is as shown in Fig. 1, approximately sinusoidal. This means that the upper part is not radiating much as there is little current present. To improve te current distribution it is customary to add a top to the antenna and make an inverted "L" or else a "T" of it. The current distribution then becomes like Figure 2. Because these shifts in current distribution must be allowed for in calculations we have the "form factor" that appeared in Equation 3. Radiation from the flat-top itself is small.

Cage Construction

The wires of a vertical antenna, a T antenna, and L, or almost any other type may be arranged around a circle in "cage" fashion. This cage becomes the equivalent of a single wire of great size and consequently the concentration of the electrical field about it is enormously reduced. This brings with it a great reduction in the inductance of the arrangement. For that reason it is desirable to make the lead-down in cage form. Incidentally *(and only if it is vertical and well away from other things)* the cage construction results in even current distribution between the wires of which it is made. This results in a slight reduction in resistance. (In the antenna top the advantage of cage construction is doubtful.—Tech. Ed.)

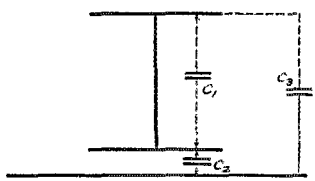


FIG. 5 - DISTRIBUTION OF CAPACITIES OF SYSTEM SHOWN IN FIG. 4

Loading Coils and Series Condensers

The purpose of a loading coil is to enable an antenna to work above its fundamental wavelength. This cannot be carried further than perhaps three times the fundamental wavelength without a very severe loss in range.

If it is necessary to work down near the fundamental or below it one has to bring the wavelength down by using a series condenser; the British call it a "shortening condenser." This too can be done only within certain limits—it is not practical to reduce the wavelength below 7/10 of the fundamental. The reason for this can be seen from Figs. 1 and 3. In Fig. 1 we have an antenna oscillating at the fundamental; the wavelength is 4 times the length of the wire. If now we put in a series condenser and make it smaller and smaller we will finally cut the antenna loose from the earth entirely and it will operate as in Fig. 3 at half the wavelength that we had before. This is very

nice except that one would now have to put the coupling coil at A and it is not convenient to build a station half way up the pole. Whether a series condenser should be used or the size of the antenna decreased to fit a particular wavelength can only be determined by experiment or by careful consideration of the factors of radiation resistance, form factor, and losses.

Counterpoises

The purpose of the counterpoise is to reduce the ground losses by substitution of a more efficient system than the ordinary conducting ground. The counterpoise may be looked at as a screen that is to catch all the flux from the antenna and prevent it from touching the earth. In that case the counterpoise should extend out at least one-fourth wavelength in all directions. However, in practice a much smaller counterpoise proves just as satisfactory, which leads to the idea that it may act mainly as a device to spread the flux *returning to the base of the antenna from the ground.* This is shown in Fig. 4, which represents a T antenna with a counterpoise. The dotted lines show roughly the distribution of the flux. Part of the flux goes from the antenna directly to the counterpoise thru the capacity between these two things (see C_1 in Fig. 5), part goes from the antenna to the earth thru the capacity of the antenna to the earth (C_3 in Fig. 5), and *all* of the flux returns to the base of the antenna by way of the counterpoise-earth capacity (C_2 in Fig. 5). The counterpoise is of varying utility, depending on the ground in the neighborhood of the antenna. When the ground is very good its resistance will probably not be improved by using a counterpoise. The test for improvement is to see which combination gives the best signals at a distant receiving station *on the same night.* Tests made at 200 meters on different nights mean nothing at all.

Loops for Sending

QUOTING from a paper by Dr. J. H. Dellinger of the Radio Section, Bureau of Standards, "In general the effectiveness of a coil aerial (loop) approaches that of an antenna only when the size of the former approaches that of an antenna." However, the loop has advantages in convenience and because it can be used to direct the transmitted energy or to reduce interference when used for receiving.

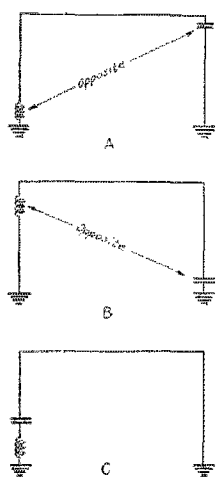


FIG. 1 CONVERTING AN ANTENNA INTO A LOOP

Converting an Antenna Into a Loop

An ordinary antenna can be converted into a loop in the fashion shown in Fig. 1A. It will usually operate at a higher wave than it did as an antenna. The condenser must be very good as it must stand a high voltage and not show too high losses.

This stunt should not be confused with the one of working the antenna multiple-tuned with two downleads as shown for the antenna at 1YK in the article on Multiple-Tuned Antennas. That stunt causes the antenna to operate at a *lower wave.*

Usually the range of such a large single-turn loop is not as great as that of the antenna from which it is made but in some locations it may be better. From various experimenters we learn that for best range the condenser and the coupling coil should be *opposite* each other as Figs. 1A and 1B, not next to each other as in Fig. 1C. For best transmission the end with the coupling coil should be pointed in the direction of the receiving station.

Indoor Sending Loops

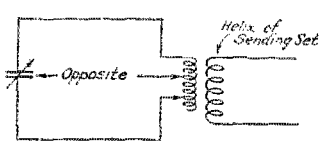
A sending loop with more than a very few turns is not efficient, hence indoor loops are generally good for very short waves only. A good deal of information on indoor sending loops is given by the article "Loop Transmission," by Leon W. Bishop, page 7 of *QST* for January, 1923. The loop described in that paper has done consistent 70-mile work when used at 1XP with a small tube sending set.

Circuits

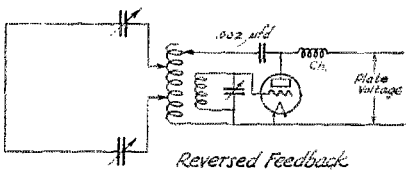
Some circuits that have done good work on small sending loops are shown in Fig. 2.

Resistance

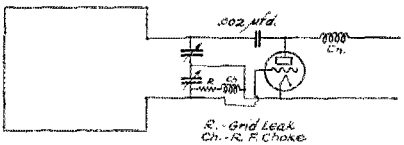
In loop work—especially sending—it is very important to keep the resistance very low. Use plenty of copper in the winding, space the turns far apart (using not over 3 of them), and use a mica condenser or else a hard rubber-insulated variable condenser. In one case the current in a loop was increased from .6 amperes to 2.5 amperes by removing a winding made of No. 14 B.&S. copper wire and rewinding with copper strip two inches wide. The insulation of the winding is important—use as few insulators as possible—and the loop-frame should be made with as little material as possible. Especially must the frame be kept away from the winding to prevent dielectric losses. For the same reason the loop should be kept clear of the walls, floor and ceiling. In the case of the loop mentioned above the current



Inductively-Coupled - Any Circuit



Reversed Feedback



Colpitts

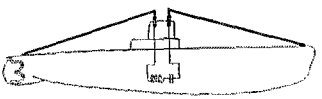
FIG. 2 LOOP SENDING CIRCUITS

dropped one half when the loop was brought within a foot of a brick house wall.

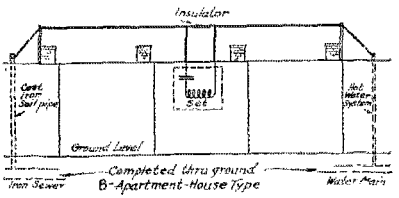
The Lowell-Willoughby Loop

Altho the Lowell-Willoughby loop was originally designed for submarines it is useful to amateurs living in apartment houses that do NOT have metal roofs.

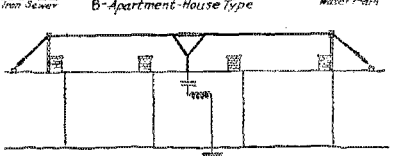
In Fig. 3A the loop is seen as applied to a submarine. The hull acts as the lower part of the single turn and the largest currents are thru it. The small currents and high voltages are in the upper part of the loop where they can be insulated. In Figure 3B is shown the way the Willoughby-Lowell loop can be used in an apartment house. Such a loop was operated at the home of Mr. J. A. Willoughby at Washington, D. C. The range obtained



A - Submarine Type



B - Apartment-House Type



C - Re-converted as T Antenna

FIG. 3 LOWELL-WILLOUGHBY LOOPS

with this loop was considerably better than with the T antenna arrangement shown in Fig. 3C.

References (Loop Transmission)

"Loop Transmission," Leon W. Bishop, 1XP, *QST*, January, 1922, page 7.

"Development of Loop Aerials for Submarine Radio Communication," by J. A. Willoughby and P. D. Lowell, *Physical Review*, August, 1919.

"Loop Antennas for Submarines," by Ralph R. Batcher, *The Wireless Age*, January, 1920.

"Radio Transmission Formulae for Antenna Coil Aerials," by J. H. Dellinger, Journal Franklin Institute; July, 1919.

Publication of the Bureau of Standards, S. P. 354, "Principles of Radio Transmission and Reception with Antennas and Coil Aerials," by J. H. Dellinger.

CR 120 C, "The theory of Antennas and Closed Coil Radiators," by J. H. Dellinger.

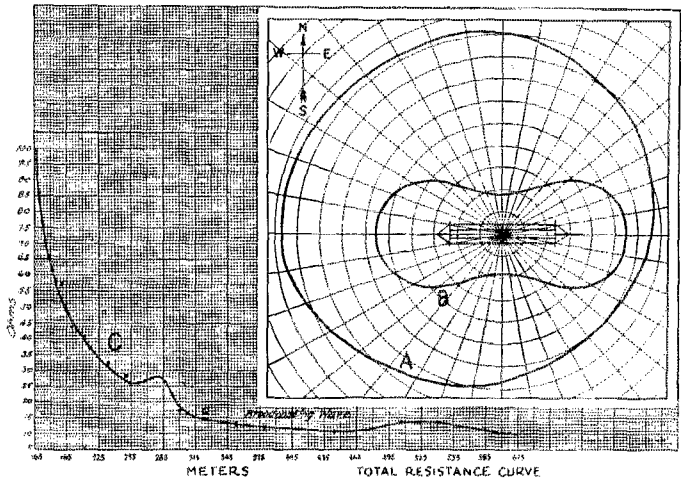
CR 412 H, "The Development of Radio Telephone Communication Between U. S. Coast Guard Boats and Shore Stations," by F. W. Dunmore.

NEXT MONTH we will resume our usual variety of articles and items—we have some good ones waiting.

From Antenna to Ground

Outdoor Lead-in Insulation

Be sure that none of the precious watts in the antenna circuit go to ground through a leaky lead-in support or lightning switch before they reach the antenna. At old 9LQ and 9DM in the same town the strength of received signals and also the transmitting antenna current was almost doubled by swinging the lead-in clear of all insulating supports, and by cooking the marble base of the lightning switch in paraffin. At still another station the antenna current practically disappeared every time a rain began. The trouble was finally cured by building a little dog house over the lightning switch so as to keep rain off of the bakelite switch base. Lightning switches and safety gaps can now be bought mounted on porcelain insulators. These are very good if the insulators are long and thin, but ordinary bus-bar support insulators are not very good for this purpose.



Curves on the Antenna at 8AQO

A—Curve showing the intensity of transmission in various directions from the antenna.
B—Theoretical curve for this type of antenna.
C—Resistance curve for the same antenna. Fundamental wave length seems to be about 175 meters. Hump at 278 meters probably due to resonant guy wires. Maybe nearby power line or other wiring however.

Guy Wires

This squib has 34 authors; there is no theory in it; it is an experience meeting purely.

Material. Hard steel galvanized wire is beautifully strong but the stuff is brittle and unreliable. Bronze is O.K. but expensive and mean to handle. The best all around wire is a good heavy soft galvanized telephone wire.

Joints. Don't make short hard twists in joining guys to each other or to the insulators and the pole—not unless you want to put up another pole right away. Make a long "Western Union splice"—ten inches at least. Any wire man will show you how—it gives him a chance to show off.

Insulators. Porcelain knobs and eggs are O.K. for breaking up the guy wires; the bigger they are the worse they are because that means they have a bigger capacity. Use the smallest that will stand the strain.

The right way to do it is to break up the guys into sections that are *all the same length.* Then if they do resonate they will put ONE hump on your wave instead of 47 of them. Make the sections short—the shorter the better. There is going to be 50 meter transmission pretty soon and you will spoil your chances with great long lengths of guy wire that have only one insulator at each end.

Guy Anchors. Down at the guy anchors, run all the wires together and put a string of at least 3 porcelain eggs between the guys and the anchor. Use *one* string and not one for each guy. The idea is to decrease the capacity to ground thru the

insulators—they are punk condensers. This sounds funny but in one antenna it decreased the resistance about 2 ohms.

How Many Guy Wires. For once everybody agrees—the fewer the better. No, wait—here's a minority report from 8ML that says use 4 sets PLUS a top back-guy.

Where Shall We Put the Guy Wires? Again everybody agrees—keep them away from the antenna and the space under it. Here are some methods suggested—keep the top guys ten feet down from the top of the mast and use a single back guy to take the pull of the antenna; put a cross-arm at the top of the mast and hang the antenna clear of the guys; make the mast high enough and keep it far enough from the station so that you can let the antenna sag clear of the mast and guys.

Concerning Antenna and Ground Leads John C. Strobel's article in May, 1921, *QST* proved pretty conclusively that a bunched downlead from the antenna is debunque. He proved that while a spread-out antenna lead does not improve the resistance it does reduce the inductance and let one use a bigger antenna top so that the antenna has more effective height. Putting it another way—one can get the effect of a *higher antenna* by using a *longer top* and then spreading out the lead-in into a cage. 6 inches is a nice size; a larger one has too much capacity to ground. It can be 3 feet across where it hits the top, tho.

Kewpie sez that he can't see any sense in using caged antenna leads and then sticking to a solid ground lead. Neither can we; if the ground or C.P. lead is more than a yard long, cage it too.

One of the Arizona gang forgot the trifling detail of signing a letter that calls attention to a waste of steam that a lot of fellows are getting up because it worries them to cage the lead, spread out the top and then bunch the wires for 6 inches where the top and the lead join. Arizona sez that this is harmless because caging the wires does not do much for the *resistance* anyway. Correct; you took the words out of our mouth.

Small receiving antennas win by a landslide. They are easier to put up, collect less static and tune better. You won't hear Mr. Ether-Buster as loud but you will get a decent chance to hear the 5-watter on the opposite coast. Approved sizes (from the experiences of our gang) appear to be—height 30 feet and length 60 feet. For B.C. work the length may be run up to 100 feet, but keep the height down.

Receiving grounds are worth worrying about. There is no rule except that the ground must be near the set. Try all the grounds in sight; one will prove to be a LOT better. Sometimes a two-wire receiving c.p. has helped. A water-pipe ground is often N.G.—who started this water-pipe ground business anyway?

Receiving insulators should be replaced every year. They don't work so well after the soot gets an inch thick.

Wire for receiving antennas is worth worrying about. A lot of the gang have found stranded wire to be strictly N. G. after the soft-coal furnaces have been working on it for one week. The best yet is No. 12 *enameled solid copper. It is good and it stays good.*

Series condensers are N.G. if they warm up. Most of the variables are strictly terrible for use in sending antennas. Use a condenser made of mica, a hard-rubber insulated V.C., or one with good glass in it. The glass is a makeshift but does not cost as many $$$$$ as the mica does. For the love of Mike lay off anything that is insulated with "moulded mud" or that has little bakelite bushings.

Indoor sending antennas have been getting polished up again since this 100 meter thing started. Kewpie has been doing some pretty good work with a Tesla Coil operated on a 50-watt tube at about 160 meters. It works best when worked just below the brushing point. By hanging the secondary up horizontally a directive effect can be gotten. This is the same as General Squier's "resonance wave coil."

3EM has been doing 15 miles with a "*condenser*" antenna inside of a victrola booth in a music store; just two 6-foot squares of copper screen, one under the rug and one hung from the ceiling by four insulators. Current .5 amps.

Speaking of 100 meters we have heard a lot of fellows beautifully on 100 meters and less when the main wave was around 200. But it is *not* a good idea to try working a 400 meter antenna on a harmonic—the darn thing might get absentminded and start working at 400 and that would be all wrong.

Speaking of 400 meters have you noticed that every A.C. tube set in the universe seems to have a beautiful hump at double the wave? C'mon, gang, lay off the A.C. plate stuff—even if you don't believe that a 400 meter hump does any harm it is still nice not to raise "so much hell" on 200.

Indoor antennas again. Hey! One of the Canadian members just rises to remark that at 100 meters it is worth while to think of the Hertzian oscillator again and can the troublesome ground connection. *Por que no?* How would it be to stretch out a straight wire with a coupling coil right in the center and try some 50-meter work? It has been done by several labs. here recently and offers relief from the

problem of "How do I get down with a ground lead 9 stories long."

Antenna on houses need not be so rotten. Forget to remember to use a ground and use a c.p. that is way up in the air. To get the idea take a look at the descriptions of 1BKQ, 2AHO, 6ZA, in the list on page 21 of March *QST*. And also remember old 2PM that used to be read at Denver on a crystal—he was on a 9 story apartment house. Moral—don't try to use a 9-story ground lead; use a nice large c.p. hung out in the middle of the street.

Concerning punk dielectrics under the antenna. 3ZA sez that one can find bum dielectrics that are absorbing energy by looking for them with a wavemeter that has a detector and phones connected. If the old apple tree emits a buzz when tested this way it must come out—no matter what the family sez. This is a spark test—someone pse try it with C.W. and a chopper?

Rusty old wires. Will someone PLEASE settle this fuss about dirty antennas? First someone up in New England replaces the old wire with nice shiny wire and gets an whole flock of new amperes and then 6ZZ comes along and sez that he has tried it a lot of times and the "old crusty wire is just as good as the new."

Perfect insulators. Someone blew in here the other day and sed he had discovered the perfect insulator at last—it was made out of sulphur and had no losses at all in any sort of weather. Only one trouble; if there happens to be the least brush discharge the darn things take fire—and then they smell like hell!

Concerning the size of the Antenna Top. A list of stations too long to mention have been getting improved results by "canning" the little cage antenna top and putting in its place a pair of cages, a single big cage (ten feet or so across), or else a good wide flat-top. These stations seem without exception to be in places where the space under the antenna swarms with trees, houses, etc. This seems plausible; when we have a punk ground we do not try to connect to it at a single point but cover a large area with a big c.p. Why not act the same way when an antenna has to connect with a chunk of second-grade air that swarms with bum dielectrics? Next!

Trees and houses near the antenna. If you are not sure that trees and houses near an antenna are "bad medicine" send 5¢ to the Supt. of Documents, Govt. Printing Office, Washington, D. C., and ask him to send you Scientific Paper of the Bureau of Stds. No. 269. It is called "Effect of Imperfect Dielectrics in the Field of Antennas." There is no theory at all in this paper but a lot of cold fact. It will help your station to reach out.

Receiving on a buried wire. 3HS at Washington, D. C. has been doing some very fine work in receiving on a length of wire buried in the back yard. The set is down within two feet of the ground, the ground leads are less than 3 feet long, and there is no antenna in sight. It never stops because of static.

Does a ground connection go stale? One of the Texas gang claims that every so often he has to put in a new ground connection 'coz the old one has got tired and quit. After a rest it is O.K. agn.

The ammeter is a liar. 9MC reminds us that you can't tell whether a ground has been made better by watching the ammeter. His big buried wire fan does not give much more antenna current than does a flock of pipes driven in the ground but the range is many times better.

Tin roofs. The gang does not seem to have the same experience with tin roofs. Sometimes grounding them raises the antenna current, sometimes it lowers the meter reading. The only way to see if things have gotten better is to try it on the other fellow a ways off. And try it on the same night—not on two different nights.

Antenna Upkeep. There is all kinds of evidence in the antenna-symposium letters that shows that antennas go dead after a while. The insulators accumulates a layer of dirt and soot and soak up water. The wire itself becomes coated with oxide and sulphite, in other words corrodes, and its resistance increases. The result is the well-known decrease in antenna current.

Now the funny part is that when the owner takes down an old antenna and replaces it with a new one of a different type, nine times out of ten he will give the credit for the better performance to the new *type* of antenna rather than to the new *wire* and *insulators*.

Moral: Don't be too sure that your antenna works well because it is *different* than your last one. Maybe it works well just because it is *new*.

Receiving loops. For short wave receiving a loop is supposed to be poor. It is not too poor, tho, as about half of the DX stations in Washington, D. C., are receiving 6th and 7th district stations nightly on loops with detector and one stage audio—no r.f.a. at all. For detailed dope see "The loop receiver at 3ZY" in April, 1922, *QST*. See also 3LR's station description in April, 1923, *QST*. Bu. Standards publication No. C.R. 124 U. "Wavelength Ranges for 4-Ft. Square Coils with Various Turns and Tuning Capacities," (Radio No. 780) will also help.

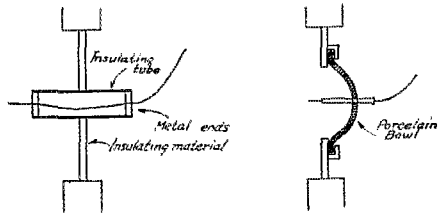
The main reason why results are never obtained when a series condenser is used

is because it is difficult to secure a good condenser that will stand C.W. without absorbing all of the power that we try to put thru it.

Lead-Ins. There is more to a good lead-in than simply providing enough insulation so that it does not flash-over. The insulator should be absolutely waterproof, should have low losses; in other words should be made of the very best material and have not very much of that. This does *not* mean that the lead-in insulator is to be small, it means that there must be a small amount of material well located. There is not, as far as we know, a satisfactory amateur lead-in bushing on the market now. About the best thing we can do now is to bring the leads thru the center of a window-pane. The figure below shows other suggested arrangements.

If the lead-in insulator can be put thru a thin piece of material rather than thru a wall, the losses will be very much less.

Mr. D. W. Richardson, formerly of 3XM, tells of a case where a lead-in passing thru a very good insulator in a brick wall added 4 ohms to the antenna system. Mr.



M. B. West in one case found that the removal of a very large composition lead-in insulator decreased the antenna capacity by 10%. At WWV a 20% increase in antenna current was obtained by taking out a very good electrose bushing and running the lead thru the center of a window-pane.

Notes on the Resistance of Receiving Antennas

***By John C. Warner** **

MUCH has been written on the reduction of the resistance of sending antennas, but the receiving antenna has been given much less attention. The reason is that any improvement in the sending antenna gives a definite increase in the antenna current while the advantage of low resistance receiving antenna is somewhat obscure.

The majority of antennas that are used only for receiving consist of a single wire with a mediocre ground connection. It is not hard to see why such antennas are used; most tuners today are regenerative, either tuned plate or feed-back. The popular idea of such a circuit is that regeneration introduces energy into the grid circuit which produces the efect of a negative resistance; further that the total effective resistance on the grid circuit can in this way be reduced indefinitely until the tube goes into oscillation. Experimental proof on this point is incomplete and not at all conclusive. Ballantine maintains that even with maximum regeneration the signal strength is proportional to the current in the antenna, which is of course inversely proportional to the antenna resistance. On the other hand many well known engineers support the statement that (at least within wide limits) an increase in regeneration will completely compensate for an increase in the antenna resistance.

However, even if we can compensate for the antenna resistance by regenerating into it, it is highly objectional to allow a receiving set to radiate energy from the antenna, either continuously—as when receiving C.W.—or intermittently during the process of tuning into modulating C.W. For this reason present development is coming to be along the line of circuits which do not regenerate into the antenna, either by reason of not regenerating at all or else by regenerating into an intermediate tuned circuit which is in no way coupled to the antenna. Thus, regardless of whether a low resistance is of vital importance when used with the usual broadcast receiver, there are sufficient reasons for seriously considering the reduction of antenna resistance for other types of sets today and for nearly all sets in the future. Attempting to increase the signal strength in spite of the antenna resistance by making the antenna higher is not satisfactory. The mechanical structure required for a high antenna is difficult, the ratio of signal strength to static is not as good as on a low antenna, and finally a high antenna is less selective than a low one. The only means of increasing the antenna current is to decrease the antenna resistance.

The resistance of a receiving antenna may be considered as having three com-

*Formerly Assistant Physicist, Bureau of Standards, Radio Section.

ponents: radiation resistance, resistance of conductors, and resistance due to losses in the dielectric of the antenna (including the earth underneath it). The dielectric loss component is by far the largest of the three and at the same time is the only one which can be reduced to any great extent.

A series of experiments was made at the U. S. Bureau of Standards from which conclusions may be drawn as to the proper method of reducing antenna resistance. These experiments were made on what is known as a two-plate condenser and tuner. The plates consisted of two pieces of copper screening 45 to 180 centimeters in width and from 180 to 400 centimeters in length, mounted one over the other and not grounded. The upper plate corresponded to the usual overhead antenna and the lower plate to the usual ground or counterpoise. Resistance measurements showed that when sufficient precautions were taken to keep all solid dielectric out of the field of the antenna, the resistance fell to a very low value, in some cases to less than ½ of one ohm at 200 meters. The introduction of solid objects such as boards between the two plates increased the resistance to as much as double the original value. It was found ncessary to make the lower plate considerably larger than the upper in order to screen the upper plate from the ground and to prevent the losses which would otherwise result from ground current. Measurements of received signal strength were made, comparing the signal of the condenser antenna with that gotten from two small loops, one having two turns 90 centimeters by 125 centimeters and the other seven turns 80 centimeters square. Tests were made only on a non-regenerative detector with I.C.W. signals. Below 300 meters the two-plate antennas gave far greater signal strength than the loop, in some cases as much as 10 to 1. Above 300 meters the difference was less and at 1000 meters the two-plate antenna was quite ineffective.

Two conclusions may be drawn from these tests: first, the two-plate condenser antenna is worthy of serious study and more experimental investigations in short wave receiving (and why not transmitting? —Ed). Second the method of reducing the resistance of the two-plate antennas might well be applied to elevated antennas with equal success. Practically this means to make the antenna of the ordinary cage type, not too far off the ground, and then to use a counterpoise extending far out in all directions from the antenna. The counterpoise must be very well insulated with as few insulators as possible and must have enough wire to keep stray fields from the antenna direct to the ground. The entire arrangement should be placed as far as possible from trees and buildings. The best dimensions can be determined only by trial but the general procedure outlined should make possible much lower antenna resistances than ever found in the haphazard constructions so widely used at present.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of QST, published monthly at Hartford, Conn., for April 1, 1923.

County of Hartford } ss.
State of Connecticut }

Before me a Notary Public in and for the State and county aforesaid personally appeared K. B. Warner, who, having been duly sworn according to law, deposes and says that he is the business manager of QST and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The American Radio Relay League, Inc., Hartford, Conn.; Editor, Kenneth B. Warner, Hartford, Conn.; Managing Editor, (none); Business Manager, Kenneth B. Warner, Hartford, Conn.

2. That the owers are: (Give names and addresses of the individual owners, of, if a corporation, give its names and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock). The American Radio Relay League, Inc., an association without capital stock, incorporated under the laws of the State of Connecticut. President, Hiram Percy Maxim, Hartford, Conn.; vice-president, Chas. H. Stewart, St. David's Pa.; treasurer, A. A. Hebert, Nutley, N. J.; traffic manager, F. H. Schnell, Hartford, Conn.; secretary, K. B. Warner, Hartford, Conn.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If they are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear on the books of the company, but also, in cases where the stockholder or security holder appeared upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustees acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is.....(This information is required from daily publications only.)

K. B. Warner.

Sworn to and subscribed before me this 26th day of March, 1923.

F. L. Pratt, Notary Public
(My commission expires February 1, 1924.)

What Antenna Wire?

By C. P. Sweeny, 5KM

Stranded Wire

Stranded wire of any kind has higher resistance than solid wire when worked at radio frequencies. The wire rapidly gets very much worse when it corrodes. Solid wires are cheaper, easier to handle, stronger, and have lower resistance. (Note —This applies to stranded bronze, copper, and aluminum, whether as a 7-strand cable or in the shape of some of the fancy braids now sold.—Ed.)

Litzendraht

The only stranded wire that has lower resistance than solid wire is the so-called "litzendraht" made of many strands of fine enameled or silk-covered wire braided together. Experience shows that at 200 meters these strands must be so fine (at the most No. 38 B.&S.) that it is almost impossible to make up a length without broken or "crossed" strands which will run the resistance away above what is expected. It does not matter, tho—"litz" is impractical stuff to put out of doors anyway.

Bronze

Bronze is stronger than plain copper and not so much subject to the effects of corrosion as copper. However, I want to call the attention of the reader to the fact that an alloy always has a resistance higher than that of the *poorest* conductor used in the alloy. The conductivity of the alloy antenna wires is low as compared to copper, ⅛ to ⅓ as much. In addition the bronzes are very hard to handle and solder.

Copper, Copper-Clad Steel, and Aluminum

This brings us down to the solid wires (not stranded) with a choice of copper, either hard or soft drawn, copper-clad steel, and aluminum. Any one of them is preferable to the other wires above.

Copper-clad wire has about the same resistance as solid copper. (This statement does not include the cheap electro-plated "coppered wire."—Ed.)

Aluminum can be compared with copper as follows. For the same direct current resistance aluminum has a cross section of about 1.59 times as great as copper. Because it is well known that high frequency currents travel on and near the surface of the wire and because the aluminum wire has a larger surface it would appear that it should offer a lower high-frequency resistance than the smaller copper wire. However, the larger skin of the aluminum wire is an aluminum skin and has about 1.59 times as much resistance for the same area so that in reality the h.f. resistance, like the D.C. resistance, will be nearly the same for a copper and an aluminum wire that has 1.59 times as large a cross section. In other words—for either antenna or direct current work an aluminum wire is equal to a smaller copper one 4 sizes up in the B.&S. gage.

Weight and Strength

Aluminum has (for the same conductivity) about 1.3 times the strength and a little less than ½ the weight of copper wire. Consequently the strain on the towers is less, altho part of this is made up for by the greater effect of the wind on the larger aluminum wire.

Copper-clad wire is quite a lot stronger than either aluminum or hard-drawn copper, and hard-drawn copper is somewhat better than soft-drawn copper.

Bronze is the strongest of all, but the reasons for throwing it out have already been mentioned.

Pliability

Soft drawn copper is the most pliable of all and stays so, but it is not very strong. Hard drawn copper, hard-drawn aluminum, and copper-clad steel are all only moderately pliable and must not be kinked. Hard drawn copper becomes brittle with age; aluminum does not do this because after the first coating of oxide, it does not corrode further. (This seems a bit doubtful. Copper and aluminum both become quite brittle when not subject to corrosion, perhaps for the same reason that "vibration fatigue" causes machine and bridge parts to crystalize and break.—Ed.)

Corrosion

Copper, copper-clad, and bronze wires soon acquire a green or black coating that serves as a protection against further corrosion and does not increase the h.f. resistance very much. Aluminum is not attacked after the first thin film is formed, hence maintains its conductivity.

All rules fail where there are chemical or soft-coal fumes; corrosion will then go deeper, probably less in the aluminum than with other materials.

Enameled copper does not corrode until the enamel comes off. (Several stations in soft-coal regions are getting good results with No. 12 enameled copper wire. Both the Belden Mfg. Co. and the Acme Wire Co. make enameled antenna wires.)

Sleet

The oxide coating on an aluminum wire is slightly greasy and sleet will not adhere to it as easily as to copper. I do not say that sleet will not stick to aluminum, but only that it will not stick as readily.

Joints

Joints in copper and copper-clad steel offer no difficulty if ordinary care is taken not to nick or kink the wire. Between aluminum wires I have found the McIntyre sleeve to make a good joint. Trouble was found in making a connection to the lightning switch. I get a very good connection at this point by using a large McIntyre sleeve and joining with it the (bunched) antenna wires to a short piece of heavy copper wire which was then connected to the switch. (This is unusual; power companies have found that they cannot use copper McIntyres on aluminum lines because of corrosion and must use aluminum sleeves. It would be better to make the antenna so that there would not be any joints at all in it. This is perfectly easy to do.—Tech. Ed.)

Price

Copper-clad is the cheapest, bronze the dearest and between them lie copper and aluminum. Some may think the price of aluminum is more than that of copper. Aluminum *does* cost more per pound than copper but you get more than twice as many feet of aluminum per pound. Therefore the aluminum will be cheaper. However, for the small amateur antenna the price of either will not be a factor.

(Thanks are due various correspondents, especially the Copper Clad Steel Co., the Bureau of Standards, and Messrs. Frank Conrad and W. F. Grimes for the information on copper-clad and litz. wires, which imformation has been used partly within the article and also in the shape of editorial notes.—Tech. Ed.)

Your Station According to Underwriters

AT one time private radio stations labored under an oppressive National Electrical Code that required protection out of all proportion to the dangers of such stations. This code in recent times became intolerable and after a series of conferences in which R. H. G. Mathews represented the A.R.R.L. there were drawn up "Tentative Regulations of the National Board of Fire Underwriters." These were issued in pamphlet form in May, 1922, and while they are not officially in force are nevertheless universally recognized by all insurance companies to the complete exclusion of the old requirements. This new code is an entirely reasonable one and adjusts the protection to the station.

The regulations have back of them the authority of the National Board of Fire Underwriters and it is foolishness to install a station that does not comply with them in every respect; not only does this invite fire but it also *is very likely to cancel your fire insurance if a fire does occur.* The comparatively slight expenditure required to meet the Underwriter's requirements is therefore money very well spent.

A copy of the "Tentative Regulations of the National Board of Fire Underwriters for Radio Signaling Apparatus" may be secured free of charge by writing to the Underwriter's Laboratories, National Board of Fire Underwriters, 109 Leonard Street, New York City. The rules should be followed to the letter, not only as regards the antenna and ground lead but also as regards the station wiring, which must be in complete accord with the National Electrical Code.

Approved Apparatus

Unapproved apparatus absolutely should not be used; it will have the same effect in cancelling insurance as will ignoring the rules completely.

Excepting only that no lead-in bushing has been approved, the Underwriters now list as approved almost anything that is required to make a radio station safe. This is not an entirely satisfactory state of affairs as it is extremely hard to get a lead-in tube that satisfies the requirements unless one lives in a large city. It is hoped that approved tubes will make their appearance soon. In the meantime we can follow a letter by Mr. Dana Pierce of the Underwriters' Laboratories in which he says, "It has not appeared to us at all necessary to approve special lead-in tubes for such service, as any substantial porcelain tube or tube of good non-combustible insulating material is acceptable." The dimensions of the tube must, of course, be in accordance with requirements.

A list of radio appliances approved by the Underwriters' Laboratories up to February 7th is as follows:—

Barkelew Electric Mfg. Co., Middletown, Ohio.
Barkelew Lightning Arrester Switch, Cat. No. 602.
Barkelew Tube No. 622.
Barkelew Electric Mfg. Co., Middletown, Ohio
Barkelew Antenna Grounding Switch.
Brach Mfg. Co., L. S., Newark, N. J.
Brach Vacuum Radio Protector.
Brach Radio Vacuum Gap Lightning Protector, Type 210.
L. S. Brach Mfg. Co., Vacuum Type 223.
Branston, Inc., Chas. A., Buffalo, N. Y.
Branston vacuum tube lightning arrestors R-51.
Connecticut Elec. Mfg. Co., Bridgeport, Conn.
S.P.D.T. radio antenna grounding switches, Cat. Nos. 587, 589, 588, 590.
Dubilier Condenser & Radio Corporation, New York, N. Y.
"Ducon" radio appliance.

Electra Lightning Rod Co., Cresco, Ia.
Type R. lightning arrestor of the air gap type.
Electric Service Supplies Co., Philadelphia, Pa.
"Keystone" lightning arrestor of the air-gap type.
Foote, Pierson & Co., Inc., New York, N. Y.
"Argus" lightning arrestor of the air gap type.
Freeman Electric Co., E. H., Trenton, N. J.
"Hystatic" lightning arrestor of the air gap type.
"Little Joe" lightning arresters of the air gap type.
General Electric Co., Schenectady, N. Y.
"C. E." lightning arresters of the vacuum type-UQ-1310.
Heinemann Electric Co., Philadelphia, Pa.
Single-pole, double-throw knife switch for use as lightning switch.
Heinemann Electric Co., Philadelphia, Pa.
"Sensory" lightning arresters of the air-gap type.
Horne Mfg. Co., Jersey City, N. J.
"Horne", lightning arresters of the air-gap type.
Jacobus, E., Newark, N. J.
"Jacobus" Type JSW vacuum gap lightning arrester.
Jewell Electrical Instrument Co., Chicago, Ill.
"Jewell" radio lightning arrester of the air gap type.
K-A-K-A Radio Co., Bellevue, Pa.
"K-A-K-A" lightning arrester—air gap.
Radio Products Corporation, Detroit, Mich.
"No Aerial Rad-o-plug" radio appliance.
Radio Receptor Co., Inc., New York, N. Y.
"Anchor" lightning arrester—air gap type.
Radio Sales and Service Corporation, Chicago, Ill.
"Super Antenna" radio appliance.
Reliable Electric Co., Chicago, Ill.
"Frost" air gap lightning arresters.
Schweitzer & Conrad, Inc., Chicago, Ill.
"S. & C." lightning arrester, Type FCR.
Shinn Mfg. Co., W. C., Chicago, Ill.
Type SA 2" air gap lightning arrester.
Teleradio Engineering Corporation, New York, N. Y.
"Teleradio" lightning arrester—air gap type.
Trumbull Electric Mfg. Co., The., Plainville, Conn.
S.P.D.T. knife switches, Cat. Nos. 8747, 8729.
Western Electric Co., New York, N. Y.
Type 1-A transformer.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Radio protector S-356991 Type PB.

—S.K.

Laboratory Oscillators

A low-powered portable oscillator or "driver" is one of the most useful things that an amateur station can have. As pointed out by Mr. White, it may be used a separate heterodyne, for the calibration of receiving sets and wave meters, and to measure resistance, capacity, and inductance, both inside the station and for the antenna structure. It is not necessary to give detailed methods here; they may be found in Circular 74 of the Bureau of Standards. This circular is called "Radio Instruments and Measurements" and may be obtained from the Superintendent of Documents at the Government Printing Office at Washington, D. C., for 60¢; it is worth the money.—Ed.

A Short-wave Oscillator

By Elliott White, 1YB

THE handiest oscillator I have found for general testing, measurements, and calibration is shown in Figure 1. The circuit explains itself. L,M,N,C_1 is the tuned circuit. The main inductance L is made of 20 turns of No. 16 D.C.C. wire wound on a 3½-inch tube. The winding is tapped at the tenth turn. With this coil the set will oscillate over a range of 50 to

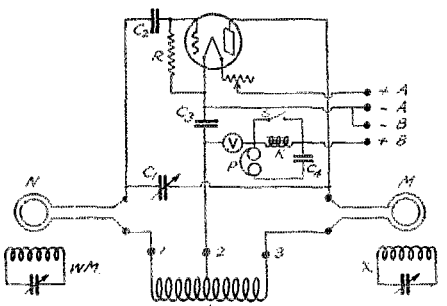


FIG. 1

375 meters. Other ranges may be secured by substituting other coils. The two exploring coils M and N are made of four turns of No. 18 annunicator wire with 16-inch leads which are solidly tapped together. C_1 is a variable condenser of .001 microfarad maximum capacity; C_2 is a fixed mica condenser of .0003 microfarad capacity. The values of C_3 and C_4 are not very critical; they may be paper telephone condensers of 0.5 microfarad capacity. R is the usual grid leak; it may have a value of 50,000 ohms. K is an iron-core choke coil whose exact value is not at all important, provided that its resistance is between 500 and 1,000 ohms. The use of the milliammeter, V, will be explained later.

The tube had better be an oxide-filament 5-watt sending tube such as the Western Electric "E" or 205-B tube. The plate supply voltage may be 220 volts from dry cells or from a motor generator or dynamotor. If the voltage is taken from a machine it had better be battery-driven.

To measure the wave length of an unknown circuit the entire rig is set up as shown, with N loosely coupled to the wavemeter WM, and M loosely coupled to the unknown circuit X which is to be measured. The switch S should be closed. First set the condenser of the wave meter at zero so that it is sure not to be on the same tune as the unknown circuit. Then rotate the condenser C_1 of the oscillator very slowly and watch the needle of the milliammeter (or voltmeter) closely. When the oscillator comes into tune with the circuit, X, some power will be taken from the oscillator by X and the input to the tube will rise suddenly, that is to say there will be a quick jump of the needle of the meter. The setting where this jump happens should be found very carefully, and if there is any doubt the adjustment should be repeated

with loose coupling between M and X. Now leave both X and C_1 alone and turn the wavemeter condenser until the needle of V jumps again. The wavemeter is now in tune with the oscillator and as the oscillator is in tune with X this of course means that WM and X are on the same wave. The reading is quite exact. It is perfectly obvious that X may be another wave meter, a receiving set, or an antenna circuit. In any case it is a quite simple and rapid process to make a series of wave length readings for different adjustments of X.

If X is an oscillating receiver or another laboratory oscillator, measurements may be made a different way. The switch S is opened and the condenser C_1 is slowly turned while listening to the note in the headset P. When the oscillator comes into tune with the set being tested, the beat note will go down to zero. On either side of the correct adjustment the note in the phones will go up rapidly. Anyone that has ever listened to C.W. signals will understand this at once.

The device is very sharp in its indication and much easier to handle than the conventional buzzer-and-crystal wavemeter. The long leads on the exploring coils save a lot of trouble in getting proper coupling. There are many uses to which the set can be put, such as in the construction of receivers for various wave lengths, adjustment of r.f. transformers, adjustment of a super-heterodyne, getting fundamental wave lengths of coils and antennas, measuring inductance, capacitance, and resistance, and studying the various wave lengths to which the component parts of even a simple receiving set respond at one setting (a chance for a lot of interesting results here that have been overlooked) and finally the oscillator may be used as a separate heterodyne.

For rough work the oscillator itself may be calibrated in wave lengths by the method first described. This calibration should not be depended on too much, however, as it will change somewhat with variations in the filament current and the plate voltage and also may change materially if a different tube is put into the socket.

The use of the voltmeter as a milliammeter is a trick worth knowing. For wave meter work it is not especially necessary to know just what plate current is flowing as long as the changes can be noticed but for other work the use of the voltmeter as a milliammeter is a very helpful kink. The voltage scale may be transalated into milliamperes by dividing the full-scale reading of the instrument by the (measured) resistance of the instrument and then multiplying by 1000. For instance, my instrument has a 0-10 scale and a resistance of 200 ohms. Then divided by 200 gives .05 amperes as the current required to give a full-scale reading and when this is multiplied by 1000 we get 50 milliamperes. In other words it takes 50 milliamperes to make the instrument show a reading of 10 volts, so that each volt on the scale represents a current of 5 milliamperes. Thus the instrument stands at 7 for the normal plate current of a five-watt tube and at less than 1 for the normal grid current of the same tube. It can accordingly be used also for the adjustment of a small C.W. transmitter.

A 100 to 3000 Meter Oscillator

By H. J. Walls,* WWV

Excerpted from a Bureau of Standards bulletin entitled "A Low-power Electron Tube Generating Set for Laboratory Use, Frequency range 100 to 3000 Kilocycles per Second."

THIS low-power electron tube set utilizes a 5-watt power tube. The set is capable of supplying about 250 milliamperes of radio-frequency current to a low-resistance tuned circuit at any frequency within its range.

The circuit is shown in Figure 2. Inductor A is used when it is desired to obtain frequencies from 3,000 to 630 kilo-

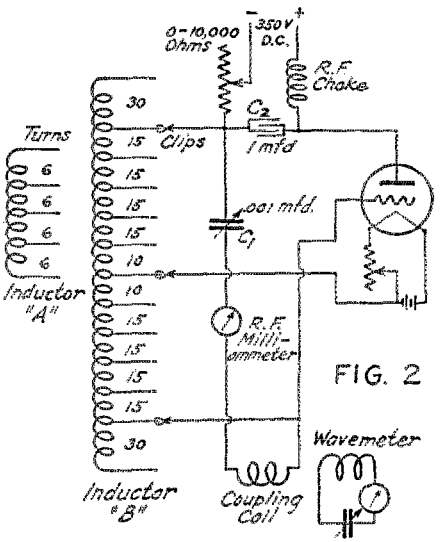


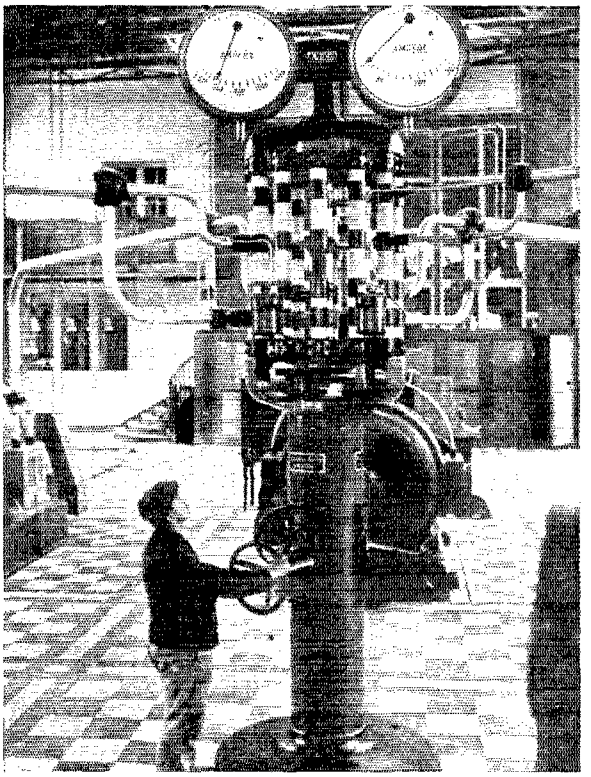
FIG. 2

cycles (100 to 475 meters) and inductor B is used when frequencies from 1,000 to 100 kilocycles (300 to 3000 meters) are desired. The small coil A consists of 24 turns of No. 18 B. & S. gage D.C.C. wire wound on a tube 3⅛ inches in diameter and about 2½ inches long. The space occupied by the winding is about 1⅝ inches.

*Junior Electrical Engineer, Radio Section, Bureau of Standards.

Taps are brought out from the 6th, 12th, and 17th turns and are staggered somewhat so there will be no danger of the clip touching. The taps are made by twisting a two-inch loop of wire. After the winding is completed the insulation is removed from the wire which forms the loop and it is then firmly twisted together and soldered. The large coil B consists of 200 turns of No. 22 B. & S. gage D.C.C. wire wound on tube 5¾ inches in diameter and about 9 inches long. The winding occupies 7¾ inches. Taps are brought out from the 30th, 45th, 60th, 75th, 90th, 100th, 110th, 125th, 140th, 155th, and 170th turns. It

denser having a capacity of 1 microfarad. It is used to by-pass the radio frequency around the high voltage supply. The radio frequency choke coil consists of about 100 turns of No. 25 B. & S. gage D.C.C. wire wound in a single layer on a 4-inch tube. Its purpose is to prevent any radio frequency current from flowing into the high voltage supply. A variable resistance capable of carrying 50 milliamperes (grid leak resistances of the type sold for 250-watt tubes are suggested.—Ed.) is inserted in series with the high voltage supply. This resistance should have a value of about 10,000 ohms and be variable. It is



Wouldn't This Make an "Ampere-Hound" Sad?

This is the antenna transfer switch at the famous POZ, Nauen, Germany.

The interest centers in the antenna ammeters. The one to the right has a 0-300 scale which suffices for low power. That to the left goes from 300-1500. The operator is tuning up hence the reading it at the moment a miserable 650 amps.

Nauen is getting a new set with which they hope to get a decent antenna current.

International Newsreel photo.

would be desirable to place the completed coils in a warm oven for a few hours and then to give them a coat of good insulating varnish (not shellac) to exclude moisture. The coupling coil consists of 2 or 3 turns of wire (about No. 16 or 18 B. & S. D.C.C.) about 4 inches in diameter. It is arranged so that the wave meter may be readily coupled to it for measuring the frequency of the circuit. This coil may be dispensed with if desired.

Condenser C_1 is a variable air condenser which has a maximum capacity of .001 microfarad. Condenser C_2 is a paper con-

used to vary the plate voltage supply and consequently the radio-frequency current in the oscillatory circuit.

The apparatus should be wired up with wire not smaller than No. 18 B. & S. gage, encased in varnished cambric tubing ("spaghetti"). Lamp-cord with a clip securely soldered to one end is very convenient in making the connections to the inductors.

It will be found that the maximum current will be obtained when the condenser C_1 is set at full scale. In view of this fact it is well so to adjust the inductor

clips that the desired frequency (wave length) is obtained when the capacity of this condenser is near maximum. It will also be found difficult to obtain as great a current on the lower frequencies (longer wave-lengths).

If the generating set is to be used for precise work such as wave meter standardization by signals of known wave length it is desirable to surround it completely with fine mesh screening which is grounded. It would also be well to ground the circuit at some low potential point as for example the negative side of the filament. In order to get very close adjustment, a stick about 4 feet long may be fastened to the knob of the condenser C_1 and adjustments made by means of this stick.

The filament current for the tube may be A.C. supplied by a small transformer with a tap in the center of the secondary winding or by a storage battery. (Our experience has been that the voltage of commercial lines is far too unsteady for such work. —Ed.) A storage battery is preferable. The plate current may be supplied by a small generator or by small block "B" batteries. This generating set has been operated on voltages as low as 80. A higher voltage is preferable, however.

The meter should have a range of 0.500 milliamperes (one half ampere). It is very desirable to have this meter in the circuit as it indicates when radio frequency energy is being generated.

Amateur Radio Again Proves Its Worth

AN amateur operator in Cleveland standing by his apparatus through which he had just received a call for assistance—

A small power boat, sheathed in ice and carrying coast guardsmen and a doctor heading out to sea in the teeth of a forty mile gale—

This was the scene enacted in Cleveland, Ohio on March 28th when amateur radio performed an invaluable assistance in helpto secure medical attention for Harry Holzworth as he tossed in a fever of tonsilitis and near-pneumonia in his bed on a waterworks crib, five miles out in Lake Erie beyond Cleveland harbor.

A spark coil transmitter had been installed on the crib with the amateur call 8AJO. It was operated by Mr. Keller, one of the attendants, and was frequently used to communicate with shore. 8AUV in Cleveland was listening in between six and seven one evening when he heard the call for assistance from the crib station. He answered and received a message to the effect that one of the three men, marooned out there five miles from land, was sick and needed medical attention. 8AUV delivered the message to the city waterworks commissioner, just as thousands of messages are delivered daily by members of the A.R.R.L. Preparations were commenced to make a trip to the crib and bring the sick man ashore. At one o'clock 8CUR and 8AUV received another message that the condition of the sick man was rapidly becoming worse and that a doctor was required immediately.

A few minutes after this message was delivered, the coast guard power boat left the harbor, and passing the breakwater, headed into the open sea. After what seemed to be hours, the lifeboat neared the crib; but on account of the heavy seas, it was impossible to effect a landing. There was only one recourse. The power boat circled the crib about a dozen times while the doctor shouted advice to the other two men on the crib. In this way the doctor learned the condition of the man who was ill and shouted back instructions for proper treatment. The men on the power boat saw that there was nothing else that they could do, so they headed again for the harbor. The gale was increasing and the little craft barely escaped destruction in returning.

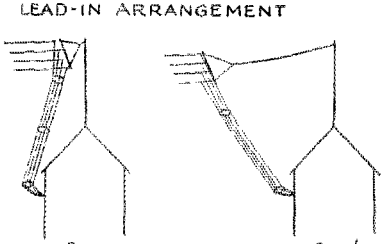
Immediately preparations were started to send a larger tugboat to the aid of the stricken man; but the storm increased to such an extent that it was useless to try to make a landing at the crib. All through the day the crib was in constant communication with land by means of amateur radio and words of encouragement were sent to the men on the crib and the sick man's family was always informed of conditions on the crib. At five thirty in the evening the storm abated somewhat and the tugboat was able to go out and make a landing at the crib, whereupon the sick man was rescued.

So it is that amateur radio has again proven its worth. At a time and in a place where there was no other means of communication, the ever watchful radio amateur on the job to handle the messages which probably meant the saving of a human life.

Long live amateur radio!

—*H.F.M.*

LEAD-IN ARRANGEMENT



Adapted from "Kick-Backs"

EDITORIALS de AMERICAN RADIO RELAY LEAGUE

How Cum?

LATELY some of the w.k. proprietors of rock-crushers, gravel-grinders and ether-busters (or whatever other titles big watt-eating spark sets may have) have been breaking into print in defense of spark transmission. We're mighty sorry to see this. We think the dead past ought to be permitted to bury its dead spark sets. It is perfectly true that it is legal to own and operate a spark transmitter, but it is also legal to use a decrement of 0.2 which everybody knows is more than we really can afford in these days of ether congestion.

We don't want to be misunderstood; *QST* is not in favor of prohibiting the spark by law—not yet. We do not believe in prohibition. There are many amateurs without the financial means to change over on sudden notice to tube sets, and to forbid sparks would be to exclude them from the rights and privileges of amateur radio. We do *discourage* spark transmission, but the A.R.R.L. has opposed the attempts occasionally made to *outlaw* the spark by those folks who would benefit commercially by such a change.

Yet the spark must go, and there is no use blinking at that fact. It simply cuts entirely too big a swath thru the ether. Its present-day boosters claim that that it is a most effective relay transmitter. By a strange anomalism this is true—in fact, it is too darned effective. Think back a little over a year ago, fellows, when everything was spark except a few hardy pioneers who were breaking into C.W. There were but these few C.W. sigs to be found on a tuner and the C.W. crew had a great time of it—no QRM, long jumps, everybody happy. With the spark, however, things were well nigh intolerable. It got so that there were so many of us, using big sparks, that only the very few with extra punch could get messages thru the QRM. And so the big bunch of us switched to C.W., where the inherent sharpness of the wave has permitted us to continue to enjoy our radio altho our number grows daily. With our abandonment of spark, the few remaining spark-hounds are having as much sport as the original C.W. pathfinders. There're alone in their glory, 16,000 other amateurs have changed to C.W., and *of course* their sparks are effective. Where they hadn't a ghost of a show thru regular amateur activity, they are succeeding immensely today when most of the bunch have had consideration for the rest of the world and changed to tubes. But suppose the rest of us were back on spark—then where would the "effectiveness" go?

Dr. Goldsmith recently likened C.W. to a motorcycle, narrow and speedy, darting thru the traffic right to its destination, while he compared the spark with a big lumbering street-car, which not content with its already huge dimensions had equipped itself with vast wings extending out a block on each side, and then ploughed up the street bowling over people into the gutters, mowing down autos and buildings, and leaving death and destruction in its wake as the toll for occupying an unnecesarily broad channel. The doctor hit the nail on the head—the spark eats up too many cycles to be tolerated much longer.

Consider the C.W. set, quiet, less expensive for the same reliable range, capable of reaching untold distances, letting the neighbors exist in peace whether they be listeners or fellow amateurs, and making it possible for hundreds of stations to work where one spark formerly stood. Our spark friends cite the fact that C.W. stations are constantly heard calling CQ in an effort to establish communication. The answer is that C.W. is still young and our tuners are hardly yet properly arranged to take the fullest advantage of it, nor have we become acquainted with all the benefits of working on schedule, in which C.W. particularly shines. The difficulty of hooking up in C.W. work is a tribute to the sharpness of the method—the sharper the wave the harder it will be. But do we for that reason want to go back to spark? A thousand noes! Of course a spark signal gets thru—it forces its way willy-nilly onto thousands of tuners where it is an unwelcome guest, just to be sure of attracting the attention of the single operator it wants.

After all that is what is going to kill the spark—it's *selfish*. And so, we think, is the operator who sticks to that method of transmission.

Bugaboo Nr. 1,234, 567, 890.

UNDER the title "Anti-Amateur Ordinances" we had some things to say last month calculated to help in those unfortunate communities where ill-advised movements are undertaken to label amateur radio stations as "nuisances" and prohibit their operation in favor of broadcast reception.

Recently several additional bits of helpful information have come to light—things which we here put forth for the help of any amateurs in such cities. At the Radio Telephony Conference in Washington in late March Secretary Hoover said: "The Government owns the ether." This is very significant. If our federal government owns the ether, no one else has the authority to make regulations for its use: no municipality has the power to limit or expand any privilege granted under a federal license except in the matter of police regulations to control things strictly of local concern. Under the constitution of our country matters of interstate aspect are subject to the federal government alone, and that the Department of Commerce so believes is attested by the following extract from a letter written by the Bureau of Navigation recently to an A.R.R.L. member in a Kansas town:

"The federal laws give to the Secretary of Commerce control over radio transmitting stations carrying on interstate communication or which would cause interference with interstate communication, and the city authorities can not make regulations governing matters over which the U. S. Government has control."

Now do you remember the "anti-amateur" ordinance actually enacted at Atchison, Kansas—the ordinance which was said to prohibit amateur transmission within the city limits, and which was used in certain quarters as an argument for such attempts in other cities? Here is what Mr. Orlin A. Weede, City Attorney of Atchison, writes us under date of March 30th:

"The Atchison radio ordinance does not prohibit the operation of licensed amateur telegraph transmitting stations. In the first place, a city ordinance cannot supersede a federal statute; and, secondly, the ordinance itself as enacted by the Atchison City Commissioners does not apply to same."

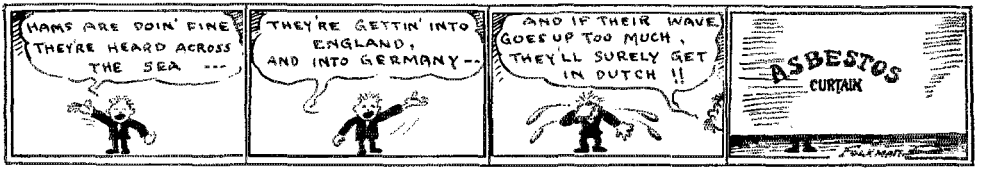
So that's that. Our members are requested to give wide dissemination to these significant aspects of the amateur-novice problem, and to act promptly and vigorously along the lines suggested in our previous editorial, if ever such a movement is started in the community in which they reside.

Ouch!

WE amateurs have had many things blamed upon us but nothing quite so funny as came the way of Canadian General Manager Duncan during the ill-starred Trans-Canadian Relay of late March. We've been accused of causing all the funny noises that broadcast listeners hear in their phones, from static to leaky arc-light circuits, from howling amplifiers to noisy B batteries. But we are used to that—those are tangible things, definite, capable of examination and correction. When something happens like befell Mr. Duncan we don't know quite what to do.

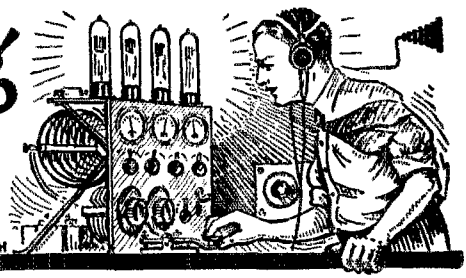
The thing that squashed the first attempt of the Canadians to relay from coast to coast was a peculiar atmospheric condition that put a blanket on reception and made it impossible to get any signals from greater distance than in daytime—aurora phenomena, in other words. As a result, of course, there was no DX broadcast reception. In Toronto some of the B.C.L.'s heard that the amateurs were trying to run a test, and when they found the air so dead they promptly rang up Director Duncan and threatened to have all sorts of dire things done to him if he didn't instruct the Canadian amateurs to turn on the phone sigs and stop hogging the air for their own uses.

Hellup! But you've got the wrong number, operator—give old Dame Nature a buzz.



The Operating Department

F. H. SCHNELL, Traffic Manager
1045 Main St., Hartford, Conn.



8ZD holds the greatest honor the Operating Department can bestow upon any amateur station. This honor was rightfully gained because 8ZD has established a record of handling 2855 messages in one month—something no one ever dreamed of even in this modern day. Six operators pounded the key in turn with the result that 8ZD was on the air practically every hour of the day and night. Much credit is due F.B. Westervelt, "WX", and we hope this may be some remuneration for the twenty pounds of flesh he lost in being the most consistent operator.

Wiggin & Westervelt (8ZD)
Pittsburgh, Pa.
Atlantic Division
2855 messages

Official A.R.R.L. Amateur Broadcasting Stations

Feeling the need for a definite means of distributing up-to-the-minute news regarding tests, etc., the Operating Department is selecting about 125 of our best amateur transmitters who will broadcast these news items. All Official A.R.R.L. Broadcasting stations will broadcast every Saturday and Sunday at 12:01 A.M. local standard time. These stations will cover the entire country—so if you want to keep posted on what is going on in amateur circles listen in at the appointed time. The first broadcast will start about May 19th-20th.—200 meters.

Message Traffic Report By Divisions.

M A R C H

Division	C.W. Stns.	C.W. Msgs.	SPARK Stns.	SPARK Msgs.	TOTAL Stns.	TOTAL Msgs.
Atlantic	234	35156	26	3185	260	38341
Central	236	37143	47	5165	283	42308
Dakota	73	7664	12	427	85	8091
East Gulf	40	3503	7	1001	47	4504
Midwest	96	15831	19	4966	115	20797
New England	109	17917	9	424	118	18341
Northwestern	50	3426	6	146	56	3572
Ontario	37	2141	—	—	37	2141
Pacific	56	4506	11	628	67	5134
Roanoke	48	4991	4	421	52	5412
Rocky Mountain	28	3792	4	158	32	3950
Vancouver	9	454	—	—	9	454
West Gulf	48	6454	5	252	53	6706
Winnipeg	7	341	1	8	8	349
Total	1071	143319	151	16781	1222	160100

C.W. Messages, 143319—89%
Spark Messages, 16781—11%

Two new appointments were made during the month. Bird B. Bliss, Jr. (7ZN) 417 Bannock St., Boise, Idaho, takes over the management of the Northwestern Division while B. W. Cochran (4EB) Palmetto, Ga., becomes manager of the East Gulf Divsion. Both men were selected by a majority vote, cast by A.R.R.L. Members in the respective divisions. Lest ye forget; we urge the cooperation *of every man in lending his best efforts towards* the promotion of affairs under his new manager.

In the desire to conserve space because of this splendid antenna number of *QST*, brass pounders having at least 300 messages to their credit were not listed individually. There were so many of them that only those having not less than 400 could be listed.

TRAFFIC REPORTS FROM A.R.R.L. OFFICIAL RELAY STATIONS

CENTRAL DIVISION—C.W.: (Ohio) 8GZ, 1570; 8IJ, 1068; 8CYT, 857; 8BEN, 843; 8CWP, 780; 8BNH, 675; 8BDO, 570; 8FT, 463; 8ANB, 431; 8YBO, 410; 8BVR, 363; 8IIR, 362; 8CJZ, 350; 8AJX, 344; 8QK, 331; 8CXW, 322; 8AIZ, 321 8FU, 317; 8SM, 310; 8CGX, 258; 8CKV, 244; 8BZQ, 240; 8BYN, 237; 8BWA, 232; 8CYU, 189; 8EB, 186 8BXX, 183; 8AIK, 182; 8BXH, 180; 8BWB, 163; 8TJ, 147; 8BFQ, 142; 8DAG, 137; 8CWC, 127;

8AVT 120; 8CBX 108; 8AA, 104; 8BWK, 104 8BOZ, 95; 8TT 92; 8AER 90; 8AXT 88; 8HN 86; 8PD 86; 8CMY 75; 8CXP, 72; 8UC, 72; 8ES, 71; 8CRC, 68; 8CMI, 66; 8BKO, 64; 8BHY, 59; 8AWN, 58; 8AZH, 56; 8CAB, 55; 8BNZ, 49; 8BIU, 37; 8CXX, 31; 8BFB, 29; 8WY, 19; 8AVM, 18; 8BBH, 16; 8DDE, 2; (Illinois) 9MC, 616; 9CLZ, 508; 9DQU, 504; 9BYX; 488; 9CDU, 411; 9CTF, 382; 9DWF, 372; 9CTF, 364; 9YM, 364; 9DVW, 359; 9DPV, 350; 9BJT, 330, 9AJH, 328; 9AUS, 253; 9BHD, 250; 9CFK, 210; 9DYN, 201; 9ET, 201; 9OS, 178; 9DLR, 175; 9CZL, 162; 9BAH, 159; 9DCR, 153; 9BQW, 150; 9UU,

BRASS POUNDERS' LEAGUE

Call	Msgs.	Call	Msgs.
8ZD	2855	9CVO	538
3XM	2146	2BMR	537
*9AOJ	1948	8NB	532
3ZO	1808	9AZA	527
8GZ	1570	8AGO	525
1BAN	1227	8ALF	524
5KP	1184	**8BDA	514
1CPN	1124	9CLZ	508
*9AAW	1086	9UH	506
8IJ	1068	9DQU	504
1BYN	1011	9CMK	501
6ZZ	871	7AFW	496
*9BMN	871	5XAJ	484
1MY	858	3BIT	480
8CYT	857	8FT	463
8BEN	843	*9AHQ	447
8CEJ	843	1CBP	446
**2OM	785	1CJR	442
3SU	780	3AAY	437
8CWP	780	9APS	436
2CPK	757	9BYX	433
8AVD	750	8ANB	431
*9EFC	731	9DTA	431
3ADX	724	3WF	426
8BJS	708	*9DAY	426
8CEI	701	8ZF	425
9OX	678	9DGV	425
8BNH	675	1CPI	420
1BOQ	661	6ZH	415
8AUE	631	8ADH	415
9MC	616	9CDU	411
3APR	580	8BYO	410
8BDO	570	8COO	410
9AMB	539		

(**) Spark and C.W.
(*) Spark

146; 9AWQ, 145; 9AIH, 136; 9CHF, 130; 9DVL, 120; 9CKP, 116; 9BUH, 113; 9CEB, 109; 9BTA, 107; 9CMN, 104; 9EJ, 90; 9ALW, 90; 9EFW, 88; 9AQA, 79; 9CMC, 74; 9WX, 62; 9BIL, 62; 9ASD, 61; 9DXL, 60; 9EAC, 57; 9BIZ, 53; 9DZG, 53; 9DC, 52; 9BIJ, 46; 8BHX, 45; 9BGO, 40; 9DDY, 40; 9BXD, 31; 9AMS, 27; 9DG, 23; 9PE, 12; 9BZQ, 23; 9CWG, 20; 9ACW, 14; 9AFN, 13; 9DJO, 10; 9CXT, 10; 9FW, 9; 9BIT, 6; 9BWA, 5; 9DGA, 4; 9DWS, 4. Michigan; 8ZF, 425; 8CAA, 381; 8YN, 382; 8CED, 814; 8CF, 272; 8BGT, 228; 8CGJ, 200; 8JJ, 186; 8BCY, 167; 8BXA, 158; 8ATX, 122; 8BWY, 120; 8ZZ, 116; 8KH, 87; 8BZY, 86; 9CE, 76; 8DAT, 73; 8CP, 69; 8CBO, 57; 8OM, 58; 8AZG, 51; 8BGQ, 47; 8ZAG, 41; 9BOH, 41; 8BYF, 39; 8BBJ, 36; 8DI, 36; 9DRR, 30; 8BGJ, 29; 8AND, 26; 8BDR, 24; 8AGG, 18; 8CF, 18; 9DWR, 10; 8KI, 5; 8BGO, 5. Wisconsin; 9AZA, 527; 9CM, 305, 9AZN, 248; 9CZY, 207; 9DIO, 155; 9CHK, 136; 9EEY, 125; 9ATO, 117; 9AFK, 115; 9AKY, 114; 9DCT,112;9CVI,83;9AAP, 75; 9BKC, 66; 9EAR, 60; 9ZY,42; 9CKW, 41; 9CWR, 33; 9ALG, 30; 9EIL 27; 9ARC, 24; 9BCH, 23; 9CSX, 20; 9BHQ, 20; 9BAC, 20; 9CZF, 18; 9CHE, 15; 9AMQ, 15; 9DPR, 11; 9CJI, 10; 9BVA, 9; 9EGH, 8; 9PN, 7. Kentucky; 9OX, 678; 9APS, 436; 9ASE, 350; 9LH, 310; 9EP, 150; 9DRI, 115; 9AWF, 107; 9AMH, 104; 9EI, 50; 9ARU, 30; 9ZI, 26; 9CEN, 10; Northern Indiana; 9CTE, 340; 9BOP, 148; 9DGX, 86; 9PC, 52; 9BBI, 16; 9AKD, 8. Southern Indiana; 9BRK, 337; 9DCB, 232; 9BJR, 230; 9YT, 196; 9BDB, 160; 9CYW, 146; 9BVZ, 120; 9UR, 114; 9AMO, 108; 9BGW, 102; 9ARR, 68; 9BVP, 46; 9DIS, 43; 9DYU, 30; 9ALP, 26; 9AQJ, 26; 9EJT, 15; 9DWM, 6; 9BJY, 6; 9BQR, 4. SPARK; Ohio; 8BYO, 236; 8CNR, 128; 8CVD, 119; 8CNL, 74; 8PU, 51; 8BBY, 41; 8EB, 25; 8AHY, 20; 8BHY, 2. Illinois; 9AAW, 1086; 9AHQ, 447; 9DAY, 426; 9NQ, 381; 9CA, 323; 9BLU, 301; 9DHZ, 240; 9DZU, 152; 9AZF, 143; 9CZL, 97; 9ASL, 36; 9BDF, 35; 9DHD, 26; 9ANH, 23; 9ABH, 18; 9CGV, 10; 9AIJ, 7. Wsconsin; 9FI, 97; 9DHG, 86; 9DMG, 37; 9CCF, 35; 9DLN, 14; 9YAC, 10; 9BQG, 9; 9DXT, 8; 9AHU, 3; 9CYL, 2; 9BMU, 2. Northen Indiana; 9CP, 2. Southern Indiana; 9AGG, 95; 9AUC, 81; 9BEC, 79; 9AZE, 68; 9PD, 27; 9YJ, 27; 9CIC, 26; 9BTJ, 15.

DAKOTA DIVISION—Minnesota; C.W.: 9ABB, 86; 9DAF, 186; 9AOR, 112; 9BAF, 191; 9BAV, 16; 9CMJ, 137; 9DCC, 10; 9DUQ, 17; 9GW, 142; 9EA, 14; 9ZC, 138; 9COF, 19; 9APW, 251; 9AUA, 178; 9BTI, 180; 9BKJ, 126; 9CIP, 110; 9DPX, 104; 9ASK, 38; 9ASN, 28; 9MO, 32; 9AUX, 11; 9BRC, 20; 9BVY, 130; 9BKP, 391; 9DMA, 153; 9CBW, 69; 9CAL, 51; 9DSW, 232; 9BXB, 46 9EKR, 6; 9EGG, 103; 9CDR, 20; 9CDP, 13; 9QF, 150; 9BBF, 150; 9CPQ, 168; 9CIT, 33; 9AJV, 35; 9CVV, 25; 9COC, 52; 9AQV, 26; 9AWO, 5; 9BOV, 13; 9ZT, 308; 9DGV, 425; 9BTL, 86; 9BKW, 117; 9BPP, 5; 9DAW, 105; 91G, 135; 9DGN, 22; 9AWS, 100; 9DGE, 263; 9BLY, 5; 9AUL, 26;. North Dakota; C.W.: 9GK, 26; 9AHC, 52; 9ADZ, 23; 9DLF, 48; 9BFQ, 22; 9ABU, 321; 9UH, 506; 9AEJ, 16; South Dakota; C.W.: 9CGA, 305; 9BRI, 188; 9AVZ, 181; 9CXV, 164; 9YW, 72; 9DKQ, 70; 9ASF, 56; 9DDP, 34; 9PI, 14. SPARK: Minnesota; 9ZC, 78; 9EAU, 22; 9FH, 8; 9EGF, 15; 9XT, 45; 9DAG, 40; 9DGW, 17; 9BPN, 11; 9DYZ, 5; 9CRW, 12; 9BPQ, 58. South Dakota; 9BOF, 121.

EAST GULF—C.W.: 4JK, 89; 4FQ, 23; 4FD, 19; 4BW, 18; 5ZAS, 140; 5XA, 51; 4AG, 193; 4FG, 85; 4PD, 96; 4YA, 318; 4HW, 312; 4MB, 275; 4CY, 115; 4EH, 84; 4EQ, 75; 4KU, 58; 4BG, 55; 4ME, 54; 4GZ, 35; 4BI, 25; 4LE, 20; 4JL, 25; 4DN, 6; 4AZ, 5; 4FD, 19; 4EB, 316; 4FS, 220; 4JZ, 62; 4NU, 82; 4JI, 2; 4MT, 21; 4IW, 16; 4JY, 12; 5ADE, 98; 5UP, 67; 5AGJ, 52; 5ADS, 10; 4EL, 364; 4BY, 10; SPARK: 4FB, 247; 4GN, 170; 4FD, 95; 5XA, 28; 4DF, 206; 4HS, 180; 4MY, 75.

MIDWEST DIVISION—C.W.: Iowa; 9FK, 388; 9AEQ, 265; 9BZI, 260; 9DXC, 242; 9ATN, 227; 9BGH, 200; 9BGI, 242; 9EDB, 180; 9CHN, 212; 9CIQ, 171; 9CXP, 159; 9BZE, 138; 9BVL, 150; 9BXC, 130; 9BXJ, 102; 9HK, 69; 9ARZ,55;,9DBL 47 9AMI, 130; 9BXJ, 102; 9HK, 69; 9ARZ, 55; 9BGT, 9BGT, 46; 9UL, 54; 9BDR, 50; 9BAL, 35; 9AE, 35; 9BFG, 37; 9BIF, 29; 9EER, 12; 9DMH, 9. Nebraska; 9ANF, 80; 9AEC, 90; 9BDU, 147; 9DTU, 22; 9CIM, 86; 9DXY, 157; 9VE, 21; 9JK, 79; 9CPB, 302; 9DSM, 35; 9CMK, 501. Kansas; 9CFI, 263; 9DEF, 4; 9CCV, 206; 9CLW, 311; 9DTA, 431; 9AEY, 66; 9CKM, 266; 9CVT, 10; 9ANQ, 10; 9AOG, 372; 9EHT, 180; 9AOD, 173; 9DSD, 52; 9CCS, 368; 9CAC, 323; 9CPY, 48; 9DPD, 81; 9CJE, 204; 9BZZ, 164; 9BHJ, 81. Missouri; 9CVO, 538; 9BDS, 356; 9BLG, 316; 9BWR, 311; 9DXK, 308; 9BKK, 285 9AYL, 246; 9CTG, 357; 9CEE, 238; 9PW, 234; 9CKS, 203; 9EKF, 191; 9BED, 187; 9AON, 139; 9BJC, 150; 9DLT, 147; 9DXN, 132; 9BJB, 123; 9YM, 67; 9BOZ, 55; 9CRR, 53; 9CXO, 47; 9AAU, 49; 9BHI, 48; 9CGK, 45; 9NU, 45; 9VB, 25; 9DZY, 62; 9EQ, 55; 9DMJ, 15; 9CHJ, 12; 9BZH, 9; 9AQZ, 6; 9ACB, 4. SPARK: Iowa; 9BRS, 40; 9CS, 10; Nebraska; 9DNC, 215; 9ASO, 147; Miissouri; 9AOJ, 1948; 9BMN, 871; 9EFC, 731; 9DAE, 323; 9BCJ, 185; 9EFB, 109; 9DCW,

85; 9RR, 69; 9DMJ, 60; 9AQB, 45; 9DZY, 45; 9AUK, 35; 9ACB, 19; 9CUF, 15; 9BZH, 14.

NEW ENGLAND DIVISION—C.W.: 1AQU, 30; 1BGD, 11. 1OW, 40; 1GV, 304; 1CMP, 203; 1ATY, 40; 1II, 324; 1ALZ, 99; 1BQD, 304; 1CSW, 143; 1ABC, 25; 1CAB, 96; 1CBP, 446; 1BVB, 382; 1CR, 35; 1FD, 40; 1CBS, 83; 1BAG, 107; 1TL, 302; 1VK, 103; 1BOQ, 661; 1CQZ, 15; 1BMS, 35; 1UJ, 55; 1BFE, 388; 1AYQ, 156; 1AGH, 39; 1AJP, 34; 1AVW, 82; 1IV, 306; 1EX, 5; 1BIY, 254; 1KV, 145; 1AP, 79; 1AW, 156; 1WC, 325 1MY, 858; 1BK, 103; 1BFI, 12; 1CJZ, 326; 1CKP, 258; 1AWB, 150; 1FY, 305; 1QP, 239; 1CPN, 1124; 1BAN, 1227; 1BYN. 1011; 1JR, 442; 1CPI, 420; 1BVH, 342; 1RV, 189; 1LK, 29; 1SN, 100; 1SK, 152; 1CNI, 144; 1BKQ, 167; 1BVR, 222; 1AWW, 148; 1CMK, 126; 1BSJ, 104; 1ABF, 70; 1IL, 68; 1CHP, 61; 1AOT, 55; 1VC, 54; 1CGR, 51; 1BLN. 41; 1AOJ, 34; 1CHJ, 31; 1ARF, 16; 1BSZ, 3; 1AJX, 2; 1BMP, 19; 1AQM, 39; 1CIT, 92; 1AST, 37; 1BNP, 40; 1CPI, 240; 1CBJ, 166; 1CAK, 91; 1BDU, 165; 1AIR, 39; 1BBM, 4; 1AED, 25; 1TV, 149; 1CJD, 217; 1ADN, 178; 1AAC, 92; 1COT, 160; 1CJH, 48; 1ARY, 57; 1AIQ, 1BAS, 150; 1CKQ, 126; 1BQL, 86; 1BNL, 22; 1UL, 18; 1BRQ, 300; 1CRU, 69; 1BDI, 135; 1CDO, 213; 1IT, 76; 1CTP, 12; 1ALI, 72; 1EE, 8; 1BQ, 14; 1BID, 12; 1BJS, 12; 1ZE, 167. SPARK: 1BRQ, 5; 1ACO, 10; 1APT, 4; 1CIB, 41; 1CGU, 44; 1ARY, 20; 1AED, 61; 1LZ, 7; 1CNI, 232.

NORTHWESTERN DIVISION—C.W.: 7GE, 332; 7NA, 318; 7WM, 181; 7ABB, 184; 7EQ, 151; 7AIF, 166; 7HJ, 125; 7AFH, 111; 7AFO, 133; 7LN, 104; 7ZN, 103; 7JG, 102; 7BJ, 92; 7GP, 83; 7AIM, 79; 7ACA, 71; 7WS, 69; 7KF, 60; 7AK, 53; 7NE, 110; 7LR, 162; 7PE, 46; 7AIC, 45; 7DC, 58; 7NF, 42; 7ZL, 76; 7ZU, 47; 7SC, 34; 7AGF, 32; 7OE, 25; 7OO, 26; 7ADP, 26; 7KJ, 30; 7AEL, 21; 7MH, 21; 7AHI, 19; 7ADQ, 14; 7QN, 14; 7CG, 12; 7HM, 18; 7TQ, 48; 7RI, 10; 7ADF, 10; 7OZ, 8; 7JF, 10; 7ADR, 5; 7AJV, 3; 7GH, 3; 7IO, 2; 7NG, 10. SPARK: 7AIO, 58; 7EX, 29; 7WD, 21; 7YM, 20; 7LR, 13; 7BG, 6.

ONTARIO DIVISION— 3CO, 32; 3JT, 40; 3DE, 96, 3SX, 69; 3SI, 108; 3GH, 36; 3PG, 7; 3OH, 50; 3FO, 30; 9BJ, 66; 9CD, 10; 9BU, 20; 9AJ, 90; 9BX, 25; 3KO, 111; 9BS, 7; 3BV, 8; 3UJ, 40; 3ADN, 57; 3LP, 1; 3ACY, 8; 3XN, 52; 3DH, 83; 3GH, 51; 3NI, 202; 3HE, 48; 3IL, 25; 3OY, 41; 3HG, 139; 3YH, 27; 3JL, 26; 9AL, 216; 3IN, 40; 3XX, 115; 3TL, 113; 3KP, 32; 3BS, 16; 3OE, 4.

PACIFIC DIVISION—C.W.: California; 6ZH, 415; 6EC, 28; 6IV, 76; 6ANH, 50; 6BJU, 6; 6BJY, 30; 6NX, 25; 6LU, 106; 6ZX, 56; 6AK, 40; 6AOI, 157; 6BPL, 35; 6SU, 56; 6AAJ, 24; 6BUA, 41; 6ABK, 40; 6VK, 71; 6CC, 210; 6TC, 10; 6BTZ, 12; 6UW, 24; 6XAS, 79; 6BOD, 42; 6GD, 30; 6BH, 116; 6OL, 22; 6AAK, 226; 6XK, 88; 6BUN, 59; 6OM, 103; 6KA, 136; 6BQG, 42; 6BVF, 20; 6BVW, 50; 6BQR, 10; 6BWE, 40; 6BMC, 3; 6BQY, 8; 6CU, 73; 6BQD, 12; 6BMO, 10; 6BQC, 8; 6BEG, 65; 6BEQ, 12; (6ZAO) 6EN, 50; 6EF, 31; 6AWX, 140. Nevada; 6BIP, 98; 6AJR, 40; 6ZO, 18. Arizona: 6ZZ, 871; 6BSQ, 302; 6CAJ, 137; 6BBH, 46; 6BPI, 14; 6GS, 18. SPARK: California; 6BJU, 45; 6TU, 61; 6AMK, 68; 6BAE, 76; 6BAJ, 82; 6BRA, 55; 6OD, 74; 6OL, 2. Nevada; 6QR, 76. Arizona; 6ZZ, 30; 6AAH, 60.

ROANOKE DIVISION—C.W.: 3APR, 580; (3BLF-3ZP, 303) 3CA, 169; 3BMN, 315; 3XAL, 166; 3BVC, 150; 3TJ, 133; 3BUY, 117; 3MO, 80; 3RF, 52; 3CEL, 51; 3BFE, 50; 3ATS, 45; 3BHL, 37; 3BVL, 35; 3ZZ, 32; 3AFW, 31; 3AUU, 28; 3BZ, 20; 3ATB, 12; 3ZAA, 12; 3BIY, 8; 3HL, 7; 3AOT, 5; 3IW, 4; 3SG, 3; 3BCH, 2; 4LJ, 163; 4GG, 5; 4NV, 72; 4DC, 75; 4AF, 17; 4ZI, 2; 4KC, 48; 4MW, 3; 4GW, 12; 4MI, 2; 8AUE, 631; 8AQV, 285; 8BPU, 234; 8SP, 166; 8AFD, 60; 8ATC, 135; 8BDB, 105; 8CQH, 50; 8ZW, 111; 8BDA, 227; 4OI, 141. SPARK: 4MV, 34; 8BDA, 287; 8TH, 100.

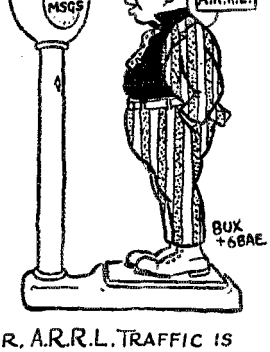
ROCKY MOUNTAIN DIVISION—C.W.: Wyoming: 7DH, 195; 7AFW, 496; 7ZV, 140; 7LU, 160; 7ZO, 73. Utah; 6BOE, 157; 6RM, 18; 6ZA, 12; 6ZM, 14; 6ZT, 118; 6ATQ, 47. Colorado; 9AMB, 539; 9DTM, 319; 9EKH. 225; 9BUN, 217; 9BJI, 200; 9DTE, 123; 9CJY, 107; 9CAA, 107; 9DHI, 90; 9BXM, 84; 9BXA, 83; 9FV, 82; 9BVO, 63; 9CFY, 54; 9BJK, 40; 9BXQ, 15; 9CDE, 14. SPARK: Utah; 6AWH, 42; 6BUH, 4; 6APL, 87; 6BKE, 25.

VANCOUVER DIVISION—C.W.: 5GO, 187; 5EJ, 30; 5CN, 15; 5AK, 15; 5CT, 88; 4DQ, 56; 4AB, 6; 4CW, 1; 9BP, 58.

WEST GULF DIVISION—C.W.: Oklahoma; 5XT, 100; 5KE, 130; 5ZAT, 30; 5ZM, 10; 5BM, 75; 5HM, 68; 5IA, 60; 5ZG, 10; 5VM, 20. Texas; 5VA, 140; 5JL, 120; 5IX, 315; 5ACQ, 75; 5AL, 12; 5LM, 307; 5UN, 4; 5EL, 183; 5UO, 82; 5CY, 61; 5ZADA, 50; 5XAJ, (330) (154) 5NS, 127; 5ZH, 197; 5HZ, 147; 5ZX. 12; 5NN, 84; 5AE, 62; 5PB, 26; 5JM, 20; 5NK, 142; 5ACF, 25; 5IM, 167; 5VY, 102; 5KP, 1184; 5TM, 315; 5RN, 52; 5JT, 68; 5YK, 14; 5ZAK, 88; 5ZAE, 15; 5VO, 20; 5MT, 10; 5SS, 106; 5KG, 30; 5AEW, 14; (5JZ-ex 5FA, 68) 5ADB, 121. SPARK: Texas; 5HY, 50; 5TU, 168; 5AJT, 3; 5KX, 25; 5ADI, 6.

WINNIPEG DIVISION—C.W.: Manitoba; 4CN, 36; 4DK, 64; 4CJ, 5; 4CE, 8. Saskatchewan; 4HH, 109; 9BX, 92; 4BV, 27. SPARK: 4FZ, 8.

ATLANTIC DIVISION—C.W.: Northern New Jersey: 2FC, 26; 2CQZ, 302; 2BTE, 20; 2CRW, 118; 2CQO, 58; 2EX, 74; 2AJA, 50; 2AJF, 32; 2CXE, 30; 2CUI, 16; 2RZ, 10; 2ALY, 67; 2BGI, 137; 2WR, 23; 2AXF, 71; 2AFA, 325; 2BNZ, 40; 3AQX, 10; 3FP, 102; 2BMR. 537; 2BKJ, 23; 2BON, 33; 2CHG, 2; 2CUV. 18; 3XM, 2146; 3BDT, 9; 2OF, 25; 2BTE, 20; 2BJP, 30; 2CGK, 10; 2BUY, 169; 2ARS, 40; 2AWL, 48; 3BLZ, 17; 2CQI, 155; 2AFC, 117; 2AZY, 212; 2AYV, 65; 2BVH, 56; 2BME, 5; 2AFP, 134; 2LE. 54; 2CGS, 47; 2BFE, 45; 2CKL, 42; 2ACD, 115; 2BBB, 91. (Southern New Jersey) 3BEI, 72. (Eastern New York) 2BBM, 20; 2CSL, 111; 2CPO, 130; 2CHK, 70; 2BNL, 40; 2CNK, 27; 2AQL, 9; 2VV, 6; 2BQU, 50; 2NZ, 210; 2ACZ, 166; 2IG, 12; 2MX, 14; 2ABQ, 20; 2PV, 144; 2AWF, 114; 2AJW, 25; 2BLP, 183; 2BRC, 45; 2AWS, 237; 2CGT, 153; 2CUF, 40; 2BJO 180; 2CPK, 757; 2AUY, 111; 2VH, 71; 2CIM, 51; 2CEI, 107; 2CNH, 12; 2ASU, 3; 2BWA, 132; 2BCK, 15; 2AVE, 26; 2HW, 22; 2ANM, 19; 8TB, 35 8AOT. 4; 2CJR, 208; 2CCD, 165; 2CGY, 106, 2CFE, 90; 2HV, 75; 2BWR, 60; 2AUC, 40; 2KE, 28; 2CHQ, 16; 2PE, 6; 2CWO, 4; 2BO, 4; 2BRB, 12; 2CLA, 85; 2CFA, 26; 2CHY, 60; 2CGT, 153. (Western New York) 8CNV, 6; 8BZU, 3; 8BCP, 33; 8AZO, 57; 8AIW, 42; 8TC, 18; 8ATR, 180; 8NB, 532; 8CUU, 108; 8KS, 7; 8CTN, 370; 8BQA, 261; 8BOE, 235; 8AXN, 182; 8ASL, 60; 8BUX, 13; 8AVD, 750; 8ADH, 415; 8COO, 410; 8ACM, 306; 8DAA, 150; 8BOA, 120; 8BHF, 177; 8AOS, 46; 8BFV, 20; 8AWP, 130; 8BNY, 84; 8BUM, 40; 8CLW, 3; 8COI, 46; 8CQL, 22;,8AXI, 6; 8DPW 15; 8BJS 708; 8XAW 265; 8BXT, 78; 8HJ, 140; 8ASK, 2. (Western Penna.) 8BUT, 51 8AGY, 8; 8XG, 171; 8CEJ, 848; 8BDU, 131; 8OW, 4; 8BRM, 125; 8AGO, 525; 8CJY, 82; 8CFB, 12; 8CQX. 61; 8BRL, 190; 8AIO, 358; 8ALF, 524; 8CEI, 701; 8CI, 48; 8AAF, 389; 8VQ, 186; 8BJV,



MR. A.R.R.L. TRAFFIC IS GETTING HEAVY

349; 8ZD, 2855; 8AIG, 56; 8UT, 136; 8ALT, 126; 8CLE, 6; 8AZQ, 227; 8QC, 144; 8AG, 11; 8VH, 10; 8AGR, 264; 8RC, 5. (Dist. of Col.) 3AB, 262; 3BWT, 136; 3HS, 206; 3BGJ, 30; 3KM, 39; 3PZ, 236; 3SU, 780; 3BSB, 89; 3BHM, 18; 3JJ, 89; 3IL, 29; NOF, 50. (Delaware) 3BSS, 19; 3AIS, 18. (Baltimore) 3WF, 426; 3FQ, 133; 3APT, 51; 3MF, 56; 3GZ, 30; 3GL, 20; 3HG, 234; 3BKS, 18; 3EM, 23. (Eastern Penna.) 8CDI, 96; 3AWH, 56; 3BLU, 48; 3ADX, 724; 3BTL, 103; 3BSF, 100; 3ADP, 137; 3ADQ, 240; 3BNU, 220; 3LK, 61; 3JG, 14; 8CTZ, 12;3BLP, 60; 3EK, 4; 3ZO, 1808; 3AUV, 152; 3CBT, 16; 3AIC, 90; 3MB, 84; 3CCU, 297; 3ACY, 202; 3BRF, 156; 3BIT, 480; 3CCX, 21; 3CX, 59; 3AAO, 258; 3AAY 437; 3ARP, 224; 3BGG, 42; 3BQ, 11; 3KD, 38; 3BUT, 31; 3VW, 43; 3BJY, 117; 3OE, 109; 3DS, 14; 3QV, 90; 3AWA, 86; 3FS, 45; 3HD, 28. SPARK: (Northern New Jersey) 2CJX, 253; 2SQ, 216; 2BQZ, 112; 2CJA, 221; (2OM, 785; Spk. or C.W.) 2BK, 42; 3JL, 10; 2AER, 80; 2AWZ, 68; 2JG, 16; 3BLZ, 11; 2CAD, 19; 3CS, 28; 3FP, 68; 2CJX, 253. (Eastern New York) 2DI, 112; 2BEG, 318. (Western New York) 8BUM, 24; 8TC, 126; 8AXX, 122; 8AXN, 21. (Western Penna.) 8EW, 103. (Dist. of Colo.) 3BHM, 110. (Eastern Penna.) 3QN, 2; 3BIP, 5; 3API, 50.

ATLANTIC DIVISION
Chas. H. Stewart, Mgr.

SUMMARY OF TRAFFIC BY STATES

State	C.W. Msgs.	Spk. Msgs.	Total Msgs.
Western New York	5986	293	6279
Eastern New York	4610	430	5040
Northern New Jersey	5990	2182	8172
Southern New Jersey	172	——	172
Eastern Penna.	6717	67	6784
Western Penna.	8694	103	8797
Delaware	37	——	37
Maryland	986	——	986
Dist. of Col.	1964	110	2074

Many very important changes have been made during the past month, in the fact that stations and traffic officers have reported so splendidly The most note-worthy of these happenings is the appointment as Assistant Division Manager for Western New York of a well known amateur in the person of Samuel Woodworth, 8AWP, of Syracuse, New York, to succeed Mr. Benzee who was unable to find enough time to give to the work connected with this office. In view of the fact that Mr. Potter, superintendent of the 10th New York District, has left for the west coast, we have appointed to succeed him, Alfred Marcy, 8BUM, of Syracuse, who is also well known throughout Western New York. Almost complete reports were received from every section of Northern New Jersey continuing with an unbroken record of reports for five consecutive months from every district superintendent. A record worth being proud of!

8ASL, Superintendent of the 16th New York District is deserving of mention for his continued fine reports from stations throughout his district, and the pep he injects into the fellows. 8NB sure has the fellows going F.B. 2AHM is leaving for Pasadena, Calif. 2BNZ is City Manager for Orange and East Orange, 2VH, 2CEI, 2CIM, 2BUE, 2CEC, and 2FZ are to be especially commended on their efforts in keeping the Bronx on the map, handling much DX and all local traffic for that borough. Severe weather caused a shut down of station 3CG on account of frozen rectifier jars and two fifty watters having gone west. 3XM takes the cake with a grand and glorious total of 2146 messages. The chief operator reports that this feat of handling this large number of messages was a considerable strain on the fellows and it is very doubtful if it will be tried again—at least until 3XM's operators get back to normal health.

Convention completely demoralized traffic around New York City and suburbs during that week.

We regret to announce that 2CDR our City Manager for Newark, New Jersey is moving out of that city.

8AVD, superintendent of the 11th New York District comes through with a report of 2,456 messages for that district alone. Can you imagine fellows, what our total would be if we could all report like that?

EASTERN PENNA: Reports came through in fine shape this month with a few missing from City Managers. Individual activities were not mentioned in some of the reports but a wonderful message total was lined up which proves that all stations were active.

Dist. No. 1: 3ADX came back last month after a long silence and is sure batting a high average for this month. He peeled off a 100 in one night, and has schedules with 3ZO, 3SU, 8OWP, and 1CMP. 3AKR was out last month, having had a felon on his key hand. 3AWH cracks down on traffic in daylight. 3BTL and 3BLU are doing great DX work. Chester is coming to the front with 3BSF, 3ADP, 3ADQ, and 3BIP all reporting good traffic totals.

Dist. No. 4: 3MB will blossom forth with a WONDER set and hold up a record for Reading. 3AIC reports this month for the first time.

Dist. No. 5: 3BRF makes his initial report handling Lancaster traffic. 3ACY was reported in the Canal Zone on 10 watts. 3CCU has worked every district but the sixth. 3CX is now using 50 watts replacing the 5-watt set. 3CCX and 3API continue to move Harrisburg traffic. C. R. Grim, 3BBV, is the new City Manager for Harrisburg and hands in his initial report fine. 3AAO reported in Panama, Hawaii, and ships in Pacific and Pacific Coast.

Dist. No. 6: There appears to be "dead spot" trouble in this district. Many stations not being able to work out to any advantage on either spark or C.W. 8BRE and 8XN are having considerable trouble.

PHILADELPHIA: 3KD, 3BUT, and 3VW are working DX consistently. 3QV has daylight schedules with 3AIC, 3XM, 2AZY and many others. Late reports are acceptable at the office of the Assistant Division Manager via local telephone. (Frankford 2248-W).

WESTERN PENNA.: Western Penna. feels more than proud of this month's report. The Assistant Division Manager wishes to take this opportunity of extending to each and every individual his expression of appreciation and wishes each and every one of you the best of luck. Total messages handled speak louder than words and we believe we are right up near the peak of the traffic wave.

Dist. No. 9: The ninth Penna. district has broken all records this month in message traffic. The record for handling traffic during the period goes to radio station 8ZD. The total number of messages handled at this station amounts to 2855 which certainly is a wonderful showing. The little square below will be self-explanatory.

CALL.	MSGS.
8ZD	2855
8CEI	701
8CEJ	548
8AGO	525
8ALF	524
8AAF	389
8AIO	358
8BJV	349

8AGY has had all messages handled through 8RP, who in turn has been out of business for several weeks on account of sickness. 8XG is back on the list once more with a welcome report of 171 messages. 8CEJ came back strong this month and it looks as though the old spark is gone forever at this station. 8BDU handled a total of 131 during the period and promises to tear up the ether in general next month with a new 1-K.W. set. 8OW has the same old line, still going to school and more experimenting. 8BRM sends in a report of 125 and says that is nothing much doing in Uniontown as he can't get any DX out of his bottles. 8AGO set a new record this month by handling 525. 8AGO uses 2 50-watt tubes in a self-rectifying Hartley circuit and has been heard in all states, also Canada, and was recently reported as being received QSA in the Canal Zone. 8CJY has

changed over to chemical rectified A.C. and says that this kind of power supply is the "berries" for raising them quick. 8DFB is still hard at school work and is unable to make a very large report. 8EW is still working the old rock crusher in spite of the fact that he swore off two months ago. We notice that Cramp operates his own station on Friday and Saturday mornings and spends Sunday morning at 8BRL on C.W. 8CQX has one 50-watter working and seems to be getting out fairly well but on account of heavy school operation is not consistent. 8BRL is using C.W. entirely and has a report of 190. This station is being operated by The MacChesney, Haberl, and Cramp and is operated mostly over week-end periods. 8AIO is still turning in a consistent report which goes to show that his station is one of the best in the district. Signals from 8AIO have been reported a great number of times all up and down the Pacific Coast during the past month. 8WR is still building the 200-watt CW. set. 8VN has been out of commission since the last report on account of the storm which blew down both masts. 8CI still finds time to operate now, but no permanent schedule on account of school work. 8BJV handled 349 during the period which is a new mark for this station. 8BUT handled 51 and expects to do better next month after the installation of a new counterpoise and a change in the aerial system 8AAF has taken good care of traffic in his section by handling 389 during the past month. 8CEI set a new mark this month with a report of 701. We'll bet that he certainly did get a lot of orders this month out of a pile like that. 8ALF is still handling considerable traffic at Butler in spite of the fact that he goes to school all during the week in Pittsburgh. 8VQ fell down this month having changed over to C.W. which goes as far but don't seem to raise as many as the I.C.W. 8AIG has been having considerable trouble with his antenna and counterpoise system and consequently did not handle a great amount. 8UT came in at the last moment with a report and that is about all we know.

Several months ago a meeting was called at 8ZD for the purpose of getting together licensed radio amateur operators for the sole purpose of hamfesting and nothing else. From the first meeting on, the membership has increased until we had, at our last meeting a total of 37 present. Meetings are held every two weeks and all of the licensed radio amateur operators of the ninth Penna. district are eligible to attend.

DISTRICT OF COLUMBIA: More stations are being lined up for traffic which gives the message total a push this month.

No one can touch the throne of 3SU which he hangs a little higher each month. The majority of the good stations though, have uttered their disgust at the great number of "Thanks for Card" and Pse QSL" messages that constitute 75% of the traffic. Several antennas came down during an ice storm recently but are all back again, excepting 3ALN. 3BHM blew his 50-watter and has been operating a spark to keep things going.

DELAWARE: There is very little activity in this state. Practically all the traffic is handled by 8BSS and 3AIS. Traffic could have been greater had 3AFB been on the job, but this could not be helped as he has evening employment which takes away from his radio operating during the DX hours.

MARYLAND: There is little activity in this state with the exception of Baltimore going strong as can be expected. Owing to the co-operation of the best stations with the B.C.L.'s the early evening traffic has been completely discontinued, however, a few stations still persist in doing DX work before 10:30 P.M. and it makes it hard for the regular to crawl from under the blame.

The stations making the best showing are: 3WP, 3FQ, and 3HG, although 3MF will follow close next month. Two more stations may be added to the list next month in 3BCK and 3XX, a 10 and 20-watt C.W. set, respectively. 3XX will undoubtedly increase power in a short time as this is a promising station.

CENTRAL DIVISION
R. H. G. Mathews, Mgr.

A bigger message total has been piled up for March than even the record breaking one of February. Illinois is running Ohio a close race, but so far, Mrs. Candler has succeeded in keeping her state in the lead. The Division Manager is getting wonderful cooperation from all the Assistant Division Managers, and from all reports, the same cooperation is being given them by the district superintendents, city managers, and relay stations.

OHIO: Dist. No. 1: 8AA is not satisfied with his 10-watt set for it has reached only to the 3 Pacific Coast states, Hawaii, and 2400 miles east of New York City. D. W. Pinkerton, 8QK, has been appointed Toledo City Manager and has lost no time in getting hold of radio affairs there. 8BEJ, spark station, has been closed by the radio inspector. When next 8BEJ gets on the air he will blossom forth with a C.W. 8BZQ sends in a fine report, while 8BIU has not even asked for an appointment but faithfully sends in his reports.

Dist. No. 2. Mr. Red. Gebhardt, 8BCE, Norwalk, Ohio, has just been appointed superintendent of district No. 2. 8IJ, one of the state's stars was off the air one week out of the four on account of sickness. He says he hasn't much time for radio because of his school studies, but he managed to handle his 1068 in three weeks.

Dist. No. 3. This district is coming along in fine shape. Akron city manager, Warden, continues to report large totals for the active Akron stations. Mr. Domizi, newly appointed city manager of Cleveland is taking hold and is getting the Cleveland stations lined up for business. 8CUR received more cards from the 6th and 7th districts than any other except the 8th and 9th. Spark fiends 8CUY and 8BXC have fallen for C.W. Akron boasts of 9 active stations doing relay work. 8CYT and 8BNH are the Akron stars in handling traffic. 8TT believes in safety first. He has a 100-watt C.W., a 50-watt fone, and the old spark for emergency in case his "bottles" expire. Painesville boasts of a new spark station with the call 8DCN.

Dist. No. 4. 8BEN heads the list in this district. 8AIZ is using C.W. entirely now and has thereby increased his message total. 8CXP is reaching out in fine shape especially to the east. 8UC is another of those that fall back on the old spark when his tubes fail. 8ANB, the Cincinnati star stations, has more than doubled his last month's total. 8DAG now operates regularly from 10 P.M. until 1A.M. every night. 8CVD is using spark but will soon be on with C.W. 8CNL is another spark station about to change over to C.W. 8CAB is doing good work but is limited as to time he can devote to radio. 8CNR is another spark station doing excellent work. 8CKX also has nearly doubled his messages handled since changing from spark to C.W. 8BDO sprung a nice surprise on us by turning in nearly 600 messages. He operates all night on Saturday nights and has regular routes on other days. 8CWC greatly increased his report over last month. He is working on schedule with several stations in daytime. 8CWR handled no traffic this month on account of being sick. 8AXH is doing fine work for the amount of time he can devote to radio after school hours. 8EB is using both C.W. and Spark and doing fine work. 8BYO has come back into the relay game and is kicking them out by the hundreds.

Dist. No. 5: 8AJX has managed to get into the 300 circle in spite of his heavy school work. 8SG holds the state championship this month. 8BYN was off the air most of the month with transformer trouble. 8AER and 8CWP are stepping out lively and handling the messages by the wholesale. 8CJZ has made an excellent start and is increasing every month.

Dist. No. 6. 8CXW is doing his usual consistent work. 8ABE is temporarily out of commission because a young tornado completely wrecked a garage which supported one of his 40 foot masts. 8CRC is stepping out in fine shape.

ILLINOIS: Dist. No. 1. Heading the list with four 300 hitters; two spark, 9NQ and 9DAY; and two C.W., 9CTV and 9VM, the March report starts off auspiciously. 9CTV has worked every district as well as twice with 6XAD.

Dist. No. 2. Not to be outdone this district has five 300 hitters: two sparks, 9CA and 9AHQ; three C.W.'s 9CTF, 9AJH, and 9BJT. 9AJH regrets that he is only on the air week-ends.

Dist. No. 3. Better and better! Headed by the district superintendent, 9MC, with 616, the third district comes through with seven brass pounders who rate 300. HEN is proud of his district. He says 16 stations, 232 messages per station, 7 of them 300 hitters, gives him 44% real hams in the district. 9MC has discarded spark and is now using C.W. exclusively.

Dist. No. 4. 9DQU romps through with 504 this month. 9DQU was reported 2400 miles east of New York City. 9CZL using an amplifier tube has worked 1BES and 3AB. Aerials are down at 9ASK and 9BIL from the severe storm of March 11th.

Dist. No. 5. 9DZG, 9DLR, and 9AUS are all working 1000 miles on a single 5-watter. 9AUS has worked 7SC, a DX of 1900 miles. 9CWV on 15 watts does 1500. 9AMS and 9PE with 50-watters are working both coasts with ease.

Dist. No. 6. There is a 300 hitter here in the person of 9DVW. 9CEB is in an ideal location if he desires traffic. He has it between Chicago and Milwaukee. 9AFN was sick and dropped from 200 to 13. 9AKU achieved distinction after the storm of March 11th. The 1CRR had a tie-up with all telegraph wires down. 9AKU and WOC proceeded to straighten out the matter. 9AKU says the OM, WOC is not the usual hard-boiled B.C. OP, and that he is one of the "ole" timers. Incidentally, 9AKU says his compensation was heavier than that given 7ZO. 9BHD almost achieved the same distinction in finding lost trains but the power went off at the critical moment.

WISCONSIN: Despite the fact that the recent storms raised particular Cain with the majority of stations in this state, traffic went on in good shape and showed a substantial increase over that of last month; with 9AZA as the star performer with 572 messages. The Wisconsin Cup was thereby awarded to K. C. Maas, (9AZA) Whitewater, Wisc. for one month.

Dist. No. 1. The stations who are consistent relay men are: 9ATO, 9CZF, 9CJM, 9AFK, 9AAP, 9DIO, 9DMG, 9DXT, 9FI, 9CII, 9CRA, 9CDA, 9CKW, and 9CCD. The storms in the past month have curtailed activities until antenna systems can be overhauled and fixed over.

Dist. No. 2. Stations doing good work are: 9AZA, 9CHE, 9EAR, 9CHK, (a long needed station at Madison) 9EGH also of Madison and 9ALG (ex-9XL), 9ALG relayed two important messages concerning the illness of a U. of W. Professor and another in locating a lost locomotive during the storm period. Other storm relays were also handled by 9AZA and 9CHK.

Dist. No. 3. Spring fever seems to have interfered quite seriously with traffic in this district. The superintendent claims he can't figure out any other reason. Lawrence College at Appleton now have 20-watt C.W. and fone. 9BHQ is assisting them. Wire service in the eastern part of the state has not been dependable lately. This was found out by inquiry and by the quality of amateur traffic. Snow and sleet caused considerable damage here. 9CZY and his 5-watter are the stars again this month. 9BHQ is changing to 50 watts. 9AMQ's masts are down and 9CJI's sockets are empty. 9BCH is tired. Hi!

District No. 4. 9EIL are the only stations outside of La Crosse doing work in this district. La Crosse is becoming known as the Master Oscillator City as most of the stations are following the example of the assistant division manager and building their sets into that circuit. 9ZY was down for a considerable time this month due to damage by the storms in this city.

Dist. No. 5. E. J. Krusel complains that the small amount of traffic handled is due to the fact that things are swinging too much to the E. F. side even good DX stations turning to B.C.L. He also complains that it is impossible to commence transmitting before 11 P.M. and most generally midnight without incurring the wrath of the B.C.L.s The B.C.L.s have even gone so far as to destroy the antenna system of one man in Duluth and threats are a common thing in the City of Superior.

NORTHERN INDIANA: Dist. No 2. Miller has sent in quite a good message total despite the small number of stations and he deserves to be congratulated on the interest that he is taking. 9BOP is a new station now in operation. 9AIU is back on the job. Traffic is going regularly through South Bend; 9CTE, and 9FP, handling the most. 9BBI will be on the job with 50 watts. 9CXZ has moved. 9DGX is another good station this month.

SOUTHERN INDIANA: Dist. No. 1. 9BRK is still high man in Southern Indiana with 337. He has gone over 300 for three months straight and on four fivers. 9DYU has opened up again on C.W. and will continue to do good work as long as the tubes last. 9DIS and 9ARR are the only stations in that part of the state. 9CIC on spark is the only active station in Seymour and when he is on 9DYU and 9AMO at Columbus 20 miles away) have to QRX. The recent high winds brought down the aerial at 9DXE and the tower at 9ASJ.

Dist. No. 2. Mr. Kriel the newly appointed district superintendent of district No. 2 is getting along fine and has uncovered several stations in Terre Haute. A daylight route is in working order from Indianapolis to Greencastle (9YJ) and Terre Haute. 9AQJ and 9NH are the stations in Terre Haute. 9BGW, 9BJR, 9UR, 9BVZ, and 9BVP are doing fine work in Indianapolis.

Dist. No. 3. 9AMO has increased his power to 20 watts. 9CYW, 9BDB, and 9AGG are doing the best work in Richmond. 9PD the Richmond city manager is acting district superintendent until one can be appointed.

MICHIGAN: C. E. Darr, assistant division manager, has been quite sick since the Flint Convention, but is improving. 8ATX is doing fine DX receiving, sixes and sevens are easy meat. 8JJ is increasing his power to ¼ K.W. 8YN handled 75 messages in one day during the past month. 8ZZ has been relaying police reports direct to Hartford, 1AW-1MO each evening at 6:45 8KH using only 20 watts has been getting out in fine shape having worked 6XAD a number of times and has handled a good message total.

Dist. No. 1. This month brings the highest number of messages yet handled by the 1st district, 1574, this is due to the very good cooperation of the stations in the district, especially in getting in their reports, even now all are not in, but this will make a good boost for the Michigan totals for the month.

In the recent district No. 1 tests on Sunday, February 18th, it was possible to make a favorable report for the same reason outlined above —cooperation among the stations. Each station was checked from the office of the district superintendent. The trouble and time taken to arrange this test and assign time etc. was well re-paid. The wave of each was measured at this station and the information delivered to the transmitting station together with hearty thanks for their fine cooperation.

Ann Arbor shows up in the lead this month. There are a number of good stations there and much message traffic from students. The total from Ann Arbor runs very high and has made possible the large total for this month. 8BGT handled a good number. 8CF reports working every district in one morning and a card from the Canal Zone. 8CAA puts nearly three amperes into the antenna at present and does some fine DX. 8CBO has schedules with 8ATN in daylight. Many daylight schedules are now in operation and more details available next month. Flint (8AGG) works with 8BGT and 8AND arranging daylight tests with 8DI, 8KI, and

8BBJ. We believe this summer most all traffic will be daylight, either morning or noon, especially the early morning.

DAKOTA DIVISION
N. H. Jensen, Mgr.

All districts and practically all stations reported this month which is greatly appreciated by the division manager. Traffic again increased 20% over the previous month. 9UH grabs the honors with 506 messages.

MINNESOTA: Dist. No. 1. Superintendent Wagner reports the largest volume of traffic since the organization of the district, and states that every relay station sent in a report. 9ADF, 9GW, and 9DUQ are clearing in all directions, and 9BAV and 9BAF are on the job night and day. 9ZC worked Canadian 9BX quite often for Pacific Coast traffic and also reports that he has a daylight schedule with 9EAU and that he is trying for a new route to Duluth via 9BOH. 9AOR maintains regular schedule with 9ZC to the north and 9BAF to the south. There is now a fine north and south route right through the center of Minnesota running in steps, and at times direct, from the Twin Cities to Brainerd to Pequot and thence to Baudette. 9CMJ is on regularly with 50 watts. 9EAU has regular schedule (daylight) with 9EGF, and 9FH is on again with more traffic than ever. 9ABB will be going with 50 watts soon and hopes to get things moving through Clarissa again. 9DCC has been heard from and 9EGU reports he has established communication with 9BCC.

Dist. No. 2. Assistant division manager, Don C. Wallace reports that all stations have turned in substantial reports this month. 9ZT has worked Pacific Coast stations on 19 out of 21 nights in operation. Radiation is 10 amperes on 200 meters and 6 amperes on 100 meters. Many stations are tuning down to 100 meters and among these are 9AUL, 9HU, 9COC, 9BOV, and 99ZT. 9DGV is high in the district with 425 messages. 9DSW is doing exceptionally good work. 9BKP is now on with 20 watts and has worked every district and been reported by 6ZY. City manager Smeby of Minneapolis makes an enthusiastic report. Only one spark reported and that is 9CRW. 9BPP, formerly 9LQ, and city manager of years ago, has been reported in Mass. on 5 watts. The new location of 9AUL turned out to be a lemon. St. Paul came across with a good increase in traffic, and city manager Goldberg, reports that 9AUA has worked 4OI with his 50-watter, the original 50 having gone up in smoke. He states that 9DGW is putting in 50 watts. 9APW continues to lead in the city.

NORTH DAKOTA: Assistant division manager, Bert Wick, has a right to feel proud of station 9UH. He says his stack of cards looks like a filing rack in a library; that his DX includes everything. 9UH has routes east to 9CMJ, north to 9ADZ and 9ZC; south to 9DAT; and west to 9BZF, 9ABU, and 7AFW; and schedules with 7ABB. 9EBT is temporarily out of commission but is standing a watch at 9GK. 9AEJ is getting organized again. 9ABU is doing fine work and 9AHC at Ellendale has started up with 5 watts. It is expected that 9ADZ at Grand Forks will come across with a good traffic report next month.

SOUTH DAKOTA: District superintendent Orville Wheelon is working out a plan to cut South Dakota into two districts which he believes will be a big help in securing proper supervision. He reports that 9BOF "the last o the sparks" is now about to change to C.W. and that 9ASP has junked his fone and will soon be a real station. 9AVZ is getting fair distances with his new UV-204. 9DWN has worked both coasts with 15 watts and Lloyd Olander of 9YAK will soon be going under his new call 9ALN. 9YW blew his tubes (you are not the only one OM.) but will have new ones with a motor-generator soon. 9ASF has been getting wonderful DX with 10 watts. The former report that this station was using 15-watts was incorrect. (Pardon OM—D.M.)

EAST GULF DIVISION
B. W. Cochran, Mgr.

It is very gratifying to be able to report a new record for the division. Over 4500 messages were handled this month. The large number of excellent stations doing more and better work than ever before and their co-operation with the officers of the division have made this record possible. Some F.B. gang.

FLORIDA: Traffic is flowing in and out of the state with ease. With more active stations than ever before and each station handling a larger volume of work we have established new records for the state. We are now set for real summer work.

Dist. No. 1. 4FS leads the state in both messages handled and in DX. With 50-watts C.W. and I.C.W. he has been reported in Calif. 17 times in one month. He works 4OI and "BX" Mexican stations, also is copied QSA in Ancon, Canal Zone, and has schedules with 1BAF, 4CG, 4IZ, and a daylight schedule with 4MT. 4HZ has had trouble with his power tubes and is temporarily using spark with which he is doing consistent DX work. 4ZC is doing splendid work. 4MT, with 5 watts works 4OI and has worked 750 miles in daylight. 4PI is a new station that will help 4MT handle the work in St. Augustine.

Dist. No. 2. This district is upheld by 4JZ, 4IZ, 4NU, and 4JI, all of whom are active and keep central Florida open for traffic. 4IZ maintains schedules with north and south Florida and is a valuable relay point. 4ZH has a 500-watt set practically completed.

Dist. No. 3 is finally coming to life with an active station, 4IC, Miami, and is heard throughout the state.

Dist. No. 4. 4BC has the best and most consistent spark in the state. 4BC to 4FD and 4GN is a dependable relay route and handles much traffic. 4BC is consistently QSA at 4OI.

The Assistant division manager is grateful to all district superintendents and city managers for their splendid co-operation and promptness in reporting.

SOUTH CAROLINA: In Greenville, 4FE, 4KI, and 4JK put the traffic through with 4JK leading the state in messages handled. Lightning, entering via the power line, converted 4EG's set into junk and did much damage to the premises. With the true amateur spirit he soon rigged up another set and is handling traffic as usual. 4FQ has been the most active station in Spartanburg. 4LA will soon be on the air with 100 watts. 4IT and 4PV are new stations and are ready to help with the traffic.

ALABAMA: A number of stations are handling traffic but only a few have made a report.

Dist. No. 1. 5ZAS has handled a lot of traffic and leads the state in messages handled. 5AGJ has also handled quite a bit and with 100 watts is reaching out all over the country.

5ADS sends in a nice message report. 5ADE at Pratt City and 5UP at Irondale are on the air regularly and keep the traffic moving. Connoly "HZ," at 5ZAS, will soon have a 50-watter of his own going, having already applied for a license.

Dist. No. 3. 5XAE has had some trouble but will soon be in operation again.

Dist. No. 4. Due to defective tubes, 5XA has not been able to cooperate much this month but in a few days put through quite a nice bunch of traffic. A report, since verified, states that 5XA has been copied in London by British 2SH.

GEORGIA: 4BQ has been sick and this familiar call is only heard at infrequent intervals. 4DB and 4MR are getting into the game. 4IV is moving a lot of traffic in the early morning hours. 4PD is increasing his power to 20 watts. He is working most of the country and is often heard on the west coast. With a remodeled spark 4FB is leading the state in spark traffic. 4FG and 4LI have combined their resources and turn in a good report. 4EB besides handling considerable traffic has worked the west coast 8 times. 4GN and 4FD, both spark, keep the traffic moving and are a good gateway for Flori-

da traffic. 4GN reports working nearly everybody he hears and has 2 reports from California this month. Macon has several good stations. 4BW was the only one to report and has at last got the 10-watter going F.B. 4BY, 4EL, and 4GE at Savannah are handling traffic with 4EL leading the state in number of messages handled. He has early morning schedules in several directions.

ATLANTA: The quiet period from 8:00 to 9:30 P.M. is being fully observed due to the efforts of the Atlanta Radio Club, and the co-operation of the local broadcasting stations has been thus secured. 4YA leads in messages handled but 4HW and 4MB pushed him for first honors. On Spark, 4DF is the leading station with 4HS and 4MY not far behind. We are sorry to lose 4HX and 4GG who have joined the Navy. 4CG now has 100 watts and is batting them out in great style. In the coming months, the leaders will have to cope with 4CY, 4EQ, 4BG, and 4ME who have each handled a big batch of messages. 4EH and 4BI handle a good share of the traffic and are regularly heard on the west coast. The secretary of the local club. 4KU found time to oil up the old key and grind out a nice lot as did 4LE, ex-4BX. Other stations handling traffic are 4GZ, 4JL, 4DN, and 4AZ. 4DO, 4DG, and 4FV are on the air but made no report. 4YA, 4HW, 4CG, and 4IK report working the west coast. A C.W. set at 4AP will soon be on the air. 4OD at Newnan is a new station and with 4DT, 4MJ, and 4JD at La Grange should serve as outlets or traffic from Atlanta and other points to the south.

HAWAIIAN DIVISION
K. A. Cantin, Acting Mgr.

Hawaii broke all records this month and the total of "ONE" message is the report that I have the "honor" to turn in. It shows that Hawaii is trying to keep this division going and the above number of message"s" handled is proof to some extent that Hawaii is still QSO. The message was received, signal C.W.

Two new licensed stations (C.W.) have been added to our total here and they are burning midnight oil in the effort to reach and work the coast. It is now up to the stations on the mainland to listen for Hawaii, as we have very little trouble in the reception of signals from the coast, but have difficulty in raising 'em.

Kindly make a mention that "Hu" is used for an abbreviation for Honolulu so that when coast stations hear us say our QRA is "Hu" it will signify that the station is located in Honolulu.

MIDWEST DIVISION
G. S. Turner, Mgr.

GANGWAY, GIVE US ROOM!!! We're headin' straight for the top and if we don't give some of you other divisions a run for your life, I'm not Manager of the 'ol midwest.

"Read 'Em and Weep" was OK once, but not now. Now it's "Glance at 'EM and Go Way Back and Sit Down." Here's how:

9AOJ, 1948 on Spark
Missouri, 9592 alone
Midwest Division, 20797

MISSOURI: 9CVQ, 9EFC, and 9AOJ have done very good this month. 9CEE, 9EKY, and 9EKF are going great. We still have room for more official stations and you fellows who are spasmodically showing signs of activity get busy and show us that your name should be placed along side of the other honor stations. 9RR in addition to his job as DS of the western half of Missouri and CM of Kansas City has just recently been appointed Division publicity manager. 9AUK is busy getting Springfield in shape. He is begging for work and traffic and with tears in his eyes. 9DWK reports that he has had bad luck, losing his masts in a recent storm. 9DXN is going great. He is after everyone to do their bit. Schoening is a hard worker, universally liked and they are all supporting him. McDaniel of Columbia is back on the job and putting the routes in excellent condition. 9BMN, 9EFC, and 9COVO deserve much credit for their excellent work. 9BMN on spark handled 871. ('Smatter you C.W. stations?) Then along comes another spark station and handles 781. (F.B. 9EFC.) Now fourth in line comes a C.W. station with a comparatively small total of 538. (How come?) The DS of Western Missouri reports 9CHJ very active and has appointed him CM. Three stations in Sedalia handled a total of 1291 messages this month. 9DAE is F.B. relaying 323 messages in six days. K.C. is still F.B. with a little more tendency on the part of the broadcasting stations to co-operate, thanks to Moore. 9CTG is continuing to do good work. The Mayor has promised to recommend to the City Council that the old fashioned arc lights be replaced by incandescent lights. We hope with St. Joe that arc QRM will be a thing of the past.

NEBRASKA: 9CMK handles largest volume of traffic in Nebraska this month with 501 messaegs. It is surely a pleasure to report that the Omaha stations are awake and handling their share of Nebraska's traffic. The north Nebraska district is dead with the exception of 9AIN, and 9CNS. 9OMK deserves special mention for the good work he has been doing with his 100-watts rectified CW. He handled over 500 messages on one 5-watter. Special mention goes to 9YU who accounted for 375. This month the Omaha boys set out to chalk up a greater total than the Lincoln gang. That they succeeded admirably is evident when we note that 8 Omaha stations handled a total of 1878 messages, against 5 Lincoln stations handling a total of 654 messages. Each city has one spark station doing good work. In the case of Omaha, 9ASO handled 147 while at Lincoln 9DNC handled 215. 9BZC will be on the air with 10 watts soon. 9AEC blew three of his fivers and is now on with one.

The Rochester plan was recently put into effect and stations are, with few exceptions, co-operating to reduce interference for the B.C.L. at Lincoln. The Lincoln Radio Assn. there has been a great help in adjusting the differences existing between the B.C.L.s and the ops.

IOWA: 9FK wins first place this month with a total of 383 messages. Traffic has taken a jump, over 4000 messages being handled and is the largest total yet reached by Iowa. 9AEQ is second with 265. 9BZI has been quite "busi" and handled 260. Counting the large number of Iowa stations out of commission and 9BGH, 9BIF, 9ARZ, 9BGI, 9BRS and 9BCD we wonder how Iowa's total would have looked if we all had been on. 9DKY and 9ARZ have worked 4OI on five watts. 9AMU has schedules with several states and is getting out fine. In the eastern part of Iowa the DS, 9CS, reports trouble with the B.C.L.s of Clinton but in spite of this they are handling traffic. 9BGT and 9DMH are two new stations just blossoming forth.

KANSAS: 9DTA as usual wins honors in Kansas for the largest message total. The windy month has not blown down very many of our aerials from the looks of the message total. We are still over the 3500 mark and have fond hopes of raising our ante a thousand next month. Five Kansas stations pounded out more than 300-per this month; namely, 9CLW, 9CAC, 9CCS, 9AOG, and 9DTA. 9ABV has been moving and his station has been out of commission all month. 9CPV and 9BZZ are both going to bat out 300 or better next month. A new station at Topeka, 9EHX, has opened up with a 5-watt set and threatens to break the long silence at that city on amateur waves. 9CJE and 9BHJ are getting in the game and handling traffic. 9CCS handled the most messages in his district with 368. 9AOD has been heard 700 miles off England with his 5-watter. Other stations deserving special mention are 9CFI 9CCV, 9CKM, and 9EHT.

NEW ENGLAND DIVISION
I. Vermilya, Mgr.

MAINE: While there are no members of the

Brass Pounders League in this state, still there are plenty in the totals, and old Maine has come ahead wonderfully. We extend hearty thanks to Edward McShane, of 1BRQ.

VERMONT: Vermont is going better, but we still need a much bigger total to keep this state up to the others. Come on, Slayton, let's see you put 'er in high.

MASSACHUSETTS: We boast six members of the Brass Pounders League here, and consider that a very good record. It sure helps to bring the messages up. In the order of their traffic, these men are as follows: 1BAN-1227 messages; 1BYN-1011 messages; 1CJR-442 messages; 1CPI-420 messages; 1BVH-342 messages.

RHODE ISLAND: Even little Rhode Island can show five members belinging to the B. P. L. They are as follows: 1CBP-446; 1BVB-382; 1II-324; 1GV-304; 1BQD-304. For its size, Rhode Island's work is something to be proud of.

CONNECTICUT: Eight members of this famous stay-up-all-night Brass Pounders League claim Connecticut as their residence. They did as follows: 1MY-858 1BOQ-661; 1CJZ-326; 1BFE-388; 1WC-326; 1IV-306; 1FY-305; 1TL-302. We have

MRS. HELEN R. XAVIER
Executive Assistant to Div. Mgr.

reason to believe that the leaders of this state are well liked and likewise well followed. The DM wishes to thank all the ORS men as well as the ADM.s of the division. 117 stations reported in this district including 108 CW. stations and 9 spark stations. Poor old sparks are beginning to lose ground.

We enclose a picture of Mrs. Helen R. Xavier, who has just been appointed executive to the New England division manager. Mrs. Xavier is a member of the League and very much interested in all matters of the gang. She intends shortly to run a station of her own as she dislikes being classed as a B.C.L.

Miss Helen Daniels has been appointed executive assistant division manager for Western Massachusetts, helping out Mr. A. S. McLean.

NORTHWESTERN DIVISION
B. B. Bliss, Jr. Mgr.

MONTANA: The effects of the spring QRN are being felt over the state and have made inroads on the message report. It is a peculiar thing that the stations in Montana are unable to work with one another, but can reach out and work with ease a much longer distance. It was attempted to get a daylight route in the state and it was requested that everybody be on the air each Sunday afternoon from 3 o'clock on and try to raise some other Montana station. After a month of trying there comes to the ADM the report that there is absolutely nothing doing. And from observances from the ADM's stations, 7ZL, it has been found impossible to raise Montana stations in daylight while coast stations and those in Kansas were worked with ease. (???? why?)

The Revised Pacific Plan is in operation at practically all the stations in the state, and for the most part seems to be serving its purpose admirably, with the exception of a few B.C.L.s who think that the amateurs hours should be from 5:59 to 6:01 A.M. on the 29th of February. The quiet rule seems to be beneficial both ways as it gives the DX listening ham a chance to hear some exceptional DX. (When the B.C.L.s are not squealing on every wave length in the deck and a few new ones or good measure). In Bozeman, there is a new station on the air 7HS who has been a second op. at the station of the ADM. He has a 5-watter going and is ready to handle traffic. The state is all C.W. but for the exception of 7EX, who is on the fence with both spark and C.W.

IDAHO: Dist. No. 1. Old 7JD from Weiser is installing the old spark and a new C.W. set of 10 watts up in Moscow. 7ZM will be back with 100 watts. 7JF continues to be district No. 1's record station. He has his new flock of tubes warming up.

Dist. No. 3. Nampa has three active stations and is prepared to handle traffic in all directions. 7CG and 7LN are handling the bulk of the traffic. 7IO is on with 10 watts and promises to have 20 soon. 7LN has worked 8BEO in Watertown, N. Y. and is heard throughout the East.

Dist. No. 4. The set at 7YA has finally been finished and is kicking out five good amps. 7HJ and 7ZN continue to hold down their end of the traffic line. All stations in Boise are making some wonderful records, all being heard throughout the east and 7ZN being heard at a distance of 4700 miles 7PJ will be on with 10 watts.

OREGON: The reorganization work is still going on and no new appointments have been issued. Things are pretty well straightened out now though, and everything will probably be F.B. by next month. The bulk of the traffic seems to be going through 7LR and 7NA. 7LR had the bad luck to have his 50-watter go west (cudn't get big enuff DX aniother way), and had to resort to the spark to clear his hook. 7LR will be on again with 100 watts. 7TQ is heard nightly and seems to be getting out, as usual. 7MF, 7TT, 7VF and 7TO are also on regularly and seem to be keeping the old hook clear.

WASHINGTON: Conditions over the state remained practically unchanged since last month. A substantial increase in the traffic handled is noted and the percentage of traffic per station is going up. There is a general trend toward C.W., all except three stations reporting being C.W.

Dist. No. 2. Reports that traffic is handled with ease in all directions. 7SC and 7NN are both installing higher powered sets and expect to increase their QSO.

Dist. No. 4. 7NF and 7GP are the only stations in this district at present. 7GP is down on 180 and reports QRN nil on that wave, but that it is hard ot work anyone. They do not seem to listen that low. 7NF is QSO all directions.

Dist. No. 5. 7BJ is still doing the bulk of the DX here assisted by 7AIC and 7AJV. They all find it easier to get the messages on the hook than to get them off. BJ has joined the owls and is now putting up a new antenna so that he can radiate a few more watts.

Dist. No. 6. 7QE, the DS is on the job but

finds that the ORS do not take the trouble to mail him their cards. 7WX and 7BA are still holding down the graveyard shift, while 7WM and 7AFO are on in the evenings and doing good work.

Dist. No. 7. 7ABB, the new y appointed DS is right on the job. Stations around Everett are doing exceptionally good work with stations in the eastern part of the U. S. 7HI has opened up with 100-watts of C.W. and if it works like the old spark did it will sure be a star station. In Seattle, 7JG is handling the bulk of the traffic with 7ADP, 7DU, 7KF, and several others helping out. Seattle is working hard to rid itself of the stigma of its undeserved reputation of having no one on the air.

Dist. No. 8. 7WD and 7AIO are on with the old reliable spark and getting about in good shape. 7JS is havng trouble getting his five watter to perk.

Dist. No. 9. 7AIY and 7NE are the only stations in this district. At present the stations in Wenatchee are forced to standby from 6:00 to 10:00 because of radical broadcast listeners.

Dist. No. 10. Several good stations are in this district but owing to poor cooperation with the acting DS, 7GE, only one reported.

Dist. No. 18. Traffic in this district has grown rapidly, particularly with the east and north and south bound relaying. The Pacific Plan hits some of the stations here rather hard as they are going to school and that requires that they QRD hay early.

ONTARIO DIVISION
A. H. K. Russell, Mgr.

"Over the top again" has been the motto of the Ontario Division for the past month. Despite some very bad weather for radio work the traffic report for the month has beaten all prevous records. Come on fellows, the next objective is 2500 messages, and let's get a couple of the gang into the 300 class next month.

Byerlay, in Western Ontario, reports that his district has not maintained its pre-eminent position as a high average station district, and several stations such as 3BV and 8BS have dropped off woefully in traffic handling due to business occupying too much time. Remember LeRoy, "All work and no play makes Jack join the Union." Carter has come out well again this month from 3DH as have several comparatively new stations such as 3ADN and 3UJ. 3KO maintains several regular schedules and despite "empty socket trouble" has a nice total. Our latest DX arrival, 3NI, has proved a Godsend, and his majestic total for his second report is a dandy. He has furnished the long looked for missing link between Ontaio and the West. 3BG is on and when he gets going and puts in C.W. instead of spark he will be great. (Hi—D.M.). 3XN has been very busy at business and has not had as much chance as usual to get in his fine work. 3GB and 3IF are F.B.

The Central Ontario district is top dog this month, but of all the stations here, the one deserving most credit is 3XX. He is on with a flivver coil on one 5-watter and for traffic handling works rings round a good many of the gang. 3BQ is also doing very fine work. Also 3TL. Hamilton has at last opened up to traffic in 3OY a newcomer to the game, but a very good "comer." He runs regular schedule with Toronto and Kitchener. The Toronto crowd are all busy with 10-watt sets showing the 50s where they get off.

The Eastern district is short and snappy, as Donnelly only reports two stations had handled any traffic, both Kingston. The DM hears from Wale or Cornwall who is putting in 10 watts.

PACIFIC DIVISION
J. Vance Wise, Mgr.

The Division Manager has been completely out of commission for some time, much of which was spent in the hospital, which accounts for the smallness of this report.

ARIZONA: E. A. Nielson, 6BBH, has been appointed city manager of Phoenix. A new station that will be of big help is 6CAJ. 6BSQ handles Texas and California traffic maintaining schedules with 5ADB, 5JZ, and 5DE. 6ZZ is trying to improve receiving conditions. More traffic would have been handled last month but for the fact that a great deal of time was spent experimenting with various types of receivers. To date, there has been but little QRN and traffic moves regularly thru 6OD, 6ZB, 5ZH, and 5XB who QSR easily.

CALIFORNIA: 6IV with his ten watts is reaching out FB. 6EC has a new 20-watt set which will be another good DX station. 6BJV has just installed a Paragon ten-watter. 6BQF is out of the game for a short time. 6ANH has been heard all over the U. S. and has just added New Zealand to his record. 6ANH-6ALU with 15 watts works into the 8th district easily. 6BUN has reached the 1st district—15 watts. 6OM is off the air for a time 6KA continues to hang up new records and managed to get 4.5 amps. out of a 5-watt tube before it blew. 6MH with 50 watts will be heard by the the time this in print. 6UP has junked the spark for C.W. and 6OD is trying to prove to himself that he can get better DX out of an amplifier tube than he got with the old spark. As a starter, 6BVF has reached the atlantic coast with his new 50-watter. 6BVW, 6CU, and 6BQY are doing good work on C.W. 6BQC is back again ready for business on C.W. 6BEG is in operation at his new location. 6JD, 6EA, and 6EN have been heard in New Zealand, 6KP, using an amplifier tube, has been heard in New York. Next! 6ZN gets good DX with his 100-watt set.

ROANOKE DIVISION
W. T. Gravely, Mgr.

Traffic has been holding up very well during the past month. High honors go to 10-watt station with a rather poor location, and with only one man on the key.

8AUE
C.W.
631

PORTO RICO: QRN is beginning to be felt and that the heavy artillery will soon "bust" loose down in this latitude. Direct communication was established between 4OI and Hartford Headquarters, 1AW, also between 4OI and Division Headquarters, 3BZ, at Danville, Va. We are afraid that 4JE will be too late with the motor-generator for this season's operation, but with effort Porto Rico may be able to keep in touch with the states during the summer months.

WEST VIRGINIA: 8BDB makes his bow with 100 watts and covers the country. 8ATC and 8CQH are placing Huntington on the map. DS Rhoades is carrying on very interesting experiments on short waves using a 5-watt tube and 3-foot loop. With this he has covered 25 miles. 8BDA has been busy getting the hams and novices together.

VIRGINIA: ADM Wohlford is very enthusiastic over his "gang" and comes with a fine report as usual. 3ATS is going strong. 3UV, 3BNE, and 3JN are new stations waking up. 3MK is installing a high powered set. 3BVC is active in Portsmouth. 3ZZ is working mostly in daytime, with regular schedules.

Dist. No. 2. 3BMN, 3AUU, 3AOT, 3SG, 3BCH, and 3TJ are all doing good work. 3XAL (ex 3BIJ) 3AHN, 3CEL, 3BVL and 3MO (with his clothes line) are holding up their end in great shape.

Dist. No. 4. 3BLF (with two ops.) and a consolidation with 3ZP will continue to make things hum.

Dist. No. 5. 3IW is temporarily out, while 3BUY, 3BOF, 3CDY, and 3AFW are accounting for that section.

Dist. No. 6. There is great improvement with 3HU, 3CBZ, and 3BFE now on the air. 3YV and 3BHL are both working.

Dist. No. 7. 3ASP, 3ZAA, 3YK, and 3ZX are holding down the job.

Dist. No. 8. 3APR is a star and he never sleeps. 3BIY, 3RF, 3CA, 3VC, and 3BDX are all active.

Dist. No. . 3HL is changing from 2OW to 100W with MG.

NORTH CAROLINA: 4KC is leading in Asheville but there are a string of new fellows who promise

to make things interesting. 4LJ and 4NV are doing fine in Winston. 4GX and 4DC are handling traffic at Greensboro. 4KC and 4MV are passing a few. If there is a man in the Division who has any suggestions or constructive criticisms on A.R.R.L. operations, come forward and let us have them.

In conclusion, do not think of stopping for summer weather, but keep going and play up, especially daylight operation. It is great!

ROCKY MOUNTAIN DIVISION
N. R. Hood, Mgr.

C.W. 539 Msgs.
Hathaways, 9AMB
Denver, Colorado

Spark 87Msgs.
Young University
6APL
Provo, Utah.

WYOMING: By the Great Horn Spoon the home state of the DM takes honors this month for the most messages handled per station reporting. Great credit is due to our 15-watt wonder, 7AFW, who put through cutting capers. 7AI has been ill so not much was done the past month. Also has burnt out a transformer and is figuring on C.W. (F.B. OM, hope the C.W. will win out.) 7ZV is still at it with his 100 watts and is certainly spreading out. 7LU has been having trouble with the plate supply and a new motor generator set will supplant the rectified A.C. at this station. 7ZO has not been on regularly lately but is on regular schedule now. 20 watts doing duty here. In all, radio is setting fine in the sage brush state. The 7th District Executive Council has received 100% backing from Wyoming. The hams here are united 100%. (Howzat?)

COLORADO: 9AMB again takes the box seat. He works 9BGH on schedule. New stations in Colorado enables quick delivery of messages now. New QRA, 9AMB, 4026 East 19th Ave., Denver, Colo. 9DTM reports no work through broadcasting. Now on 185 meters with 5 amps. 9BUN is still at it with his 10 watts. 9BJI gets real DX including Hawaii. 9CAA had been on only half a month and is QSA both coasts. 9DHI QSA up and down both coasts on 10 watts and wants to know what is the matter with the English receivers. 9BXA is rebuilding antenna as he has been using an antenna only 15 feet high and gets 800 miles. 9FV is pounding away. 9BVO works on schedule with Colorado Springs. 9BXQ has a new 75-foot mast. 9BTO is rebuilding. 9EKH says he has been off on account of love!! (Don't quite understand OM, but suppose we will be smoking on you soon, eh? Love is cruel to radio, OM.)

Denver amateurs have adopted a plan to bring about more cooperation between the B.C.L.s and the amateurs. All stations absolutely QRT from 7 to 10:30 P.M. except Wednesday and Saturday nights. Tuesday has been made silent night in Denver. The amateurs of Denver say that it will be quiet too if they have anything to do with it. No I.C.W. or fone during DX hours. Assistant Radio Inspector, McGowen, of the 6th district visited Denver March 23rd and a banquet in his honor was given by the Associated Operators of Denver (amateurs). A great time was had by all, and all stations were put in tip top shape, and a better feeling all around was left in his wake.

New appointments in Colorado are as follows: 9QL, and 9BJI ORSs: M. O. Davis, 9DCE, La Junta, Colo., DS for Southern Colorado; Philip Laskowitz DPM. The following ORS certificates were cancelled: 9WD, 9CIX, (moved from state); 9ZAF; and 9AWL.

UTAH: 6APL a worthy spark in Utah takes the box seat for most messages. 6AWH is operating on spark but C.W. is beng assembled and will be in operation soon. 6BUH operates both spark and C.W. 6NQ reports no traffic handled. 6BOE just completed a new 250-watt set and gets excellent results. 6ZA is busy at Utah "U" but managed to get a few through. 6ZM reports the big set not quite completed, although on the air some, but will soon have the 500 watts going. 6ZT pushed through 118 in two weeks. 100 watts here soon. 6ZV and 6BLH sent in no reports. (Whatsamatter, men, like to hear from your traffic or not.)

McGowen, Assistant Radio Inspector 6th district, visited Salt Lake on his inspection tour on March 10, 11, and 12. Examinations were held and many local men passed their test for amateur first grade license. All ORSs reported in district No. 1 except 6ATH. (Sure F.B. Men.) 6APL still on the rock crusher moving traffic in fine shape. New masts here soon for more DX. Radio Inspector at Povo passed five of the gang for first grade licenses. 6ATQ is at it hard again. *6BKE shows the pep, making a house to house canvas for messages, so watch the box seat Salt Lake gang.*

The following appointments were made in Utah: 6RE, 6ZT, 6RM, and, 6ZA ORSs. (Congrats Utah, you sure are on the move. Your old time pep is showing again and we are proud of the way things are shaping themselves—DM)

VANCOUVER DIVISION
J. T. North, Mgr.

VANCOUVER: 5CN is now on with a 100-watt set and is doing more work than ever. 5AC is building his station into another rock crusher. 5GO and 5AK are handling traffic, and 5AX is doing occasional work. 5BQ has also come back with some more tubes.

VANCOUVER ISLAND: 5CT is still going strong. 5DX has left for an indefinite period.

ALBERTA: 4DQ is handling most of the Alberta traffic with 4AB and 4CW helping occasionally. 4CL in Edmonton is very QSA in Vancouver.

PRINCE RUPERT: 5CX had hard luck with his tubes but is replacing them with a fifty-watter. 9BP is handling all the northern traffic with little trouble.

WEST GULF DIVISION
F. M. Corlett, Mgr.

Official relay station appointments were issued to the following: 5UO, 5JZ, 5DE, 5ZAK, 5VO, 5VYH, 5RN, 5JT, and 5JL.

Our star traffic handling station of the entire division this month is 5KP with a total of 1184 messages. (All C.W. too.) That live bunch at Fort Worth must have laid off this month to give Dallas a chance to catch up with them as their report is missing. The first time in a long time.

SOUTHERN TEXAS: 'Smatter Orange and Port Arthur? We know that you've been on the air but, gosh all fish hooks, let's have the dope! Galveston C.W. stations come in for a goodly share of the honors this month with 5BY and 5IM on the job a big part of the time. (Fine business, glad to see Galveston coming along wth us—DM.)

Some of the newer stations on the Island are 5AHH, 5AGL, 5ADY, and 5AIV. 5IM and 5VY are the two official relay stations. 5ACR and 5ADY are also A.R.R.L. stations. Houston has 26 A.R.R.L. relay statons and 6 of them hold official relay station appointments. Houston's busiest station month was 5OV. Distict superintendent, E. A. Sahm, at New Baunsfels, reports the busiest district of the entire southern Texas section and our hats are off to 5KP at Elgin for our best traffic stations. 5TM deserves mention. 5SS at Persal works both coasts "like they were a mile away," and is the best station of DS Wall's district. Both ops. at 5ADI have been down in old Mexico and came back with great ideas of a relay to Mexico City. (Go to it, fellows,—DM). 5HC is building a suitable shack to house his "PRIDE." 5ADB at El Paso, E. R. McCracken, and E. H. Funk, who try to make the "MUXES MUX" for the W.U. in the day time seems to be holding down the "WX" key pretty well in far west Texas. 5JZ, QRA, Louis Gemoets, 2500 San Diego St., (Note: Fellows, not Mobile, but El Paso, Texas,) is 5ADB's rival in the air, and El Paso is coming right along in the relay game. El Paso is on speaking terms with all of California. Shoot some of that west coast traffic to 5JZ and 5ADB. We have a new A.R.R.L. station out in the Big Bend country now, 5BO. 5YK has been under the weather but will be on soon with a 100-watter.

(Concluded on page 67)

The Junior Operator

(A department formerly known as "With Our Radio Phone Listeners.")

Your First Transmitting Antenna

By H. F. Mason, Department Editor

IN order to see why some forms of transmitting antenna are more desirable than others, let us see briefly what features are necessary in the design of a good antenna. The one thing that we are aiming for is that our antenna will have as good radiating qualities as possible. It must be efficient in transforming the current we put into it from our transmitting set into electromagnetic waves.

Consider for a few moments a single vertical wire, grounded at its lower end, as a basis for discussion. It has inductance and each portion, each foot of the wire, has a capacity to ground; this capacity being large at the lower end of the wire and decreasing towards the top as the distance between the portions of the wire and the ground becomes greater. If we connect a transmitter to the bottom end of the wire and introduce a radio frequency current in it, the current will flow by capacity paths through the air from the wire to the ground. As stated previously, the capacity of a piece of the wire one foot long is much greater near the bottom or end nearest the ground than at the upper end. Consequently, the greater part of the current will leave the antenna and go to the ground before it reaches the top of the antenna at all. What current does reach the top of the antenna will build up to a high potential because the resistance of its only path to ground through the air is so high. This condition of maximum current at the base of the antenna and maximum voltage at the high end influences the design of the antenna considerably. This distribution of current and voltage exists when the simple vertical antenna is oscillating at its fundamental wavelength. The actual length of the wire will be equal to one quarter of the length of the radiated wave because a complete wave or cycle is made up of four recurrences of the voltage and current relations mentioned above. If it is desired that the antenna have a fundamental wavelength of 200 meters, its height will have to be one fourth of this, or 163 feet. It is practically impossible for the amateur to easily erect an antenna of such a height, but changing the form of the antenna as explained later on will permit a much lower one to still have the 200 meter fundamental.

So far we have been talking about a single vertical wire. If we have two vertical wires a foot apart the capacity to ground of the combination is increased owing to the additional surface. The inductance is decreased because the current is divided between the two wires, and using the law for calculating the total inductance of two inductances in parallel, the inductance of the combination will be one-fourth that of the single wire. The result is that the increase in capacity is offset by the decrease in inductance; therefore the product of L and C, which determines the wavelength, remains practically the same.

The above holds good as long as the wires are vertical, but once we lessen the height and bend over the upper ends of the wires as in the inverted L type, the capacity is increased and this increase is not nearly offset by the lowering of the inductance occasioned by spacing the wires. The result is, then, that the wavelength of most forms of amateur antennas is more nearly six times the length from the ground to the far end, rather than four times it, as it is in the case of the single vertical wire.

Turning to a consideration of the many different types in antennas—T, inverted L fan, cage, slanting fan, an all the rest—they are only expedients adapting local conditions to the theoretical requirements of building an antenna with its capacity as high in the air as possible and having as little inductance and capacity in the lead up to the top as possible.

The antenna must have a great effective height. However, the effective height is a term that has no fixed relationship to

the actual height of the antenna above the ground in feet. Masts, trees, buildings, lightning rods, metal stacks, and wires of any kind in the vicinity of the antenna all tend to influence the effective height. To illustrate: An antenna erected on the top of a ten story building may have a height above ground of several hundreds of feet, but on account of its proximity to other objects, its effective height may amount to no more than that of an antenna fifty feet high if erected in an open field. In order that the antenna have a great effective height it is necessary that it be kept as far away from all surrounding objects as possible.

This isolation of the antenna is necessary for another reason. The antenna and ground act as the plates of a large condenser and any poor dielectric such as buildings, trees, masts, etc., between these plates will absorb energy. As an extreme case imagine a condenser in your set with tree leaves and watersoaked wood between the plates for insulation. That is the identical thing that we have to deal with in selecting a location for our antenna.

Any wires or metal objects in the vicinity of the antenna will not only tend to lower the effective height, but they also are detrimental from another standpoint. Steel buildings, metal stacks, and wires all have a natural period of oscillation of their own, depending upon their size. If it should accidentally happen that you try to operate your transmitter near the natural wavelength of a nearby mass of metal or wire, that object will absorb an unusually large amount of power. This will be shown by a large amount of antenna current at the transmitter on certain wavelengths. In some cases it is possible to remedy the difficulties by going out with a wavemeter and a pair of phones and picking up the re-radiation from these wires, and then connecting inductances and capacities to them in such a way as to shift the natural period of the object out of the way.

If circumstances do not permit the erection of two high masts with a small T between them, the next best thing to do is to get at least one end of the antenna as high as possible. This should be the end farthest from the transmitting set. It is not good practice to make a T antenna unless both ends of the T can be made nearly the same height.

The Junior Operator will have to display his ingenuity and resourcefulness in providing the supports for his antenna, because the widely varying and adverse conditions that exist in the modern backyard do not permit the prescription of a definite set of rules for erecting the masts. We will accordingly take up the actual construction of the antenna.

The number of wires that the antenna should have seems to be more a matter of individual preference than anything else. It usually lies between four and ten for transmitting antennas. The lead-in should have the same number of wires as the upper part of the antenna, even if it is a cage. The best all-around kind of wire to use is No. 14 semi-hard copper wire.

The construction of the antenna itself may conveniently be divided into two separate and distinct parts, that of the flat-top or upper portion, and the lead-in. The upper portion may be built in either the cage or sausage type, or the so-called flat-top type. In spite of terrible arguments on the merits of each, there is really no appreciable difference, electrically, between the two types, when used as the upper end of the radiating system. The cage antenna is, nevertheless, easier to handle when in the air.

The diameter of cage antennas averages probably around three feet. Some amateurs taper the upper cage from one foot at the end nearest the lead-in to ten or twelve feet at the far end with good results. Materials and objects for use as the spreaders of the cage include about everything under the sun. Heavy wire hoops, barrel hoops, bicycle wheel rims, toy wagon wheels, regular wagon wheels and piepans with the centers cut out are all pressed into service to hold the wires the proper distance apart. Probably the best type of spreader that can easily be made is of the three or four "cross-stick" type. It can be made in any size and consists of three or four sticks, nailed together at their midlength and with a saw slot cut in each end of each stick to take the antenna wires. If the spreader is large it will be well to connect a wire around the rim between each antenna wire. This binding wire should also be fastened to the ends of the cross-sticks and soldered to the antenna wires. It is customary to space the spreaders at least every twenty feet in large cages. In very small cage antennas, the spacing may be four to eight feet as necessary.

If the top portion of the antenna is to be of the flat-top type, some other things will have to be considered. A light strong straight-grained stick of wood makes the best spreader. The spreader need not be large in cross section; a spreader 20 feet long need not be over two and one half inches in diameter at the center, tapering to three fourths of an inch in diameter at the ends. A queer thing that reflects upon the radio bug is that one can nearly always tell the number of years that a fellow has been interested in radio by the length of the spreader in his antenna. Just like telling the age of a horse by

his teeth. Newcomers in the game invariably put up spreaders a few feet long while the old timers frequently put up spreaders twenty and twenty-five feet long. There is a length of spreader that will be the best for any particular case. If the spreader is too long, it will have to be specially guyed to prevent lashing about in the wind. If the top portion of the antenna is of the T type, the spreaders should both be the same length, and from ten to twenty feet long, depending somewhat upon the number of wires in the antenna. If one end of the top portion is higher than the other end, and the antenna is of the inverted L type, the spreader at the far end should be about eighteen feet long and the one at the end nearest the lead-in may be smaller, even down to three feet in length. Small pipes are also sometimes used, but once bent by the wind, they will not straighten of their own accord.

No matter what kind of a form the top part of the antenna has, the lead up to it should always be in the form of a small cage, from three to ten inches in diameter. Again, the spreaders may be of anything that suggests itself. The best looking ones are made of rings cut out of sheet metal or wood. If of wood, they may be rings turned on a lathe with a groove in the periphery. Slots can be cut for the antenna wires, an then a binding wire can be run in the groove and solder to all of the antenna wires. If of metal, the spreaders can have a hole in the edge near each antenna wire, and a short length of wire can be twisted through this hole and twisted and soldered to the antenna wire.

The best way to begin the actual construction of the antenna is to find out the exact length between insulators that the finished product is to be. There is only one way in which this can be done. Take a piece of wire or rope and put an insulator in each end just as if it were a single wire antenna. Hoist this up between the masts and vary the length between insulators until the correct length is obtained. Do not do this without first attaching a rope to pull it down with, or you will never be able to get it down. Another wire can be attached to this wire as a mock lead-in and the Junior Operator can stand off and form a mental picture of the finished antenna. He can see just how far the antenna will swing from all guy wires, trees, etc., in the vicinity and possibly a better arrangement of the antenna and lead-in will suggest itself. In this way the exact length of the antenna and lead-in are measured.

This done, the next requirement is an open space where the antenna can be built. The lengths of antenna wire are measured off approximately, leaving them plenty long enough, and one end of the antenna is built complete first. The best arrangement is to run the antenna wires through holes in the spreaders right up to the vertex of the bridle. In other words, let the bridle be formed of the antenna wires themselves. The insulators should be connected in series at the juncture of the bridle and the halyard or hoisting rope. If the insulators are subjected to a severe electrical strain, it will be the one nearest the antenna that will suffer. It is accordingly of no benefit to put an additional small insulator at each antenna wire on the antenna side of the spreader. Use glazed porcelain insulators thruout, as you canot afford to waste many watts in a poor insulator. A good assortment of small ¼ or ⅜ inch galvanized iron shackles and thimbles is always handy when neatness in the construction is desired.

Another point that should be kept in mind is that the finished antenna will be no stronger mechanically than its weakest point. Think of the unusual strain that is placed on the antenna when it is covered with heavy ice in the winter time. Pick out the weakest point and strengthen it to stand all conditions.

Upon finishing one end of the antenna, fasten that end solidly to something about three or four feet high. Go to the other end, thread the two outside wires through the spreaders and pull them taut and to the proper length, as measured by the wire that was used to gage the distance between the tops of the masts. Be sure that the spreaders lie at exact right angles to the antenna wires. When this is done, the other intermediate wires may be secured temporarily in place, and by pulling the whole antenna taut, about three feet above the ground, the length of the intermediate wires can be adjusted until they are all of the correct length, whereupon they can be permanently secured and soldered.

In the case of a cage, the best method of construction is a trifle different. One end is finished first, as before, and the end spreader is permanently put in place. That end is then fastened to something solid as before. Going to the other end, the wires are then pulled all to an even length, a little longer than the finished antenna will be. This length will be taken up when we insert in place the other end spreader, which should be done next. The antenna may now be stretched taut and the space between the end spreaders measured off into equal parts and the intermediate spreaders fastened into place and all binding wires put on and joints soldered. The antenna proper can then be laid aside and

the cage lead-in constructed in much the same manner as described above.

Joining the lead-in and the top part of the antenna is usually a proceeding that requires a little thot as to the best method. The joint must be good mechanically, in order not to break under constant swaying by the wind, and it must be good electrically. By keeping both of these requirements in mind, a good connection can be made.

Just a word about halyards. Half inch manila or hemp rope is usually used in the average antenna of the amateur. It should be tarred, with compounds marketed for that purpose, and rolled in sawdust to remove excess tar. This will greatly lengthen the life of the rope by preventing it from rotting and will lessen the tendency to contract in wet weather.

With the antenna system completed, the Junior Operator may hoist the antenna to the masthead and if he has done a good job and been careful, it will be an exact fit. Every six months or so it is a good thing to lower the antenna, clean the insulators and renew any parts that are showing wear.

A fellow with a good antenna always has an advantage over the one that builds this necessary part of his station in a haywire manner. In the case of the former, any erratic results can be directly attributed to the set itself, or freak conditions. He can test circuits and compare results with the confidence that the part of his installation outside of the radio room is performing its work in a silent and efficient manner.

The Operating Department

(Concluded from page 63)

NORTHERN TEXAS: Dallas, Greenville, and Commerce seem to be about the "crop" for district No. 1. Hurrah! for Dallas—Got ahead of Fort Worth this month—but listen, here's the dope, Fort Worth either failed to report or some of Dallas bunch made away with the report. The DM hasn't quite doped it out yet, but believes there was some underground work going on somewhere for that Fort Worth bunch was going too strong to stop right off short like this.. Maybe the Hired Hand at WBAP had something to do with it. Anyway traffic is moving though Dallas in all directions with little or no delay. 5IX lost his mast during a high wind, and had all the neighbors trying to hold down the guy anchors to save the things. But even with the help of "Daddy" Blaylock, (Mayor pro tem, and our next Mayor after April 3rd) the blooming masts insisted upon tearing down a few fences within the block. Moral: don't use two-by-fours peg fashion for guy anchors on healthy masts especially in Texas during the March winds. DS Arthur West, tenders his resignation this month due to lack of sufficent time on account of some newspaper work. (We wish you well OM.) An opening for an appointment as DS. Applications are in order—DM. J. R. Martin, 5UO, Wichita Falls. DS district No. 3 is right on time with his report which states everything picking up, even to QRM. Wichita Falls stations are doing good work. 6UN, Ralph Parker is using 30 watts instead of 300 watts as appeared in a previous report. 5EL, Randall Cranfield, is getting 2TC amps on a 5-watt set and workng first district stations direct. (F.B.) 5CY a 20-watter, wouldn't commence for awhile but is "percolating" now and handling quite a bit of message traffic. 5HQ thought he would quit the game for the Y.L.s—don't know the details, but he's getting his station going again. (?) If the wind ever lets up 5UO has a new mast all ready to stand on end. 5OK with a new C.W. is working circles around the old rock crusher he used to have. DS C. B. Baxter, and ramrod of 5XAJ at Dublin, seems to be the main traffic mover out this way. 5NS is running him a close second and his 20-watt CW. signals have been reported 1275 miles west of California. 5QT on 5 watts reported 1880 miles over land. 5QT is now located at Stephenville, Texas. 5XAJ on 25 watts was reported nearly 4,000 miles from Dublin and on same power has worked many times over 1500 miles on voice, also to Canada and Mexico City on voice. No report from district No. 2, but three live stations reported direct to the ADM, 5AJT, 5DX, and 5LM. (Glad to hear from you fellows in district No 2—ADM.) Out in the Panhandle country 5ZH is passing those friendly messages to one amateur to another or his friend's messages to some other amateur friend, and seems to have the whole district to himself. We have a new A.R.R.L. station at Childress, Texas, 5ACC.

OKLAHOMA: 5KE, 5XT, an 5ZT are handling the bulk of the messages. 5ZAV is still having generator trouble. 5ZG, while on a few hours, moved a bunch of 10. Oklahoma University station is responsible for three of relay stations being inactive this season; 5ZZ, 5LO and 5ZQ. Traffic in and out of Muskogee is being handled by 5BM, who is QSO both coasts and Canada. 5AQ is changing to C. W. The district around Tulsa has several good stations now, 5GA, 5GJ, 5SR, and 5SG, all getting out and doing good work. 5SR's call has been changed to 5HM. 5IA is a new A.R.R.L. station owned by Eugene M. Link at Fort Sill and will be a help to district No. 4.

NEW MEXICO: Old reliable, 5ZA, merely reports traffic moving OK. I don't know but what that tells the tale just as well.

WINNIPEG DIVISION
P. Socolofsky, Mgr.

This divison is on the boom, that's all there is to it. The amateur radio "flu" is hitting all our cities. We have a complete staff of good reliable men in the Operating Department. Let us see if they can prove themselves by pinching the reports out of the ORSs. How about the seven stations, can we get some help?

9BX, the star station of the division, is on doing very fine work and is open for traffic from 10 P.M. until 1 A.M. week nights, and 10:00 to Midnight Sunday nights. 4HH carries away the division prize with 109 messages, and is the best station in Moose Jaw. 4AO has a splendid 10-watt C.W. (Yanks please QSL, QRA is Moose Jaw.)

Saskatoon is well represented by 4FN's fifty-watter.

WINNIPEG: 4DK, A.J.R. Simpson, is the new DS. 4CN is shooting traffic right alnog with one fifty-watter. 4CZ is still on spark and QSRing 500 miles OK. 4CE charging the air with 10 watts. 4BT and 4CH are 5-watters.

There seems to be considerable trouble between the B.C.L.'s and the hams of Winnipeg. How about the Radio Club? Can't an agreement be made?

Daylight routes are working out fine. This division is bombarded with heavy QRN and blizzards.

Say, you fellows that are having trouble getting your inverted dupes to work; look over your circuits again, as we're getting a dozen bouquets a day about that circuit.

What's the use of having D.C. on your plates when you throw in a key click that immediately becomes known by the listeners for miles around? Truly this is getting serious so, won't someone write a nice article on "Key Clicks, Their Causes and Cure?"

French 8AB has been heard by 8CF of Ann Arbor, Mich., during the month of March. According to 8CF he was doing the famous act of "CQ-ing." Has anyone further west heard French 8AB's sigs?

Paradise

'Tis three o'clock in the morning,
I've listened the whole nite thru,
The sun will soon be shining,
And I haven't heard a CQ.

1ALI would like to have someone explain to him in simple language why sparks jump to his nose every time he talks into his microphone.

9DYV has a 1-KW spark set but no meters to tune it with. To tune the set he holds his fingers across the antenna and ground and then presses the key. He then picks himself up and measures the distance it threw him. This distance in feet is directly proportional to the transmitting range, hence the set must be in tune.

From the same source comes the information to all hams that 2300 volts A.C. is not adapted for use on the plate of a five watt tube.

Famous Words

1913—"How do I come in?"
1923—"Please send me a card."

"LQ" wants to know if anyone knows of a freight agent that can haul about three tons of descriptions of bum "supers" out into the Sahara Desert.

In a short wave honeycomb set, don't bunch all six leads from the coils and bring them through one hole in the panel and then wonder why the set doesn't work. Separate each lead as far as possible where it goes through the panel and you'll hear more sigs.

"Jake" Bolles, A.R.R.L. publicity man, holds the chess championship of the A.R.R.L. He has defeated Reinartz, Schnell and other famous players and will meet all comers any time and any place, by radio. (Please send slow).

The Committee on Application of Radio to Moving Trains of the Association of Railway Electrical Engineers desires to communicate with anyone who can give information regarding actual experiments in radio reception or transmission to or from a moving train. Kindly communicate with M. P. S. Westcott, Ass't Car-Lighting Eng'r, C. M. & S. P. Ry. Co., West Milwaukee Shops, Milwaukee, Wis.

"For Sale—Radio with aerial, 3,000 ohms, $12.00"—*Calgary Morning Albertan.*

We thought the article about the radio waves washing the insulation off an antenna was the best yet, but here's a better one:

Scene: A radio store; with radio expert (?) in background. Enter a radio fan.

Fan: "Could you tell me why I hear a lot on one night, and hardly anything the next night?"

Radio Exp: "Surely, you have a powerful receiving set near you which draws in all the radio waves around it, and then you get them after it uses them."

'Twas ever thus, that the innocent fan should be the victim for the ignorant expert.

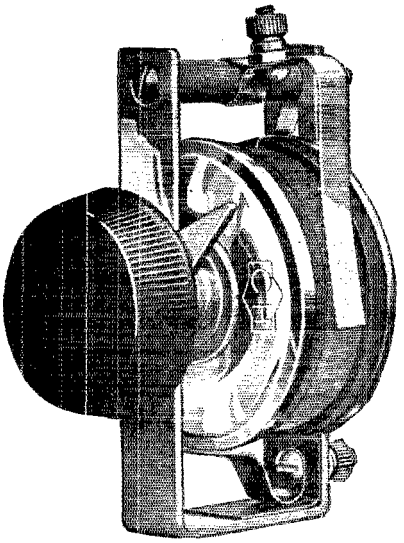
3CDQ (OW) says that winding banked coils has improved her vocabulary considerably.

Why can we do things to a C.W. transmitter which lower the antenna current and then when you ask the other fellow QRK he comes back with "Vy much more QSA nw, OM?"

NEW APPARATUS

This department is not conducted for the purpose of according free publicity to advertisers. It stands on its own bottom. Its purpose is to give QST readers accurate information on new products. Apparatus described here must be sufficiently interesting to give its description and interest to our readers. The contents of this department will be selected each month from the most interesting material at hand.

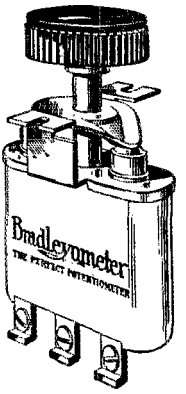
The Cutler-Hammer Mfg. Co., has just brought out a potentiometer for radio work that matches their rheostats and is a rugged and well built piece of apparatus.



This potentiometer is of the revolving drum type and the resistance unit has a resistance of 300 ohms. The resistance wire is clamped between two insulated caps which hold the wire firmly in a horizontal position. The broad, flat contact on the tightly clamped resistance unit insures that the wire will not be damaged or displaced under constant usage. The instrument is designed for panel mounting and is provided with three binding posts to facilitate wiring.

The need for a non-inductive potentiometer and variable resistance has at last been met by the Allen-Bradley Company. The Bradleyometer is just the thing for the far end of a Beverage wire or for use in some of the latest "inverse duplex" circuits where a resistance of non-inductive type is required.

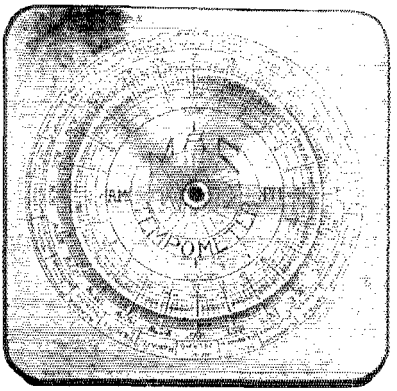
The Bradleyometer uses the same principle of compression resistance (carbon pile) that is used in the Bradleystat and is put out by the same company. Two columns of discs are assembled in the porcelain container, each column with a separate pressure plug extending through the top cover plate. The pressure knob rotates through 180 degrees and thru a special shaped cam which applies pressure to one column in one direction of rotation and to the other column in the other direction. As pressure is applied to one of the columns the pressure is released on the other.



The resistance of a column of the discs varies with the pressure, so that the action of the Bradleyometer is to *decrease* the resistance on one column and at the same time *increase* the resistance on the other. The total resistance between the outside terminals remains constant while the center connection may be shifted with respect to the resistance between it and the outside terminals.

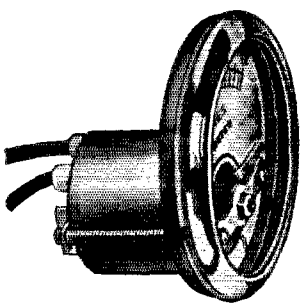
The Bradleyometer accomplishes the full range in resistance balancing with 180 degrees rotation of the knob. It is made in resistances of either 200 or 400 ohms between outside terminals.

In these days of trans-continental and international amateur radio, the "Mac-Ra-



dio" Tempometer, made by the McCallum Appliance Co., of Silver City, New Mexico is a handy thing to have around the station. It consists of a celluloid card approximately three inches square with a dial of the same material mounted on its center. By means of appropriate wording on both the dial and card the time in hours and minutes at any point in the world corresponding to our local time may be read directly by rotating the dial. Its chief use among the amateur fraternity will be in the conversion of local standard time to G.M.T. and *vice versa*. It will leave no room for argument on that subject and will save a lot of time and worry on the part of our DX men.

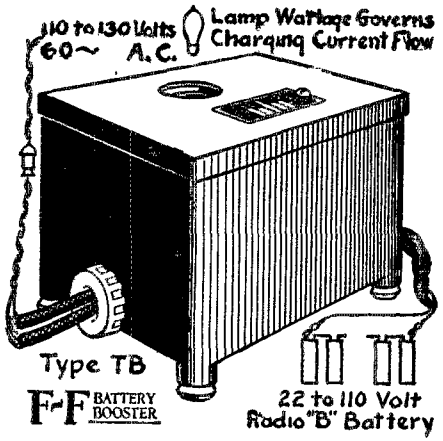
The Hoyt Peep-Hole meter has recently been put on the market by the Burton-Rogers Company. It meets the need for a low priced meter of reasonable accuracy for use in the filament circuits of receiving tubes. It can be mounted directly on the receiving panel in place of the peep-hole ordinarily used—hence its name. Any-



one who has ever had the experience of chewing a hole for a large meter out of a piece of bakelite, using a file and a drill, will be glad to hear that the Hoyt meter fits into a hole approximately seven-eighths of an inch in diameter. The meter is nickel plated, and the accompanying cut shows its actual size. Hoyt Peep-Hole meters are made to read either voltage or current. The voltmeter may be obtained with a scale of 0-6 or 0-10 volts while the ammeter is made to read 0-.8 or 0-1.2 amperes. Multipliers may be obtained which when used with the 0-10 voltmeter allow voltages up to 30, 50 or 100 volts to be read. All styles operate on either AC or DC.

Charging storage "B" batteries of 22 to 100 volts by A.C. can be easily, economically, and cleanly done with the type TB mechanical rectifier recently added to the line of "F-F Battery Boosters" made and marketed by the France Mfg. Co., of Cleveland, Ohio.

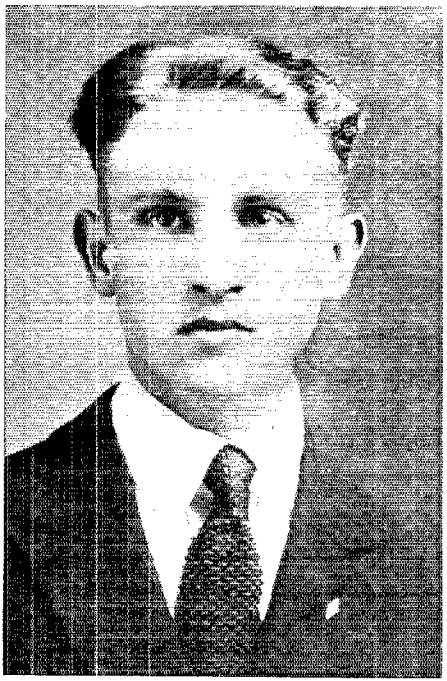
Any group of lead or Edison cells equivalent to 22 to 100 volts can be charged in series at the same time. The charging rate is regulated by an ordinary tungsten lamp screwed into the socket on the top of the rectifier. A 60-watt lamp meets the usual requirement. The battery must



be disconnected from the set before charging, as the D.C. circuits are not insulated from the A.C. end of the rectifier. An extension cord and plug makes connection to 110 V. A.C. line, and two clips with their polarities marked are used to connect to the battery terminals.

The TB charger is moderately priced. It weighs four pounds ad occupies an overall space of five by five by three inches.

Who's Who in AMATEUR WIRELESS



WM. D. WOOD

Wm. D. Wood, 9BD, (Canadian) is well known thruout the west as being responsible for the ear-rending, synchronous thunder-factory that used to radiate "power" from Vancouver, B. C. But that is not all; he has spent six of his twenty summers with "cans" clamped on his head.

He fell into the radio game while attending the Tech High at Oakland, Calif. here he operated 6KL for two winters. During the summer of 1920 he took a composite spark set to his home at the Barron Hotel at Vancouver, B. C., and proceeded to spread the call of 5BR (Can.) over the map. The station lasted only six weeks but he relates that it was worth all the trouble it caused him and the rest of the family, because it attracted the attention of the *QST* Factory to the fact that there

(Concluded on page 74)

PARKER E. WIGGIN

Among the most prominent radio amateurs in the east is Parker E. Wiggin, 8ZD of Pittsburg.

Mr. Wiggin spent the early part of his life in Kansas. After graduating from the Kansas City High School, he entered the University of Kansas where he completed a course in Electrical Engineering. He became interested in radio as an amateur in 1907 and has kept step with its development ever since. As an active amateur in Kansas, he was one of the organizers of the old Missouri Valley Radio Association.

Entering the army on April 9, 1917, he served for eighteen months in the radio research section of the United States Signal Corps under Major Armstrong. At the signing of the armistice he entered the University of Toulouse at Toulouse, France,

(Continued on page 74)

Radio Communications by the Amateurs

The Publishers of QST assume no responsibility for statements made herein by correspondents

Amateur Sigs. Recorded on Tape

S. S. Verity
Off Cape of Good Dope
March 22, 1923

Editor, *QST*:

I and the 2nd op. on this tub have been messing with a tape recorder and have got it going good now. We went down last

nite on 200 and I thot the gang might be interested in the sigs we copied there.

This is with one tube and the beauty of it is that the recording is automatic and shows EXACTLY WHAT WAS SENT.

Yours when you catch me,
S. O. Long.

QST Stays!

Dallas, Tex.

Dear Eddy:

Most folks—ordinary folks, that is—have a Designing Doctor and a Patient Preacher to whom they confide their personal joys and sorrows. The radio *amateur* adds a third court of appeals and pours out his scientific soul to the Energetic Editor of *QST*.

Just to show you how far a fellow will go when there's nobody to stop him, let me tell you a dark secret. We work for a railroad. It is up to the minute, with all latest appliance, gear shifts 'n everything and has its strikes and riots and wrecks (some of 'em barely will stay on the rails!) and, of course, its regular, absolutely-necessary, once-in-so-often salary-cuts and force-reductions.

That brings us down to the point in question. It's about these cuts in salary and their effect upon us. We were not immune or anything like that, so whenever the grim reaper *rope*, we had to kick in with a goshamighty generous chunk of our monthly recompense, just like all the other poor chaps in the office, to keep the poor old iron horse from starving to death—so they said! Well, we stopped the milkman, then the iceman; then, sometime later, we cut out the extension telephone set (why *is* a telephone, anyway?) and thought seriously of calling out the reserves and having the light meter read, with the honest intention of paying our last electric bill for some time to come. It was getting that bad.

However, before it got that far we suddenly remembered that we were subscriber to half a dozen magazines, and of course the local newspapers. Well, from now on one local was going to have to cover the field. But there were the magazines. We simply couldn't afford 'em. But which ones? All of 'em. The pretty girl pictures on the covers weren't buying us a thing and were actually making us homesick to see a real, unpainted, sweet, old-fashioned, sensible girl like our mother was when she was young. (Where are they now, Eddy?) So the magazines must go. And then came the tug of war or twanging of the heart strings, or whatever else you might want to call it, as we struggled to get rid of the periodicals with the least sacrifice. Our beloved little *QST* was listed among the unfortunates. Parting with *QST*, we knew, would be like—, well, it wouldn't be like anything but just that. Nothing else could be quite so violent a misery. So we decided to think twice.

Now, dear Eddy, we *have* thought twice. We have come to the solemn decision that before we will allow our radio intellect to lapse into a state of insensibility *we will dispense with our morning paper!* Can you grasp the import of that, old dear—such a magnificent demonstration of loyalty? You've doubtless been hauled to the office in a street car full of condensed humanity, and have observed, insofar as such a situation will permit, that here and there in the jam (we almost said *jelly!*) some cheerful bird is careening over the shoulder of some other fellow, scanning the morning's news. Ever see that? Well, we are going to do that from now on, until such a time as the high cost of living con-

descends to the level of railroad salaries—and once a month, as heretofore, our flat-footed postman will grin and hand us the li'l' ole *QST*, and we will rush indoors to flop down across the bed or somewhere—*anywhere*—happy-hearted, care-free, proud to look the whole world in the face and say, *"I'm still with the gang!"*

73 to the 'force' and very best for yourself.

Respectfully,
"Texas."

Bonehead Operating

Princeton University,
Princeton, N. J.

Dear Eddy:

There are two bonehead plays regarding traffic that I would like to raise a howl about.

Howl Nr. 1. Many of the relay stations commit the following crime. If they miss a word or two of a message, instead of coming back and giving you a plain "ND pse QTA so and so," they say, "R R R Pse QTA so and so." Now what in the hexx does that "RR" stand for? It is very confusing when a station is fading to hear him come back and say R when he means ND, to say the least. His "R" probably means, "I am still with you, old dear, but owing to unforeseen difficulties I missed a few words. Won't you do me the kindness to retransmit them?" Old timers never do it, but five different hams have set me wild with that stuff in one night. If you mean "ND," say so and don't give the other chap the apoplexy with an ambiguous "R R."

Howl Nr. 2. This is the old howl re crazy routing of traffic. The first indications of insanity the other night appeared when a bird in western New York gave me five messages for Ohio, thereby adding some 600 miles to the path. I gave them to Ohio and got worse in return. An 8 in Ohio gave me a message for Alberta, Canada. It was signed by a 6 in California! Sort of a private transcon, I gess! The last one was the worst of all. A "one" in Connecticut gave me a message for Connecticut!! I asked him "hw cum" and he sez, "Yes, . . . — . — !!"

Why not start a department for bonehead plays in *QST*? 73's.

—"J" of 3XM.

Brittle Stuff

Somewhere or Other

Dear Ed:

The millenium is here,—for me at least. I'll let you in on the dope.

Last night I wuz out with a frend and in the coarse of the evening we stopped at his place of emploiment. While there I chansed across fourteen back ishoos ov *QST*, all stranjers to me,—think ov it—14 ishoos. U know how tha fellos say they enjoi receiving their munthly copy; well, picture sum one fourteen times as happy,—can you 'majin? Say O.M. at that minut if my inward joi cud have ben expressed in radiated amps, they'd have herd me couth of Cape Horn (allow 5 miles for exaggeration). Why I could have walked out a 3rd story window and made a suksess of it, I waz that boyant!

Sum neglectful sometime-amateur had left them in a bunch of stock sold to this furm. I know that man; he's slowed up considerable tho,—(he's speed kop on our lokal forse).

On parting last nite I informed the good samertan (my friend) that he wud not see me for sum time as I wud be sojurning in Paradise for an indef'nit period, and that it wuz his fawlt 'cause he donated the whole wurks to me.

I have ben a subskriber to your magazine fur almost a year and that is wat I think of your produkt. Those two top vest buttons that just snapped off are over there in the corner—more wurk for the wife.

No kidding tho—*QST* is some magazine. Well, kind reeder I'll brake off now. Pse excuse QRM.

(QRC seventh heaven).

—(?).

Stop, Look, Listen!

Fort Worth, Tex.

Mr. Editor:—

I am handing you the following in the hope that you will publish it, and that it will help to wake my fellow amateurs to the fact that here is one more way to advertize our league. Thanks.

Sa fellers, why have we all been putting A.R.R.L. in little letters down in one corner of our cards. I for one have lit upon a bright idea. In the future all my cards will be headed "AMERICAN RADIO RELAY LEAGUE, STATION 5DI," with the accent on the first part, in large letters at the top. Don't you think this will help to give our league more prominence among the novices and non-members, than the small insignificant abbreviation at the bottom of our cards? Nobody but we hams know what it means. Think it over, fellows, and then lets all have it put at the top in a way that even the most uninformed will know that we are members of the only real honest to goodness radio organization that exists.

Yours very truly,
T. S. Depew, 5DI.

We Have With Us—

Editor, *QST*:

Don't you sometimes wish that you could know the originators of the Atrocities tha

tear holes in the Protesting Ether. Well here are just a few that you will all know.

Oswald resides in the brownstone front. He is a Delicate Child who subsides on cigarettes and sympathy. Oswald is a Leaky Condenser. His Capacity for study is about .000003 micromicrofarads. Oswald's Equipment was *Purchased Complete.* The only *Reason* that he didn't build it was because he did not *Understand* the Use of a screwdriver. His one distinction is that he can Transmit. The revised Code suits his tastes and sounds like a union suit going thru an electric wringer. His dots are long and his dashes snappy.

Budwin Blinkum's set was designed by a Boilermaker with Ideas on Interior Decoration. The Cabinet is Related to the Kitchen Variety and the Dials were copied from Steam Gauges. It is a set of Generous Proportions. His transmitting coil was taken from one of Henry Ford's offspring and sounds like Harry Lauder with a cold.

Ethelbert-the-Static-Buster has a C.W. set that is a Humdinger—at the Transmitting End. The set is a Fine one but the antenna that it has to Oscillate is the Bunk. In the least breeze it swings like a Cow-puncher's Partner in a Quadrille. To the Guy with the Phones on it sounds like a Grand Opera Company practicing the Scales.

H. Gilbert Lawrence Smythe-Jones is the radio Prodigy. About the time that Marconi found that he could Do Things with a Spark coil and was being interviewed by the Reporters, H. Gilbert got the Idea too. Marconi had him Beat To It since he had a Pull with the Higher Ups. If there is anything that you don't want to know ask H. Gilbert about it. Ask him how to figure Capacity and you will get a Free Discussion beginning with Dielectric Phenomena and the Probability of Life on Mars, proceeding with Patagonia and the Corpsular Theory and ending with a casual request to Return Tomorrow; he has forgotten the Formula at the Present.

"Tag" and "Zippy" have a secret Code. What they Say no one knows and that Includes "Tag" and "Zippy." It's a pity too, for both of them can Pound the Brass at Ten Per in a way that doesn't Require a course in Greek Grammar to Read.

"Sparks" is the Real Radio Man. He is the Guy that has the set that you can hear the Ops at Catalina Island Swapping Gum with. He has a Wave Meter that never saw as high as Two Hundred and Two. "Sparks" is the guy that helps you put up that new Antenna and the one that Stands By while you call Hortense on the Phone and ask her to take in a Movie. He amits that He Doesn't Know Nothin," but you can Bet your Oscillating Circuit that the Information he has is Accessible.

"May his Tribe Increase." Selah!

Yours sincerely,
Chas. K. Fulghum.

WM. D. WOOD

(Concluded from page 71)

were transmitting stations in Western Canada.

Upon finishing school in California and returning to Vancouver he was successful in obtaining a Canadian experimental license and was assigned the call letters 9BD. The station, which was described in the April, 1922, *QST* was one of the west coast's real HE spark stations, and did some mighty fine work. But how he ran that awful spark set in the Barron Hotel and got away with it, we don't know, unless it was because his father ran the hotel.

Mr. Wood has always taken a keen interest in various amateur radio activities. Despite his quiet and studious make-up he has multitudes of friends thruout the radio fraternity. He was until lately Manager of the Vancouver Division of our A.R.R.L. and president of the British Columbia Radio Association. He has filled these offices very capably and stands out foremost in the organization of the British Columbian amateurs.

At present he is attending college in Seattle, Wash., but he still finds time to attend club meetings once in a while or stand a watch at one of the stations.

With the coming of summer, 9BD is planning a good C.W. set in anticipation of being on the air again with the rest of the gang.

P. E. WIGGIN

(Continued from page 71)

where after five months he passed the examinations for an E.E. Degree. He later studied radio engineering at the Sorbonne University, Paris. On his return to this country Mr. Wiggin entered the employ of the Westinghouse Electric and Manufacturing Company as radio engineer. His work here dealt largely with the designing of commercial and broadcasting equipment.

Mr. Wiggin is a member of the A.I.E.E., I.R.E., A.S.M.E., A.R.R.L., and the Radio Engineering Society of Pittsburg. As a radio amateur he holds the position of District Superintendent of Pennsylvania District No. 9 of our A.R.R.L. From his station, 8ZD, he bats out a husky bunch of traffic every month.

He loves a radio argument better than food or sleep which we kinda suspected, considering that red mop o' his. His favorite subject is antennas. Those who attended the national convention at Chicago

(Concluded on page 79)

Calls Heard

HEARD DURING MARCH
Unless Otherwise Specified

On account of the vast quantity of calls reported we must ask your co-operation in the following or calls can not be published.

(1) List the calls on a separate sheet of paper—do not embody them in a letter.

(2) Arrange by districts from 1 to 9, and alphabetically thru each district; and run them across the page, not down a column.

(3) Put parentheses around calls of stations also worked.

(4) Omit initial or other unauthorized calls.

(5) In order to distinguish between spark and C.W. stations, list C.W. stations from 1 to 9 in the usual manner, and then make a second paragraph in identical form listing the spark stations.

BANG!!—and the reports echoed from coast to coast. The CQ Party held by the members of the A.R.R.L. on March 24th and 25th was a great success, fellows. The gang is absolutely "nuts" about short waves. We have actually made use of the waves below 200 meters.

The first night of the tests was a very poor night for radio in the eastern half of the country and 200 meters signals did not carry well; but there is every reason to believe that the 100 and 150 meter signals went through just as well as those on 200 did.

No doubt many of the calls logged were harmonics of the stations working on 200 meters or above. These have been eliminated from the lists as far as possible and not more than 15 per cent remain. A complete check between the stations that took part would be necessary before any definite results could be announced.

All of the calls heard during the CQ Party were copied between 80 and 190 meters. Logs were received from every district but the seventh. A number of stations were logged many times only because they transmitted incessantly and paid no attention to the schedule which was printed in March *QST* for the purpose of giving every contestant a fair chance in these tests. To these we have nothing to say; to those who contributed their real cooperation towards making the tests a success we express our heartiest appreciation of the great step they have taken towards the "practical improvement of short-wave two-way radiotelegraphic communication."

The measure of success attained can be noted from the following typical logs of stations heard:

Canadian 2CG, 493 Decarie Blvd., Montreal, 25th: 2ACD, 2AL, 2TE, 3XT, 3MF, 3AKA, 3BTL, 2AP, 2ALJ, 5XV, 3MP, 8BEO, 3CBZ, 8CRT, 3AX, 9CED,

Canadian 3XX, Port Colborne, Ont. 25th: 2ACD, 2CLA, 2CUZ 2SQ, 3AX, 3MF, 3XT, 3YO, 3OE, 3AKA, 3DQ, 3XAA, 8ZW, 8ZO, 8HJ, 8ASE, 8AMQ, 8AFL, 8CRC, 8BEO, 9BUH, 9DQU, 9CJA, 9CSR.

1BJS, 25th: 1XA, 1RD, 2CLA, 2CDK, 9DQU, 3BWT, 3YO, 3XT, 8ADH 3ALN, 3XAA, 5XV, 8AMQ, 8DAP, 8VN, 8BUM, 8ZW, 9DIO, 3OE, 5IA, 9OF, 8BYU.

1BYX, 25th: 1XA, 1XN, 1RD, 3XT 3MF, 3BWT, 3YO, 8ZW 8BUM, 8CMN, 9CSR, 8AMQ, 8HJ, 9EJ, 8CRN, 9DQU, 9DHR 9CFX, 3AEV, 3XAA, 3CBZ.

1BVL, 24th: 1XA, 8ZW. 25th: 1XM, 1RD, 1BYX, 3BWT, 9JK, 3ALN, 1CRE, 8ZW, 9DHR, 8BUM, 8VN, 9DIO, 9JK, 9COC.

L. W. Bishop, Athol, Mass., 25th: 1AQI, Can. 2CG, 2ACD, 2CLA 2BGI, 2ALK, 3OE, 3TE, 3MF, 3AKA, 3XT, 3AX, 3CBZ, 3HT, 4FA, 4PM, 5XV, 5OV, 8BEO, 8HJ 8CGS, 8RE, 8AMY, 8ADH, 8CRN, 9DYU, 9DVR, 9EJ, 9CSR, 9CED, 9DWF, 9DIO, 9BIL.

2BJO, 24th: 1QP, 2AJE, 2AVE, 2BBB 2CLA, 2COA, 2KV. 25th: 2CDK, 2CUZ, 3CBZ, 3OE, 3XAA, 5OV, 5XV, 6MH, 8ADH, 8AJX, 8CRN, 8HJ, 8ZW, 9ADF, 9CSR, 9DQU, 9DX, 9EJ, 9OF, Can. 2CG.

E. B. Wilson, Yonkers, N. Y. 25th: 2AJA, 2CSZ, 8BEO, 3YO, 2CTD, 8ZW, 2KV, 2CUZ, 2CDK, 3XT.

2CUR, 24th: 2CBW, 2CEI, 2FZ, 2KV, 2CUZ, 2XV, 2VH, 2CDK 8XK, 2BGD, 2BHI, 2COA, 2CCD, 9II 8LT, 2UA. 25th: 1XA, 2EL, 8ZW, 2KV, 9UU, 3BTW, 2CUZ, 2BOA, 3CBZ, 2COA, 2CMJ, 8CFX, 3HL, 2CXF, 2CEI, 9DHR, 8VN, 8DFU, 5IA.

3BB, 25th: 1XP, 1HX, 2CLA, 3BWT, 3MF, 9DHR 3XT, 3YO, 3FP, 8ADH, 8ACD, 2ACD, 3AX, 8ZW, 3BGU, 3XAA

3YO, 24th: 2CLA, 8XK, 2CCD, 8LT, 3ZW, 8XK, 8IB, 9CSR, 2ALK, 8HJ, 5XV, 9OF, 9AWG, 5XAD, 9YB. 25th: 1KW, 3AHP, 8BUT, 1GV, 3SU, 9DQU, 8ER, 9DZI, 3LK, 2CLA, 2KV, 2CUZ, 2CDK, 2CUR, 3BJ, 3BEI, 2CIU, 4HW, 9DHR, 8BUM, 8CRT, 9DIO, 9UR, 2EL, 9DXC, 3AEV, 6GI, 5IA, 3ALN.

3AEV, 24th & 25th: 2BRB, 2CWO, 2CLA, 2RE, 3MF, 3YO, 3CBZ, 3HS, 3XAL, (3XAA), 5IA, 5OV, 5QS, 5QI, 6GI, 8ADF, 8BUM, 8CGS, 8CRB, 8HJ, 9ADH, 9BJL, 9COC, 9EJ.

3APV, 25th: 1HX, 9DQU, 8ZW, 2CLA, 2ACD, 2CLW, 2CDK, 2CUZ, 2KV, 3FP, 3XT, 9DZS, 3BWT, 3YO, 3AKA, 3DHR, 8HJ, 3CBZ, 8BEO 9DTK, 3DQ, 3XAA, 8AQH, 9CJA, 1XP, 3AX, 5XV, 3TE, 8AMQ, 3HB, 5OV, 8HJ, 8ADH, 8CMN, 8CGS, 9CSR, 8CRN, 9EJ, 9CJA, 9DWF, 8CRB, 9ECZ, 5JF, 9DYU, 2CG, 9OF, 9CGY, 4PM, 2BLA, 2CWO 8AEV, 9CYG, 3CBZ, 9EDJ, 9BJL, 5OS, 5QI, 9CJD, 5MB, 5UY, 5OV, 6EO, 5AHR, 9DWM 8ASK, 8AXN, 8HJ, 8UT, AW5, 9BRI, 8CUN, 9CSR, 9DZK, 9DQU, 9BKO, 8CUQ, 9CYB, 8BWY

5XV, 24th: 5XK, 9DHR, 9CYG, 5ZA, 8BU, 8ADK, 9XJ, 3YO 3GL, 4EH, 5SZ, 8BRL, 5KN, 9BJI, 3TR, 9OY, 9HJ, 9XJ, 8ZW, 8IB, 9OY, 9SR, 9ZT, 9OF, 9JK. 25th: 1RD, 4MI, 1XA, 9DQU, 6GI, 8AJX, 9CSR, 8CRN, 9DID, 9DWE, 9BZZ, 9ADF.

5XAC, 24th: 3HS, 8BIY, 4PB, 4BX, 5ZA, 3PZ, 3AX, 3XAI, 5AEC. 25th: 5BM, 4GV, 2BJ, 4HW.

5XAJ, 24th: 2CLQ, 2CWO, 3HS, 3RE, 3QEV, 3CBZ, 5KP, 5OV 5XV, 6EO, 6GI, 6ZT, 6ABX, 6AJF, 6AVN, 9BJL, 9DWN. 25th: 2CLA, 2CUZ, 3YO, 5AHR 5XV, 6GI, 9JK, 9AHM, 9DQU.

5IA, 24th: 4EH, 6GI, 5ZA, 9II, 5AIR, 8ZW, 8LT, 6ZH, 8IB, 5SP, 9ECE, 9OF, 8IB, 9ZT, 9UR, 9ECE, 9JK, 5AIR, 9AWC 9DXN, 9DGK, 9BEM, 9ATN, 9HK, 9ALG, 5VA, 6GI, 9OF, 5XB, 5SP, 5ABP, 5XAD, 5KW, 5KT, 9BRI, 8HJ, 5EK, 9AHZ, 9AHH, 5KT, 5ZAV. 25th: 9JK, 5ZA, 9II, 9DHR, 6GI, 3AEV, 5XAD, 9COC, 9ABU, 9ADF, 9OF, 5XV, 6CBG, 9ADF, 9CUC, 6ZH, 5AKI, 9DIO, 8CGX, 9DQR, 6BIP, 6AAJ.

6AJF, 24th: 3BWT, 5IA, 8XK, 9JK, 8ZW, 9ECE. 25th: 5ZA, 5IA, 9DIO, 9CSR, 9EJ, 5XV, (9ABU), 6CBG.

8LW, 24th: 3ALN, 3AX, 3JX, 4EP, 4ID, 5AHT, 5CO, 5GB, 5IA 5MB, 5QI, 5XAC, 6GI, 8ABB, 8CMN, 8CUS, 8CUZ, 8IB, 8XK, 8XY, 8ZW, 9AII, 9AHR, 9BEM, 9CIE, 9CLY, 9DHR, 9ECE, 9JK. 25th: 1XP, 2ACD, 2BJO, 2CDK, 2CLA, 3AEV, 3AX, 3TE, 3XAA, 3YO, 5IA, 5OV, 5XV, 6GI, 8AJX, 8ADH, 8CMN, 8CGJ, 8HJ, 8CWC, 8LT, 8ZO, 8VY, 9ABU, 9BZE, 9DHR, 9DIO, 9DQU, 9EJ, (9OF), 9YH.

8ZW-8BSY 24th: 5OV, 5KP, 8CUN, 6AVN, 3YO, 9DQU 9CLY 4PM, 8CBC, 8CUQ, 9BRI, 9BKO, 9CYB, 8CUQ, 2FP, 9DWF, 9DQU, 9BYX, 5AHR, 8CMN, 9BRI, 9CLY, 9BYX, 9DWN, 8DFV, 5ADE. 25th: (8AX), 2ACD, 2AL, 1HX, 3TE 3MF, 8AGO, 3DQ, 8HW, 8ADH, 3CBZ, 8VT, (8ASL), 9EJ, 3AX, 3OE.

8AJX, 25th: 1XP, 2CDK, 2CTU, 2ACD, 2AL, 2CLA, 2CUZ, 2CDK, (2BWT), 3YO, 3XT, 3FP, 3MF, 3AX, 3OE, 5AHR, 5XV, 5ZA, 5XAD, 5OV, 6GI, 8IJ, 8ZW, 8HJ, 8BEO, 8ADH, 8XAN, 8DGW, 9DQU, 9BUH, 9DHR, 9DIO, 9COC, 9DX, 9CSR, 9BZE, 9ABU, Can. 2CG.

8VN, 24th: 5ZAC, 8DAK, 8BZC, 8ZW, 8CLV, 4EH, 8ALO, 8ALN, 8AOS, 9JK, 6GI, 5AD, 2CCD, 9ECE, 2ALO, 4JX, 9HK, 5IA, 5SP, 5AIR, 9DQU, 2EL, 5XAD, 1BGF, 9JK, 9BIK, 5IA. 25th: 8BSY, 1BYK, 1XM, 1XA, 8BQS, 3TE, 1RD, 5XK, 3TE, 8DFP, 8RJ, 3AKR, 3BWT, 8EO, 3AWE, 9ACW, 3CBZ, 6GI, 9DHR, Can. 3PG, 9UU, 8CUV, 3BEI, 3HL, 8BDB, 9DIO, 9ABU, 9EBI, 8BDB, 5XAJ, 4FS.

9EBV, 24th: 2CCD, 8AEV, 3CBZ, 4GA, 4EH, 4AG, 4MI, 5XK, 5XV, 5QI, 5NK, 5XAC, 5AIR, 5SP, 5MO, 5XAD, 5IA, 6GI, 8IB, 8CBO, 8AFD, 9JK, 9CUC, 9AWQ, 9AIH. 25th: 1XM, 1XA, 2CDK, 2CLA, 2CUZ, 3YO, 8ALN, 3AEV, 3BTI, 4JL, 5ZA, 5XAD, 5XV, 5IA, 6GI, 6AJF, 8BUM, 8AMQ, 8AJX, 8CRT, 9JK, 9ABU.

9DWK, 24th: 2CCD, 4EH, 5KW, 5XAD, 5IA, 5QV, 5XAC, 6GI, 8ZW, 8VN, 8LT, 8XY, 8IB, 8CGX, 9CYQ, 9APV, 9BZZ, 9BJI, 9UR, 9DWF, 9OF. 25th: 1XA, 1XM, 1RD, 1BYX, 2CUR, 2BJO, 2CCD, 8BWT, 8ALN, 8AEV, 5IA, 6GI, 8AIT, 8LW, 8ZW, 8AJX, 8CMN, 8CRB, 8VN, 8BUM, 9OF, 9ABU, 9ADF, 9SR, 9COC, 9AHH, 9JK.

9DQU, 24th: 1HX, 2BRB, 2CLA, 2BGI, 3YO, 3RE, 3HS, 3CBZ, 3HS, 3XAL, 5GB, 5AGJ, 5KP, 5QI, 5UY, 5MB, 5OV, 6AVN, 6EO, 6ZT, 6CBG, 8AMQ, 8AXN, 8IB, 8UT, 9OY, 9CVI, 9CYG, 9BJL, 9BRI.

8LT, 24th: 2CPO, 3ALN, 3BWT, 5IA, 5XK, 5ZA, 6GI, 8ADK, 8XK, 9ECE, 9JK, 8HK,. 25th: 1XA, 1XM, 2CUR, 3ZP, 8AZQ, 8BDU, 8CFX, 8DGD, 8ZQ, 9DHR, 9VE.

REGULAR CALLS HEARD

S. S. Edgehill,

Daylight(1 P.M.)550 miles East of N. Y., 1SK, 2EL, 1000 East N. Y. Spark: 1RR, 1RV, 1ARY, 1BOQ, 1CNI, 2BK, 2AWZ, 8FP, 8QW, 5XA, 8EW, 8AEO, 8BDA, 8BUM, 8COA, 9BDH. C.W.: 1MC, 1RV, 1TL, 1ANQ, 1BDI, 1BES, 1BGF, 1BOQ, 1BQL, 1BRI, 1BRQ, 1CDG, 1CDO, 1CIK, 1CKP, 1COT, 2BY, 2HO, 2AZY, 2BFE, 2BXW, 2CBT, 2CCD, 2CNK, 2CVJ, 3HD, 3MF, 3PZ, 3TJ, 3XM, 3ACY, 3ALU, 3ANJ, 3AZE 8BTL, 3CEL, 4EB, 4FT, 5KC, 5MB, 5RN, 5XV, 5ZAS, 6ZZ, 8BN, 8CK, 8CP, 8EO, 8GU, 8GZ, 8IH, 8ZW, 8BDU, 8BEO, 8BST, 8CJX, 8CJY, 9QR, 9AAP, 9BZI, 9CBA, 9DCB, 9EDB. Can. 3DH, 9BV.

1200 East N. Y. Spark: 1SN, 2JZ, 4FD. C.W.: 1GS, 1GV, 1IT, 1MC, 1ON, 1RV, 1SK, 1XM, 1ZE, 1AJU, 1AJX, 1ANA, 1ANQ, 1ASF, 1ATJ, 1AYQ, 1BAN, 1BAS, 1BDI, 1BGO, 1BOC, 1BRQ, 1CAC, 1CAJ, 1CFI, 1CIK, 1CKP, 1CMP, 2BY, 2DD, 2NZ, 2OM, 2SZ, 2ARS, 2BGI, 2BMR, 2BRC, 2BZV 2CBT, 2CEI 2CHA, 2CPD, 3FQ, 3FS, 3HJ, 3HK, 3JJ, 3KM, 3LP, 3TJ, 3AAO, 3AJJ, 3ARO, 3BJY, 3BSS, 4BI, 4EL, 4FT, 4JK, 4YA. 4ZC, 5KC, 5NS, 5QI, 5QW, 6ZZ, 8FR, 8FU, 8GZ, 8IB, 8IS, 8JJ, 8KG, 8KH, 8LH, 8SP, 8UF, 8WX, 8AAF, 8ANJ, 8AWP, 8AXN, 8BBF, 8BDO, 8BFQ, 8BKE, 8BRT, 8CCB, 8CEI, 8CFP 8CGJ, 8CHV, 8CMJ, 8CRB, 8CTP, 8CTY, 8CYU, 8DAG, 9EP, 9QF, 9QR, 9UL, 9VZ, 9ZT, 9ADF, 9AEC, 9AFK, 9AMU, 9APS, 9BKJ, 9CDR, 9CDU, 9CMK, 9CWR, 9DHS, 9ECE. Can. 1BQ, 1400 East N. Y. Spark: 1CNI. C.W.: 1GV, 1JV, 3BP, 3DH, 3SI.

1MC, 1OW, 1QP, 1RV 1SK, 1ALA, 1AOK, 1ATJ, 1AUN, 1AYZ, 1BAN, 1BAS, 1BDI, 1BOQ, 1CIV, 1CKQ, 1CNF, 1CRI, 1CWR, 2HO, 2AER, 2ATS, 2AWF, 2BBB, 2CPD, 2CQZ, 2CVJ, 3CM, 3HG, 3HK, 3PZ, 3QV, 3XM, 3ADQ, 3AHK, 3BLF, 3BSS, 3CBZ, 4EA, 4FT, 4HW, 4JZ, 4NT, 5MO, 5XB, 8ZD, 8BDU, 9EI, 9LH, 9OX.

1650 East N. Y. All C.W.: 1GV, 1MC, 1OW, 1XM, 1ZE, 1AYZ, 1BDI, 1BRQ, 1CNF, 2BY, 2OM, 2BMR, 2CCD, 2CIM, 3HD, 3AHK, 3BSS, 3XAL, 4BY, 4FS, 4JZ, 4KY, 5FV, 5MB, 5MO, 5ZA, 5ZAV, 8ZD, 8CXW, 8DAG., 9LH, 9YB, 9AAP, 9BHD, 9CBA, 9CTE. Can. 1BQ.

1900 East N. Y. All C.W.: 1BAN, 2NZ, 2AFP, 3JJ, 3ARO, 3XAL, 4FT, 4JZ, 4NT, 5AIV, 8CF, 8FQ, 8ZD, 8AAF, 8BCH, 8BFQ, 8CQL, 9CCS, NOF. 2100 East N. Y. Spark 2BK. C.W.: 1GV, 1MY, 1OW, 1RV, 1ASJ, 1BAN, 1BAS, 1BDI, 1CKP, 2XQ, 2AGD, 2ALE, 2AWL, 2BQU, 2CCD, 2CGT, 2CVJ, 3BA, 3FQ, 3HD, 3OE, 3PZ, 3SK, 3TR, 3VW, 3WF, 3XM, 3ARO, 3APR, 3BJY, 3BUY, 3XAL, 4BI, 4EA, 4FS, 4FT, 4OD, 5KC, 5MB, 5MO, 5PB, 5XB, 5ZAV, 8ARD, 8BEK, 9PS, 9DRI. NOF. Can. 1BQ. 2300 East N. Y. All C.W.: 1GV, 1JV, 1BES, 1BKQ, 1BQD, 1BRQ, 1CMK, 2FP, 2ATS, 2BNZ, 2BQU, 2CCD, 3FS, 3GZ, 3HG, 3JJ, 3OE, 3XM, 3ARO, 3CBZ, 3XAL, 4EB, 4YA, 5KC.

2600 East N. Y. All C.W.: 1GV, 1AOK, 1BAS, 1BDI, 1BES, 1BRQ, 2AYV, 3FS, 3PZ, 4NV, 4YA. Canadian 1BQ.

2750 miles East of N. Y. (180 miles from Land's End, England) All C.W.: 1GV, 1AOK, 1BAN, 1BAS, 1BRQ, 2XQ, 2AFC, 2ATS, 2AWF, 2CGV, 2COA, 4NT, 8VQ, 8ALF, 8CDV, 8CKV, 8CVH, 9LH, 9AIX, 9BDS, 9DRI. Can. 2HG, 3JL, 9BJ.

2500 mi. East of N. Y. Spark: 2FP, CW: 1GS, 1MY, 1YK, 1AOK, 1BAN, 1BTR, 2FP, 2OM, 2XQ, 2ACD, 2ATS, 2CVJ, 2CVU, 3IZ, 3MF, 3SU, 3TR, 3AJJ, 3APR, 3BLZ, 3BNU, 3CBZ, 3XAL, 4MB, 4YA, 5JT, 5NZ, 5RH, 5XB, 5ZABA, 8ZD, 8BOG, 8CXW, 9AIX, 9APS, 9CBA.

2250 miles East N. Y. Spark: 2FP. C.W.: 1KV, 1MC, 1MY, 1YK, 2EL, 2XQ, 3AGB, 2CCD, 3HG, 3AJJ, 3CFQ, 5BM, 8VQ, 8AQV, 8CEI, 8CUU. Can. 1BQ, 1OW.

2000 miles East N. Y. All C.W. 1GS, 1GV, 1MC, 1ASI, 1BAN, 1BES, 1BRQ, 1CDR, 2BO, 2EL, 2NE, 2AGD, 2ATS, 2BBB, 3FS, 3HD, 3KM, 3TR, 3WF, 3ZO, 3ZP, 3APR, 3BWT, 3XAL, 4EH, 4FA, 4FT, 4ME, 4NT, 5XB, 5XAD, 8UF, 8VQ, 8XE, 8BCH, 8BOA, 8CRB, 8CYT, 9ME, 9QR, 9UU, 9AIX, 9APE,

9APS, 9APW, 9BSG, 9BXC, 9CTE, 9DIO, 9DSM, Can. 2HG.
1800 miles East of N. Y. All C.W.: 1GV, 1BAS, 1CDR, 2CPD, 4FT, 8AAF, 8XE.
1600 miles East N. Y. All C.W.: 1ADL, 1BRQ, 2HJ, 2CCD, 3PZ, 3TR, 3XAL, 4FT, 8ZW, 8AAF, 88CH, 8CRB, 8CUR, 8XAD, 9BCB, 9DYU, Can. 3JL.

Heard by 600 at sea.

Feb. 1, 3510 W. of San Francisco: 6ARB, 6EA, 6BUN, 6CU, 7ABB, 7LR.
Feb. 2, 3729 W.: 5HO, 6ANH, 6BJY, 6XAD, 6JN, 6CU, 7BS, 7OT, 7SC, 7PF, 9ZN, 9AON, 9DXN.
Feb. 3, 3952 W.: 6AVR, 6BOE, 6BVG, 6BWE, 6RM, 6VM, 6TI, 6XAD, 7SC, 9XAC, 9AEQ.
Feb. 4, 4150 W.: 377, 6AAK, 6BOE, 7BK, 7PF, 7WM, 7OF, 7SC, 9AEY, 9DUG.
Feb. 5, 4350 W.: 6BOE, 6BUN, 7LR, 7PF, 7SC. (630 E. of Yokohama.)

B. Overstreet, Feb. 19th.
At Sea between Cuba and Haiti

C.W.: 1SN, 1MK, 1BAN, 2RM, 2XQ, 2AOI, 2BLK, 2DDL, 3FS, 3ZO, 3ZZ, 3BVA, 3BNU, 4AG, 4EM, 4FT, 5SF, 5NB, 5ADO, 5ZAS, 6ZH, 6BQE, 7ZV, 8PJ, 8AHR, 8APW, 8ATX, 8CGU, 8DAK, 9BJ, 9AAV, 9AMH, 9BED, 9BDS, 9BHI, 9BKD, 9BKK, 9BTT, 9CTG, 9CVO.

S. Y. Casiana

Mar. 20th, 1600 miles S.E. Los Angeles; 4EL, 5MB, 5KC, 5XV, 5YE, 5AKI, 6ZH, 9OX, 9APE, 9BSG, 9CKI.
Mar. 24, 50 miles W. of Panama.: 2FP, 2ZK, 4AR, 4DN, 4XJ, 5BW, 5FV, 5XB, 5AIR, 5ZAK, 8QD, 8ADG, 8BZC, 8CRB, 8CJD, 8DAT, 9DQ, 9PW, 9QR, 9XJ, 9AVC, 9DQM.

Calls heard by H. W. Money, at Sea.

Feb. 8th—666 miles N.E. Colon, 3ASP, 3FQ, 4FT, 8IJ. Feb. 10th—50 miles N.E. Colon, 3AC, 3PZ, 4BI, 4EA, 5BY, 5KC, 8BDA, 8BPX, 8BSF, 9PS, In the Panama Canal Feb. 12th, 2AYV, 2CCD, 2FP, 8AMM, 8ALF, 8WX, 9AOG, 9BZI. Feb. 13th, 100 miles south of Panama City, 1BAN, 2CQZ, 4HW, 7ABD, 8BCH, 8CAA, 8CRD, 8JV, 9DGN, 9EHI. Feb. 14th, 350 N.W. Panama City, 2EL, 6KA, 9BYN.

Carl G. Brown,
Box 133, Ancon, Canal Zone, Panama.

C.W.: 1AGH, 1AGI, 1AJP, 1ASJ, 1AW, 1AYZ, 1BAN, 1BES, 1BKQ, 1BOP, 1BRQ, 1BTR, 1CAK, 1CDR, 1CKP, 1CMK, 1CMP, 1CNI, 1CPN, 1CQN, 1ER, 1FD, 1II, 1IV, 1JV, 1MY, 1OW, 1RV, 1TL, 1XM, 1YK, 2ABZ, 2ACD, 2AF, 2AFD, 2AOS, 2ATS, 2AWF, 2AYV, 2BGI, 2BMR, 2BQH, 2BUM, 2BXP, 2BZP, 2CBC, 2CBW, 2CCD, 2CEI, 2CIM, 2CKL, 2CWO, 2CXL, 2CQZ, 2DD, 2EL, 2FP, 2GI, 2HJ, 2NZ, 2OM, 2RM, 2WR, 2XQ, 2ZK, 3ABW, 3ACY, 3AJD, 3ALN, 3ANS, 3APR, 3AQR, 3ARO, 3ATB, 3ATS,3AVA,3BGT,3BHL,3BHM,3BMM,3BOF,3BOU, 3BSS, 3BWT, 3CBZ, 3CFQ, 3FQ, 3HG, 3HL, 3IZ, 3JJ, 3KM, 3PB, 3PZ, 3TJ, 3VW, 3XA, 3XAL, 3XM, 3ZO, 3ZP, 4AG, 4AZ, 4BH, 4BI, 4BK, 4BY, 4CW, 4DC, 4DN, 4DO, 4EB, 4EL, 4FS, 4FT, 4GL, 4HW, 4IH, 4IK, 4JZ, 4KM, 4ME, 4NC, 4NV, 4OB, 4OI, 4XJ, 4YA, 5AA, 5AAR, 5AAT, 5AHT, 5BM, 5BN, 5CY, 5DA, 5DI, 5DQ, 5EK, 5EL, 5FT, 5FZ, 5GA, 5GT, 5HH, 5HO, 5HZ, 5IX, 5JF, 5JI, 5JS, 5JT, 5JZ, 5KC, 5KN, 5KS, 5KW, 5MB, 5NK, 5NZ, 5OK, 5PD, 5PF, 5PX, 5QI, 5RH, 5SK, 5TC, 5UK, 5UN, 5VO, 5VR, 5VV, 5XAD, 5XAJ, 5XB, 5XK, 5XV, 5YE, 5ZA, 5ZAK, 5ZAS, 5ZAT, 5ZAV, 5ZAX, 5ZB, 6ANH, 6AWT, 6AWX, 6BJQ, 6CBI, 6CEB, 6CGW, 6KA, 6TI, 6ZAO, 6ZH, 6ZN, 6ZZ, 7ZF, 7ZU, 8AAF, 8AB, 8AFD, 8AGO, 8AHR, 8ALO, 8ALV, 8ANB, 8AQV, 8ARD, 8AWP, 8BBE, 8BBF, 8BCH, 8BDB, 8BDO, 8BEO, 8BFM, 8BFQ, 8BFX, 8BOG, 8BUT, 8BWA, 8BXA, 8BXC, 8BXH, 8BYO, 8CBR, 8CEI, 8CGJ, 8CP, 8CPD, 8CQX, 8CRB, 8CTP, 8CYU, 8DAG, 8ER, 8FT, 8GZ, 8HN, 8JJ, 8JY, 8KH, 8LD, 8MZ, 8QK, 8UE, 8UF, 8VY, 8WX, 8XAN, 8XE, 8YK, 8ZD, 8ZO, 8ZW, 8ZZ, 9AAU, 9AIX, 9AJX, 9AMI, 9AMT, 9ANQ, 9AON, 9APE, 9APS, 9APW, 9ATN, 9AUL, 9AZA, 9BDS, 9BED, 9BIK, 9BRK, 9BSG, 9BTT, 9BVY, 9BYW, 9BZI, 9CBA, 9CCS, 9CCV, 9CDU, 9CED, 9CFB, 9CJC, 9CKP, 9CPA, 9CQU, 9CTR, 9CWC, 9DGE, 9DGQ, 9DIO, 9DLF, 9DQU, 9DRI, 9DSM, 9DWF, 9DWK, 9DXN, 9EBI, 9ECE, 9EHN, 9EKF, 9OX, 9RC, 9UU, 9VM, 9XAC, 9YB, 9ZT.
Spark: 4BC.
Fone: 2EL.
Canadians, C.W.: 3GB, 3GK, 3JL, 3NI, 3ZQ.

Can. 2CG, 493 Decarie Boulevard, Montreal.

C.W.: 1ADL, (1UJ), 1KC, (1YK), (1BFE), (1AGH), (1RD), (1KV), (1CSP), (1BTJ), (1CKP) (1CJH), (1AP), (1ARY), (1MY), (1XM), (1CAJ), (1CPN), (1DL), (1BGC), (1BYN), (1CRU), 1BAN, 1CAZ, 1ABF, (2CUZ), (2CSA), (2BY), (2AXF), (2BYW), (2ALE), (2CXL), (2CMS), (2GW), (2RM), (2AJA), (2NZ), (2CVJ), 2NE, 2BTW, 2MU, (3BMO), (3BRL), (3HS), (3IW), (3SU), 3ZS, 3IH, 3AFU, 3ATS, 3BVA, 3CAH, 3BHL, 3IJ, 4BI, 4FT, 4YA, 4CA, 4JL, 4LP, 4BX, 5ZA, 8CEI, 8CPX, 8ZW, 8VL, 8CJZ, 8VY, 8CUN, 8FI, 8BRT, 8AZV, 8ADH, 8CGU, 8AVD, (8CVJ), 8CMN, 8CHB, 8CRN, 8BFM, (8RJ), 8AEG, 8CRB, 8CIH, 8BFQ, (8UF), 8SK, 8AXN, (8CTY), (8ALU), (8BDB), (8BEK), (8CCU), (8BMG), (8AGR), (8DFD), (8BCP), (8DAA), (8ZZ), (8AKP), (8CHB), (8BBF), (8AIA), 8CMZ, 8BDU, 8AGP, (9DVL), 9CTV, 9AAP, 9BRK, 9CBI, 9DGQ, 9LZ, 9RC, 9VM, 9ARZ, 9CZR, 9DFB, 9CNV, 9DGI, 9CSR, 9CJI, 8BCH, 9EEV, 9BCB, 9DBN.
Daylight: (8UF), (1ARY), (8CTY), (1YK), (1BFE), (1CJH), (1MY), (8CCU), (2CVJ), 1BAN, 3JJ, 1CPO.
Canadian C.W.: (9AL), 9AJ, 3OH, 3ADN, (3BQ), (3SI), (3JT), 3TL.

1TS, Bristol, Conn.

C.W.: (1WC), 2OM, (3ZO), (4AF), 4AG, 4BX, 4CY, (4DO), 4EB, 4EH, 4EL, 4FG, 4GZ, 4HW, 4IK, (4IV), 4LJ, 4LP, 4MB, 4NT, 4NV, 4XJ, 4YA, 4YD, 4ZC, 5AAH, 5ABH, 5ADE, 5AEC, 5AGJ, 5AIB, 5AIC, 5AKI, 5AKR, 5BE, 5BM, 5CY, (5DA), 5DI, 5EK, 5EL, 5EN, 5GA, 5GG, 5HL, 5JF, 5JS, 5KC, 5KE, 5KW, 5MB, 5MY, 5NZ, 5PB, 5PV, 5PX, 5RH, 5SF, 5SP, 5UK, 5XAB, 5XAD, 5XB, 5XK, 5ZABA, 5ZAK, (5ZAS), 5ZAV, 5ZAX, 5ZB, 5ZG, 6ARB, 6AWT, 6AWX, 6BIK, 6BJQ, 6BNT, 6BOE, 6BUN, 6BVF, 6BVG, 6CGW, 6CU, 6EA, 6EB, 6EC, 6JD, 6QW, 6XAD, 6ZH, 7ABB, 7BA, 7LW, 7ZO, 7ZV, 8AWP, (9AAP), 9AAV, 9ACE, 9ADF, 9AFK, 9AHK, (9AIX), 9AIY, 9AJH, 9AKU, 9ALG, 9AMI, 9AMO, 9AMU, 9ANQ, 9AOD, 9APD, 9APE, (9APH), 9APS, 9APU, 9APW, 9ARI, 9ARZ, (9ASE), 9ASF, 9ATN, 9ATO, 9AUL, 9AUS, 9AW, 9AWP, 9AWS, 9AYD, 9AZE, 9BAF, 9BAK, 9BCF, 9BD, 9BDS, 9BED, 9BEH, 9BEM, (9BHD), 9BHW, 9BIK, (9BKJ), 9BKK, 9BKP, (9BLG), 9BRK, 9BSG, 9BTL, 9BUJ, 9BVP, 9BVY, 9BVZ, (9BWF), 9BWN, 9BXC, (9BXT), 9BZF, 9BZI, 9BZU, 9CAA, 9CBA, 9CBZ, 9CDB, 9CDU, 9CED, 9CEE, 9CEH, 9CFB, 9CFK, 9CGA, (9CGD), 9CGK, 9CGU, 9CHY, 9CIN, 9CIP, 9CJC, 9CJM, 9CKI, 9CKP, 9CLQ, 9CLZ, 9CPA, 9CPB, 9CPG, 9CPU, 9CTR, (9CTV), 9CUA, 9CUI, 9CUO, (9CVO), 9CXP, 9CYW, 9DAO, 9DAT, 9DAW, 9DAX, 9DBH, 9DBL, (9DC), 9DCT, 9DCW, 9DGE, (9DGN), 9DGV, 9DGX, 9DHR, 9DHS, 9DIO, 9DJB, 9DJF, 9DKA, 9DKY, 9DLI, 9DLR, 9DPF, 9DPV, 9DRI, 9DRR, 9DSG, 9DWN, 9DXM, 9DXN, 9DYN, 9DYU, 9DZG, 9EAD, 9EBI, 9EDB, 9EHT, 9EIB, 9EIL, 9EIQ, 9EKF, 9EKY, 9EP, (9FK), 9FP, 9GK, 9IH, 9II, (9IL), 9LN, 9LZ, 9NU, 9OF, 9OX, 9OY, 9PQ, 9QL, 9QR, 9RC, 9SV, 9UC, 9UH, 9US, 9UU, 9VB, 9VM, 9VC, 9VZ, 9XAM, 9XAQ, 9XM, (9XJ), 9YB, 9YH, 9ZT; Canadian: 1BQ, 2CE, 2CQ, 3AD, 3ADN, 3GK, (3HE), 3JT, 3KO, 3NI, 3OH, 3PG, (3SI), 3TA, 3TL, 3UJ, 3UZ, 4BV, 4CO, 4FN, 5CN, 9AJ, 9AL, 9BV.
Spark: 4MV, 5JD, 9AAW, 9AHQ, 9AHZ, 9AOJ, 9ASO, 9AUC, 9AUU, 9BAG, 9BDH, 9BEC, 9BHZ, 9BLU, 9BUX, 9CA, 9CCS, 9DGW, 9DHG, 9DWP, 9DZY, (9EFC), 9HJ, 9PD, 9VZ.
Canadian: 3FH.

3CK, Toronto, Ont.

C.W.: 1AJX, 1API, 1AYT, 1BAQ, 1BHR, 1BKQ, 1BOQ, 1BQI, 1BQK, 1BRQ, 1CAB, 1CAC, 1CBT, 1CDR, 1CBT, 1CDR, 1CFB, 1CPI, 1CPN, 1GS, 1MY, 1OK, 1ZE, 2APA, 2AUJ, 2BA, 2BUY, 2CFB, 2CVJ, 2EUO?, 2HO, 2MY, 3AHP, 3AKR, 3ALU, 3APH, 3APR, 3BJ, 3BRL, 3BRW, 3BTA, 3BTL, 3BUY, 3BZ, 3CBM, 3CKL, 3FI, 3GG, 3HJ, 3HH, 3HL, 3II, 3IR, 3KE, 3KM, 3OD, 3OT, 3PZ, 3RF, 3SK,

3TR, 3XM, 3ZEL, 4CI, 4EB, 4EH, 4FT, 4MB, 4ME, 4MT, 4MV, 4NV, 4YA, 5BM, 5RH, 8ABL, 8AGP, 8AIK, 8ALT, 8ANB, 8ANJ, 8AUL, 8AUK, 8AVL, 8BBF, 8BBP, 8BDB, 8BCH, 8BEM, 8BEO, 8BFO, 8BFV, 8BOG, 8BOZ, 8BPU, 8BQC, 8BRT, 8BTU, 8BTV, 8BYF, 8BYH, 8CBK, 8CBP, 8CCP, 8CFP, 8CGI, 8CGQ, 8CJZ, 8CRB, 8CVQ, 8CVX, 8CWL, 8CZN, 8DAA, 8ES, 8GZ, 8ID, 8IH, 8IJ, 8LS, 8LT, 8KU, 8OW, 8TT, 8UF, 8US, 8UT, 8VL, 8WT, 8WX, 8ZW, 9AAD, 9ALG, 9AMU, 9BAL, 8BCB, 8BEE, 9BOO, 9BSW, 9CBA, 9CCV, 9CDU, 9CHK, 9CJM, 9CZF, 9DHR, 9DJM, 9DRI, 9DWK, 9EC, 9ED, 9EIL, 9FP, 9LH, 9OR, 9PE, 9UR, 9VV, 9WX

2CUV, West Hoboken, N. J.

1ADL, 1AF, 1AYQ, 1AZL, 1BAN, 1BAS, 1BES, 1BGC, 1BKQ, 1BOP, 1BQ, 1BQD, 1BTR, 1CAN, 1CPN, 1CRE, 1EZ, 1GS, 1MC, 1RV, 1TS, 1XX, 1YD, 1ZE, 3AFB, 3AHP, 3APR, 3ATS, 3BDT, 3BGY, 3BIY, 3BMN, 3BMS, 3BUY, 3BVC, 3BWT, 3BZV, 3CEL, 3CK, 3HG, 3HO, 3HS, 3HL, 3II, 3IZ, 3JL, 3MF, 3PZ, 3SK, 3TR, 3XAL, (3XM), 3ZD, 3ZO, 3ZP, 4EB, 4EH, 4EK, 4FA, 4FT, 4NU, 4OI, 5AA, 5AGU, 5JT, 5KB, 5KC, 5MB, 5MO, 5NI, 5SP, 5XAB, 5XB, 5XK, 5XY, 5ZAV, 6KA, 7ZV, 8AAF, 8ADH, 8ADK, 8AKQ, 8ALK, 8ALO, 8AMB, 8ANB, 8AOQ, 8AQV, 8AVT, 8BBE, 8BDA, 8BDB, 8BF, 8BFQ, 8BHO, 8BIS, 8BJS, 8BLC, 8BOA, 8BOZ, 8BRM, 8BRT, 8BTO, 8BUT, 8BXX, 8CEI, 8CGU, 8CGY, 8CJH, 8CJV, 8CKO, 8CLV, 8CMN, 8CQH, 8CQX, 8CRB, 8CTY, 8CVX, 8CXT, 8CXW, 8IA, 8IB, 8IJ, 8KJ, 8OE, 8OW, 8QK, 8UF, 8VL, 8VY, 8WX, 8XAK, 8XAN, 8XE, 8ZD, 8ZW, 9AAP, 9AAU, 9ADF, 9AFK, 9AIN, 9AIX, 9ALG, 9AMS, 9ANQ, 9APS, 9APW, 9ASE, 9AVU, 9AZE, 9BCB, 9BDS, 9BIK, 9BSG, 9BZI, 9BBA, 9CDU, 9CTG, 9CTV, 9CUO, 9CUI, 9CYQ, 8CYW, 9DBV, 9DIO, 9DKK, 9DKY, 9DPV, 9DWF ,9DYN, 9EDM, 9EIL, 9EKX, 9EP, 9FK, 9GW, 9II, 9LH, 9SR, 9QR, 9UR, 9XJ, 9XM, 9YAR, 9ZT. (All inquiries will be answered—QRK 2CUV?)

3HS. Washington, D. C.

C.W.: 1ADL, 1AGI, 1AJX, (1AKL), 1ALJ, (1AOK), 1AP, 1APC, 1ARY, 1ATC, (1ATJ), 1AW, 1AWB, 1AWE, 1AWP, 1AZL), (1BGC), (1BOP), (1BQI), (1BVR), (1BYN), (1CAJ), (1CDO), (1CKI), 1CNI, 1CNP, 1CQZ, (1CSP), 1DI, 1DL, 1EZ, 1GS, (1IL), 1KW, (1OK), 1TS, (1UJ), (1WC), 1YD, 2AAX, (2ABZ), 2ACZ, (2AGB), (2AGD), 2AIU, (2AJA), 2APK, 2ATQ, (2AVE), 2AWS, 2AXF, (2AZY), 2BJO, 2BKL, (2BQB), 2BQD, 2BRF, (2BUY), 2CBW, 2CCD, 2CDK, (2CEE), 2CEI, 2CFR, (2CIM), 2CJE, 2CKL, 2CKN, 2CLA, (2COA), (2CPA), 2CPK, 2CTU, 2CUZ, (2CVJ), 2CXJ, 2CZI, (2FC), (2FP), (2IG), 2NE), (2SQ), (BY-4), (4AF), 4AG, 4AQ, 4BI, 4BK, 4BX, 4BY, 4CG, 4CY, 4DW, 4EA, (4EH), (4EL), 4ER, (4FG), (4FT), 4GV, 4HW, 4IR, (4IV), 4JK, 4KC, 4ME, 4MR, 4NV, 4PD, 4PM, 4XJ, 5ABH, (5AGJ), 5AJM, 5BM, 5FK, 5EL, 5GJ, 5HL, 5HO, 5JF, (5KC), 5KN, 5KP, 5KW, 5MB, 5MO, 5NZ, 5OV, 5PX, 5QI, 5QM, 5RH, 5SK, 5SP, 5TB, 5UK, 5XAB, 5XAC, 5XAD, 5XK, 5XV, (5ZABA), 5ZAS, 5ZAV, 5ZP, 6AJF, 6BIK, 6BVF, 6CBG, 6CBU, 6CGW, 6GI, 6IF, 6KA, 6MH, 6ZN, 6ZZ, 7DN, 7PF, (8AAF), (8AB), 8ACM, 8ADH, 8AED, 8AER, (8AFI), (8AG), 8AGO, (8AIA), (8AIK), 8AMX, (8ANB), (8ANV), (8ATA), 8ATC, (8AVD), (8AWN), 8BAA, 8BAR, (8BDU), (8BFM), (8BFQ), (8BFV), 8BGJ, 8BIS, 8BIU, 8BMG, (8BNH), (8BOA), 8BRL, (8BRT), 8BXA, (8BXT), 8BYN, 8CBC, 8CBQ, (8CEI), (8CGQ), (8CI), (8CJV), (8CJY), 8CLZ, 8CMB, 8CMN, (8CPX), 8CQX, 8CRN, (8CTN), 8CUN, 8CUV, (8CWP), (8CXP), (8CYT), (8CZC), 8CZN, 8CZZ, 8DBU, 8EO, 8ER, (8ES), 8HJ, (8KH), (8LH), 8LT, 8NB, 8QK, 8QN, 8RP, 8SM, (8SP), 8SQ, (8SS), (8VY), 8WY, (8XG), (8YAE), 8ZO, 9AAP, 9ABU, 9ADF, 9AEC, 9AEY, 9AFK, 9AHV, 9AHZ, 9AIP, 9AIX, 9AMS, 9ANQ, (9AON), 9APF, (9APS), (9AQA), 9ASF, (9AUA), 9AUS, 9AVN, 9AZE, 9AZN, (9BAK), 9BAW, 9BBP, 9BCF, (9BCL), 9BDB, (9BDS), 9BED, 9BHO, (9BHM), 9BIJ, 9BIS, 9BKJ, 9BKP, 9BKW, 9BLY, 9BOO, 9BOP, 9BPZ, 9BRK, 9TA, 9TI, (9BUO), 9BVP, 9BVZ, 9BXM, 9BZI, 9BZO, (9CBA), 9CBS, 9CBZ, 9CCS, 9CDB, 9CEH, 9CGK, (9CGU), 9CJC, 9CKF, (9CKI), (9CKP), 9CMK, 9CND, (9CNV), 9CPA, 9CPB, 9CPQ, 9CSR, 9CTE, 9CTR, 9CTV, (9CUI), 9CUO, 9CVO, 9CVU, 9CXH, 9CYG, 9CYW, 9CZU, 9DAX, 9DDY, 9DEL, 9DGQ, 9DIO, (9DKV), 9DKX, 9DPD, 9DPX, 9DQU, 9DRI, 9DSM, 9DTK, 9DUQ, 9DVR, 9DWF, 9DWM, 9DX, 9DXL, 9DYU, 9EDN, 9EEY, 9EHT, 9EIL, 9EIQ, (9EKF), 9EKX, 9EP, 9EQ, 9FK, 9FP, 9GI, (9HK), (9IL), 9IO, 9KZ, 9LH, 9LZ, 9MC, (9OF), (9OX), 9PD, (9US), 9UU, (9VM), (9VZ), 9XAZ, 9ZL, 9ZT, Canadians: 2AF, 2BE, 2BG, (2CG), 3ADN, 3BP, 3CF, 3DH, 3GB, 3KP, 3NB, (3OH), 9BS, 9BW.

4CY, Atlanta, Ga.

C.W.: (1MC), 1ADL, 1AJT., 1ALJ, 1BES, 1CMK, 1CMP, 2BRG, 3BA, 3CM, 3II, 3IZ, 3MF, 3OE, 3OV, (3PZ), 3TJ, (3TR), (3UC), 3WF, (3XM), 3ZP, 8AHK, (3AJJ), 3ANZ, 3APR, 3AQR, 3ASP, 3BIF, 3BRW, 3CFQ, 3XAL, 4BQ, 4EB, (4FA), 4FS, 4FT, 4GW, 4HZ, 4IH, 4JZ, 4KC, 4LJ, 4LZ, 4MI, 4NX, 4NT, 4XJ, (4ZC), 5BM, 5BW, 5CK, 5EK, 5ES, 5KC, 5KN, 5MB, 5MO, 5PF, (5SP), 5SZ, 5VY, (5XB), 5XE, 5XV, (5YE), 5ZB, 5AAT, 5AGJ, 5AKI, 5ANB, 5ATR, (5XAD), (5XAJ), 5XAL, 5ZAV, 5ZAU, (8ES), 8EO, 8HN, 8VQ, 8VY, (8XE), (AER), 8AHY, (AIK), 8ALT, (8ANB), (8AQV), 8ASV, 8AUZ, 8AVT, 8BCB, 8BCH, 8BDA, 8BEN, 8BHO, 8BIS, 8CGX, 8CHC, 8CJY, (8CKV), 8CLD, 8CQL, 8CQX, 8CUS, (8CXW), (8CYT), (8DAK), 8XAN, 9AL, 9BU, (9DC), (9EP), 9FP, 9KK, (3DX), 9PI, (9QR), 9RC, 9VZ, 9AAP, 9ACE, 9AEG, 9AHH, 9AHY, (9AIX), 9AKU, 9ALV, 9AMK, 9ANF, 9ANQ, 9AOA, (9APS), 9AT, 9ATZ ,(9AYD), 9BAK, (9BCB), 9BCH, 9BDB, 9BFM, 9BHD, 9BHJ, 9BIK, 9BLY, (9BSZ), 9BXY, 9CBA, 9CFI, 9CFK, 9CIY, 9CKY, 9CMK, 9CNY, 9CPD, 9CPQ, 9CSC, 9CTE, 9CTI, (9CTV), 9CUM, 9CVO, 9CZI, 9DGE, 9DGQ, 9DJB, 9DJM, (9DLE), 9DQM, (9DRI), 9DTA, 9DTP, (9DUL), 9DVP, 9DWF, 9DWK, 9DWM, 9DYU, 9DYW, 9EAD, 9EAK, 9EDB, 9EGY, 9YAC, Can. 3BP, 3DH, (3JL), (3TA), (3XN), (9BV), 9BU, 9BJ.

5ZAV, Oklahoma City, Okla.

C.W. (1AWB), 1AJP, 1APW (?), 1AJX, 1AWW, 1BOQ, 1AZL, 1BKQ, 1CNI, (1CMP), 1CDR, 1CNF, 1DEK, (1GV), 1KC, 1II, 1TS, 1YD, 1XM, 2ACD, 2AQI, 2BQD, 2CQT, 2CEI, 2CQU, 2CCD, 2CVJ, 2CQZ, 2AYV, (2COA), 2OM, (2EL), 2FP, 2NE, 2XQ, 8ALJ, 8ADX, (8AUV), 8AJJ, 8APR, 8AFK, (8AUW), 8BHW, 8BLF, 8BHL, (8BGJ), 8BVA, (8BA), 8CEL, 8CRZ, 8CAE, 8CA, 8FQ, 8LZ, 3NB, 3NF, (3SU), (3TE), 3TG, 3TJ, 3HH, 3WF, 3PZ, 3UC, 3TR, 8XK, 8XM, 3ZO, 8ZP, 4AG, 4AO, 4BI, 4BX, 4CN, 4CG, (4DN), (4EH), 4EQ, 4FB, 4FN, 4FV, 4FT, (4FR), 4FG, 4GE, 4GO, 4HW, 4HJ, (4IK), 4IV, 4JL, 4JK, 4JZ, 4KU, 4KM, 4LA, 4ME, 4NT, 4OI, (4MB), 4YA, 4YD, (5DE), (5AIB), (5ABA), (5EK), (5KP), (5PF), (5XB), (5XD), (5XAD), (5XAC), (5ZABA), 6ALX, 6AQW, (6AWT), 6ANH, 6AHK, (6AGO), 6AVV, 6BSQ, 6BQW, 6BUN, 6BMD, 6BBV, (6BQC) (6BVF), (6BOE), 6BIQ, 6BBH, 6BJY, 6BUH, 6BIP, (6BEG), 6BRU, 6BVR, (6CAJ), 6CCO, 6CKR, 6CGW, 6DEG, 6EA, (6EB), (6EC), 6CU, 6GF, 6HP, 6IF, (6LU), 6MH, 6RM, 6TC, (6XBC), 6XAD, (6ZH), (6ZT), 6ZF, 6ZZ, 7AHC, (7AIY), (7ABB), 7AFW, 7ACA, 7AII, 7BAK, 7BH, 7EX, 7CN, (7HM), 7LN, (7GP), 7PF, 7SC, (7ZB), (7ZF), 7ZN, 7ZS, 7ZU, 7ZV, 8AAF, 8AAK, (8ADG), (8AEG), 8AFD, 8ACO, (8AVD), 8AHR, 8AIK, 8ANV, 8APE, 8AQI, 8ARD, 8ARX, (8ATX), (8AXT), 8AQI, 8AQV, 8AWP, (8ATN), 8ASH, 8AZG, 8AZH, 8BAE, 8BAO, 8BBE, 8BCH, (8BEO), 8BEK, 8BEN, 8BEY, 8BFQ, 8JX, 8BDA, 8BKH, (8BDV), (8BOE), 8BOA, 8BOG, 8BGR, 8BRL, (8BNH), 8BTL, 8DKA, 8BXX, 8BSY, 8BUC, (8BQA), 8BYN, 8BYO, 8BYF, (8CAA), 8CAQ, 8CAY, 8CBV, 8CBQ, 8CBC, (8CEI), 8CDD, 8AFX, (8CGJ), (8CGX), 8CHB, 8CID, 8JY, 8JZ, (8CKV), 8CKF, (8CWX), 8CNU, (8CNO), 8CKO, 8COZ, 8CGU, 8CRC, 8TV, 8CQL, 8CPD, 8CTV, 8CUU, (8CUR), 8CWU, 8CRB, 8CXP, 8CXW, (8CYU), (8CYT), 8DAA, 8DAL, 8DAY, 8DDO, (8AL), 8AB, 8BO, (8CF), 8CE, 8BF, (8FQ), 8HN, 8HH, 8ER, 8IQ, (8IJ), 8IB, 8JN, 8JY, 8JJ, 8KC, (8KH), 8LS, 8LC, 8OI, 8PB, 8PK, (8PD), (8QK), 8QC, (8GZ), 8TX, (8RJ), (8VN), (8VL), 8RV, 8VY,

8LD, 8JY, (8WX), 8WV, 8UE, 8VQ, 8XAD, 8XAN, 8XE, 8XG, (8YAE), 8YU, 8ZD, 8ZO, 8ZZ, (8ZW), (9ACD), (9APW), (9AIX), (9AVN), (9APS), (9ANG), 9ALG), (9AAP), (9AHH), (9AVZ), (9AVU), (9AOJ), (9BKC), (9BLY), (9BCB), (9BDS), 9BZB), (9BXT), (9BRK), (9CHF), (9CFB), (9CWZ), (9CBA), (9CMD), (9CVO), (9CTO), (9CJM), 9CTV), (9CMM), (9CHK), (9CLQ), (9DON), (9DGN), (9DGV), (9DIS), (9DPX), (9DCF), (9DYN), (9DTP), (9DGV), (9DZB), (9DWF), (9DSW), (9DKK), (9DAW), (9DWN), (9DDT), (9DTU), (9DOC), (9EHN), (9EEA), (9IG), (9SV), (9RR), (9RC), (9XM), NOF, 8H7, "JH" QRA-

Canadians: 3NI, (3JL), 3CO, (3GK), 3XN, (3HE), 3SI, (4CO), 4CN, 4BV, 4HH, (5GO), 9AJ, (9BP), 9BX.

Fone: (2EL), (5AE), 5XAJ, (5ZM), 5ZA.

6RR, Los Angeles, Cal.

C.W.: 1CG, 1XM, 1XV, 2FP, 2BIR, 3GK, 8AWL, 8ZS, 4CL, 4EH, 4NB, 4YA, 5AO, 5EK, 5GT, 5HZ, 5JN, 5JZ, 5JT, 5KP, 5MK, 5NK, 5PO, 5QI, 5RH, 5SP, 5TE, 5YM, 5YO, 5AAR, 5AAU, 5ACF, 5ADB, 5ADO, 5AEE, 5AIB, 5AOS, 5XB, 5XAJ, 5ZA, 5ZH, 5ZAK, 5ZAS, 5ZAT, 5ZAV, 5ZAX, 6s too numerous; 7AT, 7BA, 7DH, 7DP, 7EQ, 7FV, 7GE, 7HJ, 7IG, 7SO, 7JE, 8JG, 7KY, 7LN, 7MF, 7NA, 7NF, 7NU, 7NX, 7PF, 7RI, 7TQ, 7WA, 7ABB, 7ADG, 7AFO, 7AFW, 7AHW, 7ASY, 7ASV, 7ATE, 7YA, 7ZF, 7ZL, 7ZN, 7ZO, 7ZU, 7ZV, 8AB, 8FG, 8IB, 8ALT, 8AQV, 8AXE, 8AZD, 8BCH, 8BDA, 8BFM, 8BMG, 8BEO, 8BVR, 8ETI, 8CYU, 8DOG, 8XAE, 8YAE, 8ZW, 9BX, 9EE, 9ET, 9LW, 9LY, 9OX, 9PI, 9PS, 9QF, 9UH, 9UU, 9AAP, 9ADF, 9ADZ, 9AEY, 9AIW, 9AIX, 9AMB, 9AMI, 9AON, 9APS, 9APW, 9ASF, 9AVE, 9AVU, 9AVH, 9VZ, 9BEG, 9BDS, 9BDZ, 9BEK, 9BIE, 9BJI, 9BJK, 9BKK, 9BSG, 9BTL, 9BUN, 9BVO, 9BVY. 9BXM, 9BZI, 9BZZ, 9CAA, 9CBA, 9CCV, 9CDU, 9CFY, 9CGA, 9CJC, 9CJY, 9CNS, 9CWK, 9DAW, 9DEL, 9DGE, 9DHI, 9DKC, 9DKY, 9DMT, 9DOC, 9DSD, 9DSM, 9DWM, 9EAC, 9EEA, 9EGY, 9EKH, 9EKV, 9XM, 9YB, 9YU, 9ZT, Canadian—4CO, 5CN. Nearly all heard between 8 and 10 P.C.T. Anyone hearing my 5OW I.C.W. Pse QSL.

7ADI, The Dalles, Oregon.

C.W. 1BES, 1CMK, 2FP, 3OT, 3ARO, 4EB, 4YA, 5EJ, 5PX, 5QT, 5UJ, 5XAJ, 6s and 7s too numerous, 8TF, 8BCH, 8BFQ, 8CNY, 9CE, 9LZ, 9UU, 9AIN, 9AAP, 9BJI, 9BVI, 9DGV, Can. 5CN, 5CT. 5GO, 9BX fone.

8YAE, Oberlin College, Oberlin, Ohio

C.W. (1II), 1IL, 1QB, 1XM, 1ZE, (1ABF), (1ATJ), 1AXE, (1BFE), (1BOQ), 1BKQ, 1BWJ, 1BSD, 1BSZ, 1CBJ, (1CMP), (1CPO), (1CQO), 2FP, 2GK, 2RY, 2ACP, 2ANM, (2AVE), 2BWR, (2BQD), (2CDK), (2CGS), (2CJR), 2CLA, (2CQZ), (3AB), 3CE, (3HS), (3IW), 3JL, 3MO, 3NI, 3SK, 3SU), (3TR), (3XM), (3ZO), (3ZP), 3ABU, (3ALO), (3ABW), (3AWA), 3BEF, 3BSS, (3BRL), (3BUY), 4CY, 4DF, (4DN), 4EB, (4DW), 4FA, 4FD, 4HP, (4MB), 4YA, 4YD, (QRA?), (5EK), 5GA, 5GJ, 5GR, 5JB, (5KC), 5KG, (5KI), (5KP), 5NZ, 5OK, (5OV), (5PX), 5RH, (5SP), (5TC), (5UK), 5XA, 5XV, 5AEC, 5AGJ, 5XAD, 5XAJ, 5ZAC, 5ZAT, (5ZAV), 5ZABA, 5ZAFA, 6FH, 6KA, 6ZW, 6AMD, 5CGW, 6CBI, (6XAD), 6XK, 7SC, 7ZO, 7ZU, 7ZV, 7AIY, (8AEG), (8AFD), (8ATP), (8BUC), (8CDD), (8CEI), (8CBQ), etc. etc.,—9AE. (9DC), (9FH), 9LZ, (9OX), 9YW, (9ZC), (9ZT), 9AAP, (9AAU), 9AAV, 9AEC, 9AIX, 9AOJ, 9ASE, (9ATO), (9AQD), 9AUA, 9AWF, 9AYD, (9BCB), (9BII), (9BOO), (9BRK), (9BSG), 9BSZ, 9BTL, 9BUO, 9BXT, (9BZO), 9CBB, (9CBY), 9CDR, (9CEE), 9CEH, (9CFK), 9CIP, 9CJC, 9CLZ, 9CMK, (9COF), 9CPB, 9CSP, (9CTC), (9CVO), (9CVV), 9DBE, (9DDL), 9DDT, (9DJB), 9DLI, 9DPX, 9DQU, 9DTA, 9DSG, (9DWN), 9EFB, 9EIQ, 9EKF, NOF, AD-7.

Can. (2AN), 2CG, 3NB, 3NI, (3XN), (4CO).

9AHC, Ellendale, N. Dak.

1ADL, 1AJP, 1AJX, 1AOK, 1ARY, 1AWB, 1BAS, 1BES, 1BKA, 1BKQ, 1BOQ, 1BRQ, 1BWM, 1CKP, 1CMP, 1CNF, 1CPN, 1CWP, 1GV, 1HW, 1II, 1SN, 1WC, 1XN, 2AGD, 2AJA, 2AWL, 2AYV, 2AZY, 2BG, 2BQH, 2BSC, 2BUE, 2BYW, 2CBG, 2CCD, 2CKL, 2CPD, 2CQ, 2CXL, 2FP, 2FW, 2HW, 2KF, 2NZ, 2RM, 2XQ, 2XZ, 2ZAX, 2ZK, 2ZS, 3AAE, 3AFB, 3AIC, 3AJJ, 3ALU, 3APR, 3AQR, 3ARO, 3ASP, 3BFQ, 3BGJ, 3BIJ, 5BJ, 3BLF, 3BMO, 3BNU, 3BUC, 3BUY, 3BVA, 3BVH, 3CEL, 3CM, 3FQ, 3FS, 3HD, 3HG, 3HJ, 3HS, 3JJ,3LP, 3MB, 3MO, 3OE, 3OT, 3PZ, 3QV, 3RF, 3WF, 3WX, 3XAL, 3XM, 3YO, 3ZO, 3ZP, 3ZS, 4AG, 4BB, 4BD, 4BG, 4BI, 4BK, 4CG, 4CY, 4DN, 4EB, 4EH, 4EL, 4FA, 4FS, 4FT, 4HW, 4HZ, 4JI, 4JL, 4KC, 4KM, 4MB, 4ME, 4QM, 4TH, 4XJ, 4YA, 6AAJ, 6AAT, 6ABK, 6ABX, 6AFH, 6AGJ, 6AK, 6ALU, 6AO, 6APW, 6AQP, 6AQW, 6ARB, 6ARD, 6AVR, 6AVV, 6AWT, 6AWW.6AWX,6BBC,6BCJ,6BCL,6BIC,6BIE, 6BIK, 6BJJ, 6BJQ, 6BJR, 6BJT, 6BPL, 6BQC, 6BQG, 6BQZ, 6BRF, 6BRK, 6BUA, 6BUM, 6BUN, 6BVF, 6BVG, 6BVW, 6BWG, 6CAJ, 6CBI, 6CC, 6CEK, 6CFQ, 6CGD, 6CLI, 6CU, 6EA, 6EB, 6EC, 6FT, 6IV, 6JN, 6JX, 6KA, 6LU, 6MH, 6RR, 6TI, 6VK, 6ZK, 6ZAO, 6ZB, 6ZH, 6ZN, 6ZO, 6ZR, 6ZX, 6ZZ, 7ABB, 7ACX, 7ADG, 7AFS, 7BA, 7EY, 7IO, 7IY, 7LR, 7LW, 7OM, 7PF, 7SC, 7TQ, NOF, (9AAM), (9ABU), (9ASF), (9BZF), (9CGA), (9COJ fone), (9DHH), (9DID fone), (9DLF), (9DUL), (9DWN), (9EBT), (9EFN), (9EGL), (9FK), (9LW), (9UH), 5-watts hr. pse QSL crd om.

P. E. WIGGINS

(Concluded from page 74)

will recall the excellent paper he presented there on the subject.

At present he is Chief Engineer and Production Manager of the Radio Electric Company of Pittsburg. He is devoting part of his time to teaching radio in the Y.M.C.A. school and is radio editor of two of Pittsburg's daily newspapers.

Some Effects of the Distributed Capacity Between Inductance Coils and The Ground

A COIL of wire wound in any of the familiar forms called "inductance coils" behaves in an electric circuit primarily as an inductance. The potentials of the different parts of the coil are, however, different from each other and from the potential of the ground. For this reason the coil also behaves to a certain extent as an electric condenser, or rather a system of condensers. These capacity effects of inductance coils are particularly important at the high frequencies employed in radio communication. The effective capacity of an inductance coil depends in general both on the capacities existing between parts of the coil itself, and on the capacities existing between parts of the coil and the ground.

On account of the importance in radio communication of capacity effects in inductance coils, careful studies of these effects, both theoretical and experimental, have been made at the Bureau of Standards. An interesting result which has been found is that one effect seems to depend primarily

on the capacity of the coil to ground. This effect is observed when two condensers in series are connected across the terminals of the inductance coil, and the common terminal of the two condensers is grounded. If the inductance coil possesses capacity to ground, the familiar criterion for resonance in the system, computed from the known values of the capacities of the two condensers, will not obtain.

If both condensers are variable, and the system is adjusted for resonance by successively assigning arbitrary values for the setting of one condenser, and then tuning with the other condenser, it would be expected from elementary considerations, neglecting the effects of distributed capacity, that the successive resonance values of the capacity of the two condensers in series, determined as the product of their capacities divided by their sum, would be constant. On account of the distributed capacities, this simple relation does not hold. It is found, however, that under the conditions above mentioned, with the common terminal grounded, the capacity of the two condensers in series determined as the product of their capacities divided by their sum, is linearly related to the reciprocal of the sum of their capacities. This relation has been verified both mathematically and experimentally.

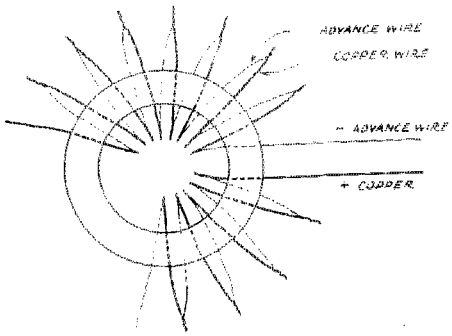
The condensers used in making accurate radio measurements are provided with metal shields and one terminal is connected to the shield. The shield is usually grounded. If two shielded condensers are connected in series so that a grounded common connection is made to the two terminals which are connected to the shield, and if the unshielded terminals are connected to an inductance coil, the relation above mentioned will obtain. This relation is therefore particularly useful in making accurate radio measurements.

The results of both the mathematical and experimental investigations of this property of inductance coils are given in a publication of the Bureau which has just appeared, Scientific Paper No. 427, "Some Effects of the Distributed Capacity between Inductance Coils and the Ground," by Gregory Breit. Copies may be purchased for 5 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

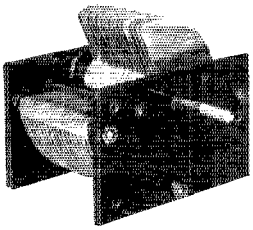
A Thermo Battery For WD-11's

A NOVELTY in the source of filament current for small dry-cell operated tubes is presented by 9ECT.

The materials required are: 40 pieces of No. 14 copper wire each six inches long. and 40 pieces of No. 14 Advance resistance wire each six inches long. Two wooden rings having an inside diameter of six inches and an outside diameter of eight inches are also necessary. With pliers, tightly twist together about one inch of the ends of wires of different materials, continuing until all the wires are used; but do not twist together the ends of the last two wires as they are the terminals of the thermo-battery. The wires are then clamped between the wooden rings as shown in the sketch, taking



care that the junctions do not touch each other. The inner circle of junctions may now be heated by placing over a gas burner or an electric heating element, or, if you live near the North Pole, you can cool the outer junctions instead. The two terminal wires may now be connected across the filament of the receiving tube, and as long as the heat (or cold) is steadily applied, the direct current produced will light the tube nicely. Q. E. D.



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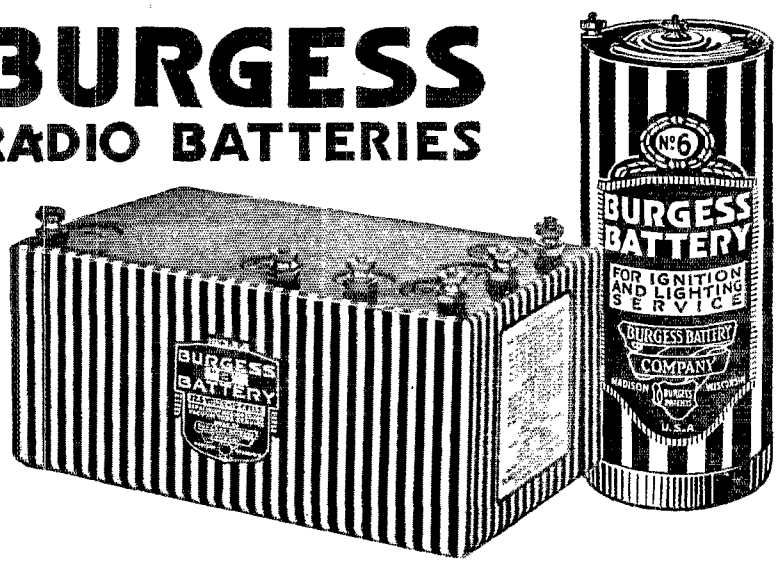

MARLE

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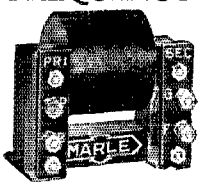

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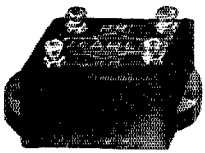

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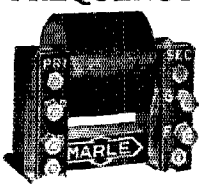

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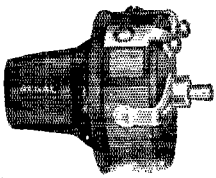

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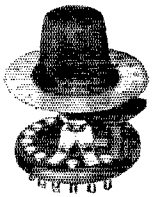

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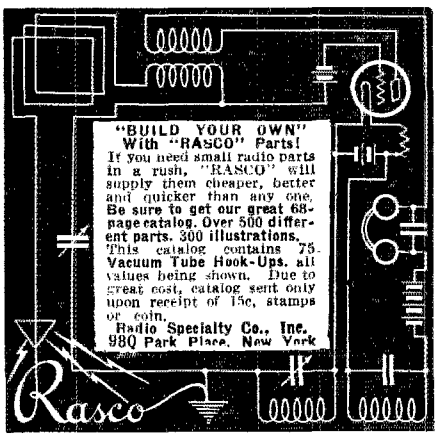

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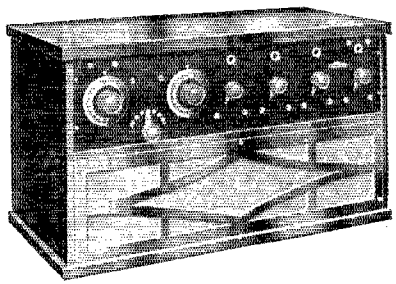
Three Beautiful Cabinet Models

The Last Word In Crosley Efficiency

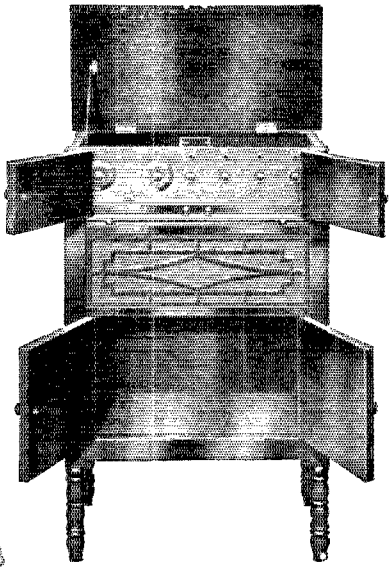


CROSLEY MODEL XV
(Above)

The receiving apparatus in this model is the same as that in our cabinet model XX. The cabinet contains no place for the batteries, however, placed on a mahogany table or stand, it forms an attractive piece of furniture. Price without tubes, batteries or phones $70.00

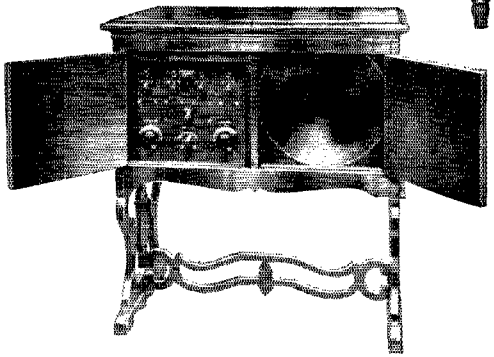
CROSLEY MODEL XX
(Below)

This attractive model is our Model X built into a highly polished mahogany cabinet. A hinged lid, when raised allows the operator access to every part of the receiving apparatus. A sliding board under the receiving apparatus forms a desk for the operator when desired. The lower compartment is made to take care of the batteries and the middle compartment contains a loud speaker which makes it possible for music, speeches, etc. to be heard clearly by every one in the room. As a beautiful piece of furniture, this model is an addition to any room. Price without tubes, batteries or phones $100.00



CROSLEY MODEL XXV
(Below)

We can conscientiously recommend this console model as the most beautiful and efficient model offered today. The receiving apparatus contains the same units as our model X though differently arranged. The cabinet, of mahogany, exceptionally well finished, is arranged to take the model R-3 Magnavox and also contains space for "A" battery, "B" battery and battery charger if desired. Guaranteed to bring in broadcasting stations 1000 miles or more distant so that they may be clearly heard all over the room.
Price without tubes, batteries or phones $150.00



CROSLEY
Better---Cost Less
RADIO

CROSLEY MANUFACTURING CO.

518 ALFRED ST., CINCINNATI, O.

Pleasant Evenings in Camp

With a Crosley Portable

No matter how far into the wilds you go on your vacation, you can keep in intimate touch with the outside world and enjoy its pleasures in the evening.

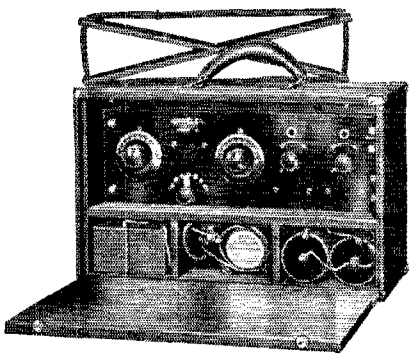
Crosley Portable Radio Outfits have made this possible. Absolutely complete in their compact cases, they may be easily carried and quickly set up.

After a hard day's motoring, fishing or canoeing what a pleasure to get out the old pipe, sit before the camp fire and listen to music, plays and innumerable other interesting things. Get a Crosley Portable and take it with you on your vacation. It will afford you the least expensive pleasure you have ever enjoyed.

CROSLEY

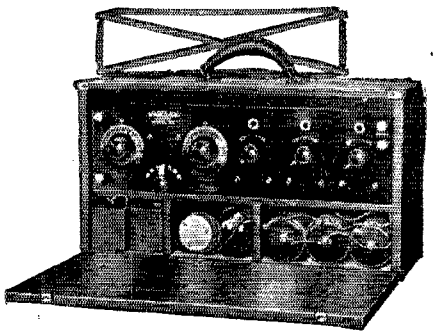
Better---Cost Less

RADIO



Crosley Model VI Portable

Consists of detector and one stage of tuned radio frequency amplification. Compact compartments are built into this set for batteries, phones, etc. Thousands of users have testified as to its satisfactory performance.
Price, without tubes, batteries or phones $40.00



Crosley Model VIII Portable

Consists of one stage of tuned radio frequency amplification, detector and one stage of audio frequency amplification. This set has the same general construction as Model VI Portable, but performs even more efficiently.
Price, without tubes, batteries or phones $60.00

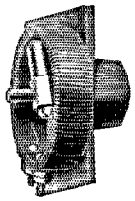
Free Catalog on Request

CROSLEY MANUFACTURING CO.

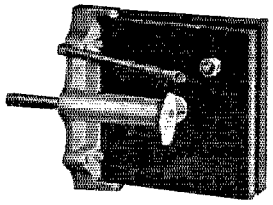
518 ALFRED ST., CINCINNATI, O.

Crosley Radio Parts

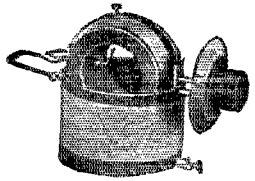
Guaranteed to Perform Satisfactorily



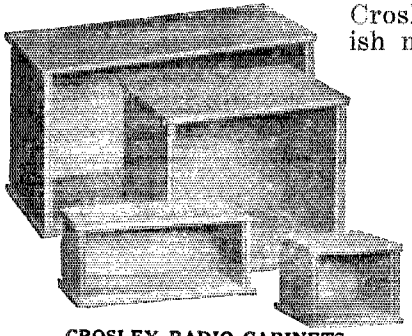
CROSLEY RHEOSTAT
Price .....50¢



CROSLEY
VARIABLE CONDENSER
Model B
.0005 Mfd. As Illustrated
Price $1.75



CROSLEY VARIO-COUPLER
Price with knob and dial....$3.00



CROSLEY RADIO CABINETS
Prices & Sizes in Catalog

In addition to the great number of radio receivers that we manufacture, we make a complete line of parts for those who wish to build their own outfits or make repairs no matter what the make of their instrument. These units are the same as those used in our various radio outfits and have therefore been tested in innumerable instances and proven to be of exceptional worth.

The Crosley Rheostat permits extraordinarily accurate and delicate variations of the filament current. With it the best possible results are achieved from expensive vacuum tubes.

The Crosley Variable Condenser has become exceeding popular because of its exceptional performance. By using it louder signals are obtained and there is less internal resistance and no body capacity effect.

The Crosley Vario-Coupler efficiently couples any two circuits. The rotor is a varnished wooden ball, the leads of which are brought out by means of flexible conductors. This insures noiseless contacts.

Crosley Cabinets of beautiful finish may be had in various sizes.

Free Catalog on Request

CROSLEY
Better---Cost Less
RADIO

CROSLEY MANUFACTURING CO.
518 ALFRED ST., CINCINNATI, O.

Crosley Radio Parts

Popularity Proves Their Worth

The fact that innumerable favorable comments are received daily from people everywhere who have used Crosley parts with entire satisfaction leads us to believe that you too will find that they will fill your every requirement.

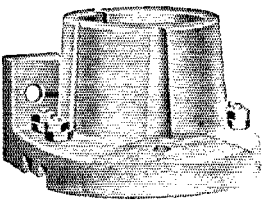
The Crosley V-T Socket has been pronounced by many radio engineers as the best socket on the market. Its popularity is based chiefly on its high quality, efficiency, service and practical unbreakability combined with its very low cost.

The Crosley Radio Frequency Amplifying Tuner consists of an inductance coil and a Crosley book type variable condenser. It can be tuned to any wave length between 200 and 600 meters. When used with non-regenerative sets it will increase the range many times.

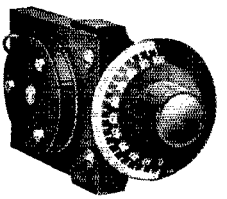
The Crosley Sheltran is a completely shielded transformer. Embodied in it are all the characteristics so essential to obtain maximum amplification from the modern vacuum tubes used in radio work. Tests have proven the design to be correct to insure maximum efficiency.

For Sale By Good Dealers Everywhere.

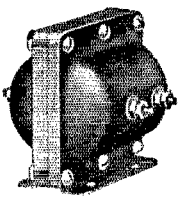
CROSLEY
BETTER-COST LESS
RADIO



CROSLEY V-T SOCKET
Made of porcelain for base or panel mounting.
Price .....40¢



CROSLEY AMPLIFYING TUNER
Price $4.00



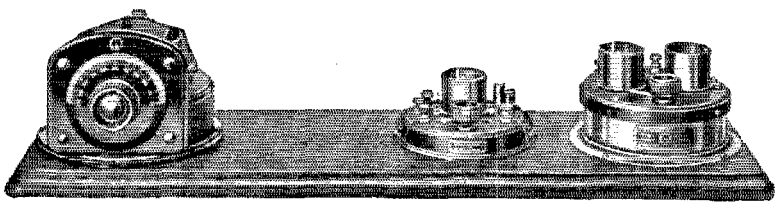
CROSLEY SHELTRAN TRANSFORMER
Price $4.00

CROSLEY MANUFACTURING CO.

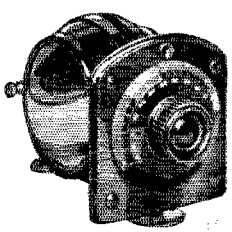
518 ALFRED ST., CINCINNATI, O.

ATWATER KENT

Receiving Sets and Parts

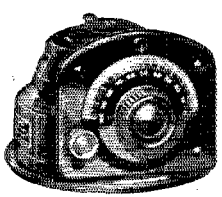


Complete Set, consisting of Coupled Circuit Tuner, Detector Unit and 2-stage Amplifier



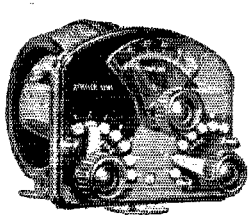
Mounted Variometer

TAKE the world with you this summer wherever you go. On your automobile and yachting trips, to your camp, or your cottage at the shore or in the mountains. An ATWATER KENT radio set will bring you music, reports, time signals, baseball scores—the world's news.

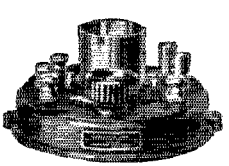


Type 11 Tuner

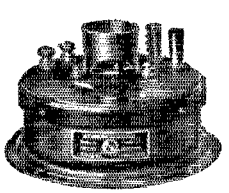
Atwater Kent products sell on appearance.



Mounted Variocoupler



Detector Unit



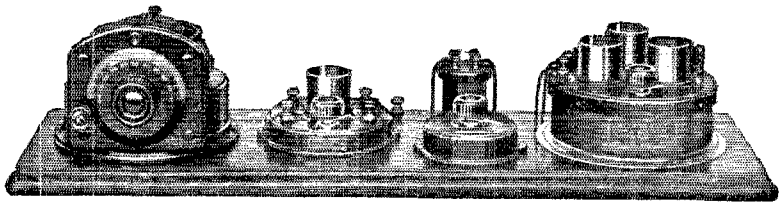
1-stage Amplifier

ATWATER KENT MANUFACTURING COMPANY

4945 STENTON AVE. *Radio Dept.* PHILADELPHIA, PA.

ATWATER KENT

Receiving Sets and Parts

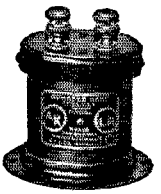


Complete Set, consisting of Type 11 Tuner, one stage of Radio Frequency Amplification and Detector 2-stage Audio Frequency Amplifier

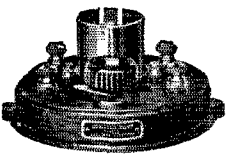
ATWATER KENT sets and parts are ideal for summer use due to their compact and rugged construction and the fact that they are moisture-proof. They are made mostly of condensite with all metal parts thoroughly water-proofed.

You will find ATWATER KENT radio equipment ideal for summer use.

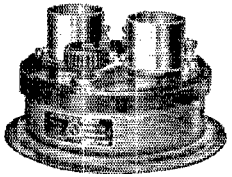
They stay sold on quality of performance.



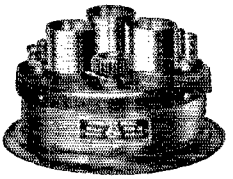
R. F. Transformer



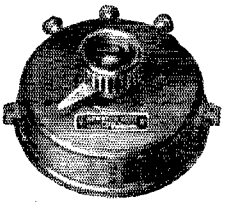
Standard Vac. Tube Unit



2-stage Amplifier. A similar unit is furnished in a Detector 1-stage Amplifier



Detector 2-stage Amplifier

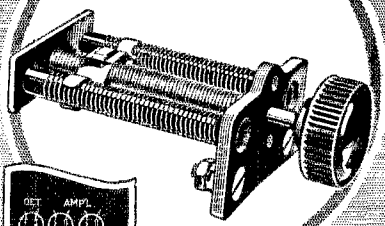


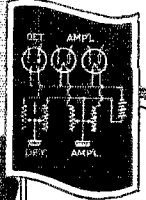
Potentiometer Also made for panel mtg.

ATWATER KENT MANUFACTURING COMPANY

4945 STENTON AVE. *Radio Dept.* PHILADELPHIA, PA.

The Autostat
A Super Radio Rheostat





Can be used with 6-volt or WD 11 detector tubes, two amplifying bulbs or one 5-Watt power tube.

The difference between a jumbled mass of signals coming from everywhere and the "sharply-tuned" concerts received clearly and distinctly from far-away stations depends largely upon the careful adjustment of your detector filament current.

Heretofore, sharp tuning has only been partially obtained thru skillful "hair-breadth" manipulations of the filament rheostat. But with

The Autostat
A Super Radio Rheostat

these much-sought-for results can be secured by anyone. Just "twirl the knob"—a full turn produces a finer adjustment than a "hair's-breadth" turn on any other.

Economical — neat — small — compact. No carbon to break or change resistance. Unqualifiedly guaranteed. Popularly priced—**$1.35.**

If the Best is none too good for the set you are building or have bought, see the Autostat at any good radio or electrical dealer Today. Or write direct for Free Bulletin which shows why the Autostat is radio's Best rheostat.

DEALERS — JOBBERS
Write or wire for Radio's most attractive merchandising proposition.

THE AUTOMATIC
ELECTRICAL DEVICES CO.
127 West Third St.
Cincinnati, Ohio

Builders of Precision Rheostats since 1914

CHARGE YOUR RADIO BATTERY *at* HOME *for a* NICKEL

PATENTED ARMATURE
The HOMCHARGER'S only moving and wearing part, replaceable after thousands of hours' use for $1.00. Tungsten contacts now used exclusively. Will not stick, corrode or wear excessively.

Enjoyable concerts and maximum receiving range are obtained only when your battery is fully charged.

THE HOMCHARGER

charges your "A" or "B" battery OVER NIGHT for a nickel without removing it from your living room. Operates silently — charging rate governed automatically. No muss—no trouble—no dirt—requires no watching.

The HOMCHARGER is the ONLY battery charger combining all of these necessary features. SELF-POLARIZING —FIVE to EIGHT-AMPERE charging rate—UNDERWRITERS' APPROVAL—beautifully finished in mahogany and old gold—UNQUALIFIEDLY GUARANTEED. Over 100,000 now in use.

The minute you buy a radio set you need a Homcharger—get it then. All good radio and electrical dealers sell it complete with ammeter, etc., for $18.50. $25.00 in Canada.

Write for FREE circular showing why the HOMCHARGER is the BEST battery charger at any price.

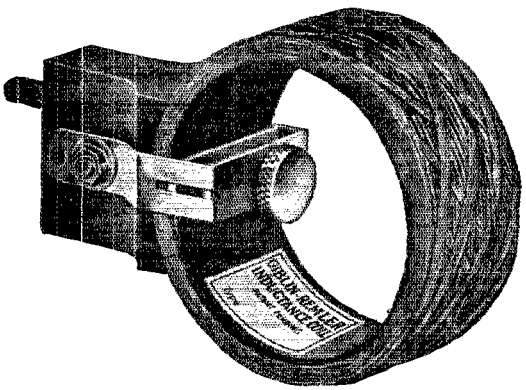
MOTORISTS — THE HOMCHARGER will also charge your AUTO Battery.

THE AUTOMATIC
ELECTRICAL DEVICES CO.
127 West Third St.
Cincinnati, Ohio

Largest Manufacturers of Vibrating Rectifiers in the World

GIBLIN-REMLER COILS

Maximum Inductance
Minimum Distributed Capacity for a given number of turns



Maximum Selectivity of tuning. Maximum signal strength and a minimum of Interference

Reducing Interference to a Minimum

THE special form of winding used in the Giblin-Remler Coil results in maximum inductance, minimum distributed capacity and minimum high frequency resistance for a given number of turns of wire. These are the three features essential in obtaining the highest degree of selectivity.

A sharply tuned circuit is one that has an extremely low resistance to a current of the particular frequency to which it is tuned, and a high resistance to currents of all other frequency. In any receiver circuit there are two kinds of resistance—one, the straight high frequency of the coil, and the other, the resistance caused by the impedance of the coil and the condenser used with it. The first remains fairly constant over a small range of wave lengths. The second resistance is zero at one particular wave length and increases as the wave length varies in either direction; hence, it is easily seen that when the inductance of the coil is extremely high in proportion to the high-frequency resistance, which is the case in the GIBLIN-REMLER COIL, the circuit in which it is used may be made to have practically no resistance to signals on one particular wave length, and yet have a proportionally high resistance to signals on all other wave lengths. This condition, which is always obtained in circuits using the GIBLIN-REMLER COIL results in a SHARPLY TUNED CIRCUIT, that is, one giving MAXIMUM SIGNAL STRENGTH on the desired wave length, with a MINIMUM OF INTERFERENCE from signals on any other wave length.

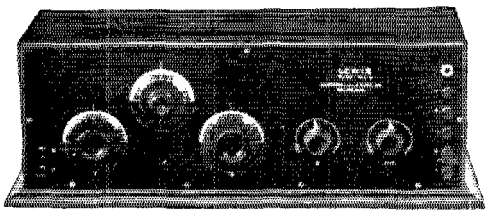
Write for Bulletin Q giving complete information, table of constants and prices on Giblin-Remler Coils.

REMLER RADIO MFG. COMPANY

FACTORY AND HOME OFFICE
248 FIRST STREET,
SAN FRANCISCO, CAL.

EASTERN SALES OFFICE
154 W. LAKE STREET
CHICAGO, ILL.

Better Results With Less Parts



The W. C. 5

is a 4 tube set. One stage of tuned radio frequency amplification is employed ahead of the detector to make it supersensitive. Two powerful stages of audio frequency are used to bring up the volume of signal strength. Simplicity of construction and the elimination of unnecessary parts make this set easy to operate and effective for receiving from long distances without high or expensive antenna.

1,000 to 2,000 MILES On Loud Speaker

The WC-5 will receive signals from stations within a radius of from 1,000 to 2,000 miles. Here is what one WC-5 owner says:

"On several occasions two different stations in Los Angeles have come in clear and strong over the loud speaker on my WC-5 set. I consider this to be remarkable when you consider that the powerful Drake Hotel station was broadcasting."

D. R. Davies, Chief Enzineer,
J. I. Case T. M. Co., Ra:'ne, Wis.

The WC-5 tunes wonderfully sharp on all popular telephone broadcasting wave lengths.

Price $80.00

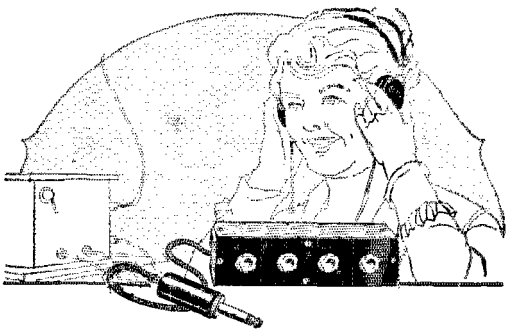
Wave length 160 to 750 meters

Efficient construction, fewer parts and quantity production enable us to sell this high quality set at a remarkably low price. The WC-5 is made from the best materials. The panel is solid bakelite—the case natural mahogany.

Write us for complete description of the WC-5. See it at your dealers or at one of the distributors below:

Julius Andrae & Sons Co., Milwaukee, Wis.
Morton Electric Co., St. Louis, Mo.
International Electric Supply Co., 29 Broadway, New York City
Western Motor Supply, Minneapolis, Minn.
Funsten Electric Co., Kansas City, Mo.
Continental Radio Co., 120 North Wells St., Chicago, Illinois

WESTERN COIL & ELECTRICAL CO.
301—5th St., Racine, Wisconsin



The Frost Jac-Box is a real convenience

EVERY owner of a radio receiving set sees at a glance how useful the new Frost Jac-Box will prove.

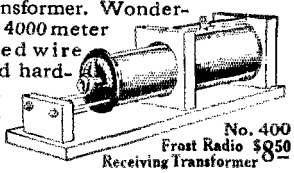
Four sets of Frost Fones — or three sets and a loud speaker — may be used at one time with this handy Jac-Box. Loud speaker may be tuned without disconnecting head-fones. Thousands have been sold, with never a dissatisfied purchaser.

Like all Frost Radio apparatus the Frost Jac-Box is a Quality Product offered at a quantity-production price. Sold alone, or with cord and plug, or with cord only, for sets equipped with binding posts instead of jacks.

The Jac-Box is made of oak, piano-polished. Has Formica panels, felt base, triple nickel plated brass parts, hand buffed. Series connected. No. 501, complete: $3.00. With cord, No. 502, $2.50. Jac-Box only, No. 503, $2.25.

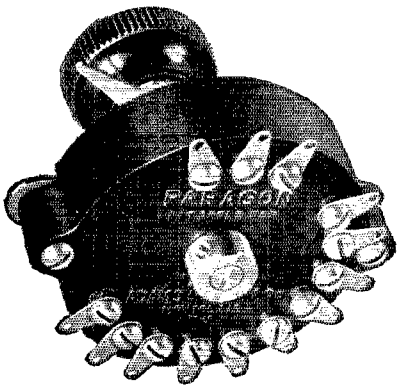
FROST-RADIO

You amateurs who want results should try a Frost Radio Receiving Transformer. Wonderfully selective. 200 to 4000 meter range. Silk covered wire wound. Mahoganized hardwood ends and base. Formica insulation. Nothing to equal it at the price.



No. 400 Frost Radio Receiving Transformer $8.50

HERBERT H. FROST, Inc.
154 WEST LAKE STREET, CHICAGO, ILLINOIS.



New Paragon Stage Control Switch

Plugs and jacks are now obsolete. The new Paragon Stage Control Switch combines the functions of three multi-circuit jacks and the telephone plug. It controls, automatically and progressively, all the filament circuits, plate battery circuits and input and output circuits of the detector-two-stage amplifier.

Switching from stage to stage is instantaneous, positive, noiseless. This switch may also be used for an unlimited combination of vacuum tube circuits. 2⅜ inches in diameter, ¾ inch in thickness. No. 90. Price $3.00.

Wiring Diagram Sent on Request

Upon request we will be glad to send you our new Bulletin No. 108. It contains a wiring diagram, showing the method of connection when this new Paragon Switch is employed for control of detector and two-stage amplifier.

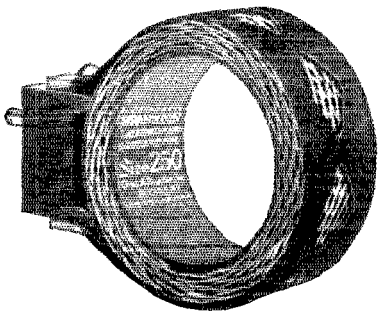
ADAMS-MORGAN CO., 4 Alvin Ave., Upper Montclair, N. J.

PARAGON

Reg. U. S. Pat. Off.

RADIO PRODUCTS

Branston Lateral Wound Honeycomb Coils



Manufactured Under DeForest Patents

The finished product resulting from many years' experience in coil winding. The most efficient and practical radio inductance ever designed. Sold unmounted or mounted with Branston Standard Mountings.

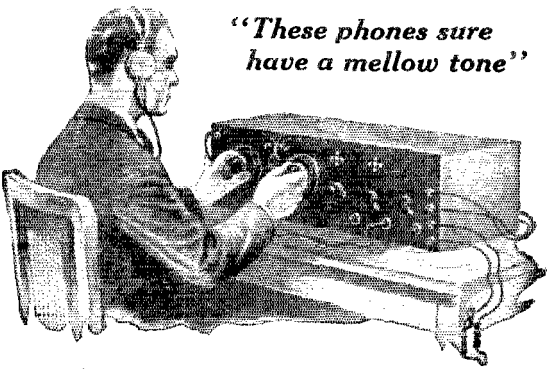
PRICE LIST

Turns	Unmounted	Mounted
L25	$ .50	$1.40
L35	.50	1.40
L50	.60	1.50
L75	.60	1.50
L100	.65	1.70
L150	.70	1.75
L200	.75	1.80
L250	.80	1.85
L300	.85	1.90
L400	.90	1.95
L500	1.00	2.20
L600	1.15	2.35
L750	1.35	2.60
L1000	1.60	2.85
L1250	2.00	3.30
L1500	2.50	3.85

3 Coil Bakelite Adjustable Mounting $5
2 Coil Ajustable Mounting.....$3.50
Single Coil Mounts .....50¢

Order through your dealer or write direct for complete catalog showing Branston "Standard" Radio Accessories.

CHAS A. BRANSTON, Inc.,
815 MAIN STREET,
BUFFALO, NEW YORK
In Canada, Chas. A. Branston, Limited, Toronto, Ontario



"These phones sure have a mellow tone"

You CAN Get BASCO Phones Despite Demand

NO need for accepting substitutes. Every possible measure is being taken by the manufacturers of BASCO Phones to keep up to the demand—and it's being done without slighting mechanical exactness. Close inspection guards BASCO Phone quality irrespective of demand. BASCO quality—keen sensitiveness — deep, natural-voice pitch — lightweight — head comfort—these features should direct your choice in selecting BASCO Phones for allround satisfaction.

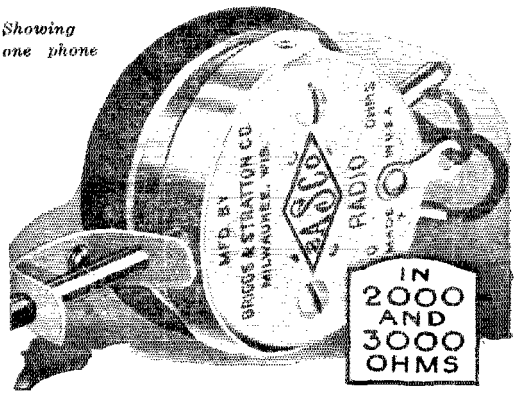
See BASCO Phones and other units of the complete BASCO Radio Line. If your dealer can't supply you, write us direct.

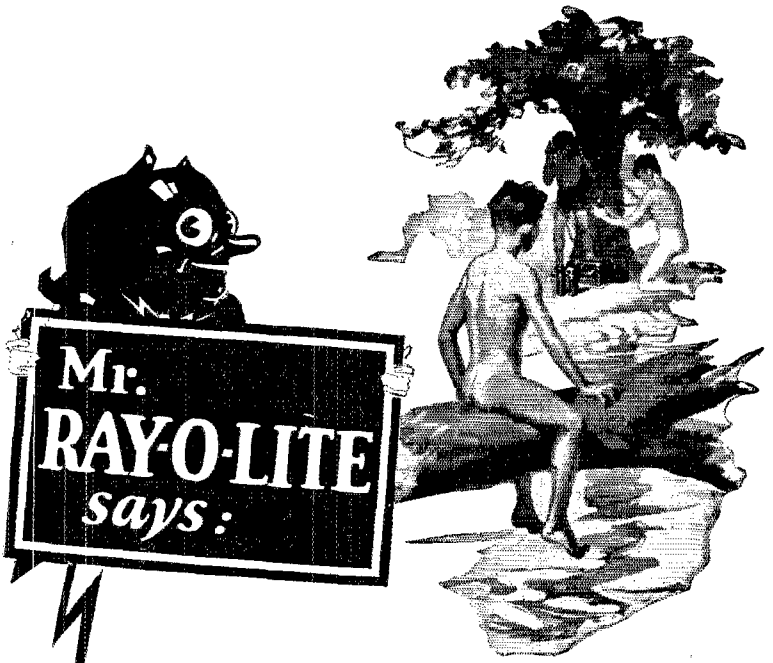
$6.00 2000 Ohm
$7.50 3000 Ohm

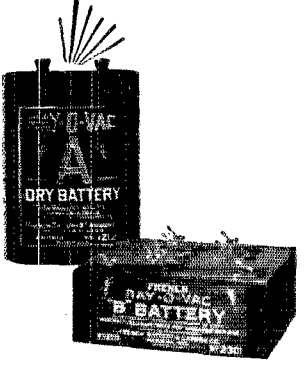
Jobbers and Dealers! Write for attractive selling proposition and name of our nearest local factory representative.

Briggs & Stratton Co.
Milwaukee, Wisconsin

Showing one phone







Ray-O-Vac "A" Batteries come in 1, 2, 4 and 6 cell units. Ray-O-Vac "B" Batteries are famous for sustained voltage and elimination of noise

Make Sets Portable With
Dry "A" Battery

Miles from care and worry—close to nature—still within ear shot of the whole nation. Truly a wonderful development is the dry battery tube and the compact dry battery. With this combination most any set is made portable. A 4-pound dry cell replaces a 40-pound storage battery.

Take your set with you this summer. The Ray-O-Vac Book *"How to Get the Most Out of Radio"* tells how to make your set portable.

Also tells how Ray-O-Vac 2-cell "A" Batteries are good for 200 hours of use, how they make reception clearer and cost less to operate than storage batteries. Send now for the Ray-O-Vac booklet.

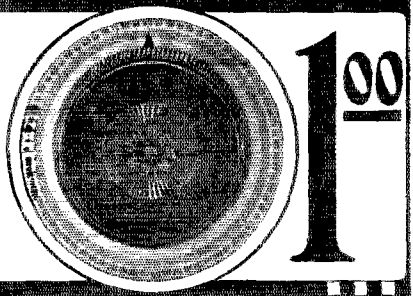
Ask your dealer for the new Ray-O-Vac "A" Battery

French Battery & Carbon Company
Madison, Wisconsin

Atlanta Dallas Denver Chicago New York
Minneapolis Kansas City

RAY-O-VAC
The Battery that Completes Radio

SOMETHING NEW



SELECTIVITY AT LAST!

The UNIVERNIER provides ultra-fine vernier adjustment for ordinary Variable Condensers, Variometers, Variocouplers, Potentiometers, Rheostats and Tickler Coils.

EASY TO INSTALL

The UNIVERNIER takes the place of the ordinary knob, and is applied in a few minutes without disturbing the set.

DISTINCTIVE

The UNIVERNIER will add to the appearance of any radio set. It is an instrument of precision and has that appearance. It consists of a well designed knob inside of which is a simple mechanism so arranged that the knob rotates nearly 12 times to one revolution of the shaft. By pressing lightly towards the panel, it functions as an ordinary knob, thus combining vernier and coarse adjustment in a single unit. DX results are surprising!

THE UNIVERNIER $1.00
360 degree finely graduated silver plated dial for use with UNIVERNIER 25¢ extra—
Complete, $1.25

At your dealers or direct on receipt of the above amount.

#251 for ¼ inch shaft
#188 for ⅛ inch shaft

DEALERS AND JOBBERS
WRITE FOR DISCOUNTS

WALBERT MANUFACTURING CO.
929 Wrightwood Ave., Chicago, Ill.

UNIVERNIER

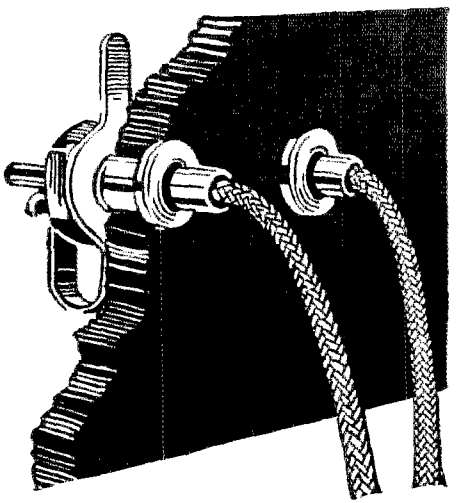
READ WHY

YOU SHOULD USE

UNION RADIO TIP JACKS

(Pat. Applied For)

25c A PAIR



Here's the Radio device that you have been waiting for. These Tip Jacks assure quick connection and a positive contact. They replace unsatisfactory binding posts. Soldering lug incorporated but use optional.

Accommodate any standard round phone tip and several sizes of bare wire. Great for W D 11 connections and coil mountings. Save buying expensive telephone plugs and jacks. They live up to the Union Radio Standard of Quality. Guaranteed to satisfy. Only 25¢ a Pair.

FOR ASSURED RESULTS

you should "try out" Union Radio Tip Jacks, Variable Condensers, Rheostats, Vacuum Tube Sockets, and Condensite Dials.

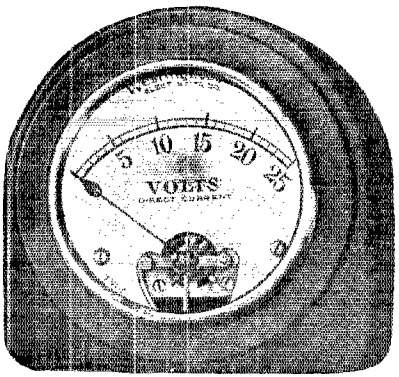
Union Radio Apparatus and Accessories are sold by most good dealers. If you can't obtain them from your local store mail your order to us. Write for a copy of our Catalogue D Radio Apparatus.

WHOLESALERS AND RETAILERS:

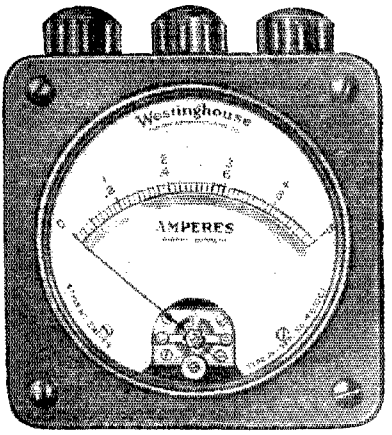
Write for our liberal proposition. Dealers Catalogue D and Price List, also samples sent on request.

UNION RADIO CORPORATION
200 MT PLEASANT AVENUE, NEWARK N.J.
NEW YORK OFFICE 116 WEST 32ND STREET.

Westinghouse Type PX-2--PX-3 Portable Radio Instruments



Type PX-2 Voltmeter



Type PX-3 Ammeter

W
WESTINGHOUSE ELECTRIC

These portable instruments are particularly useful for temporary service such as testing. They are also used where it is not convenient or desirable to mount instruments permanently on panels.

They have the same movements as our Types BX and CX panel-mounting instruments, and are enclosed in dust, moisture and acid-proof cases.–Folder 4471-A tells all about them.

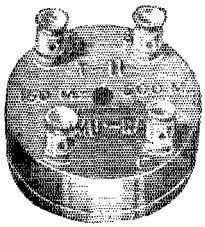
Westinghouse Electric & Manufacturing Co.
Newark Works, Newark, N. J.

Westinghouse

Mu-Rad RADIO Laboratories
AMPLIFICATION DISTANCE

Mu-Rad R-F

Amplifying Transformers



200-600 Meters Air Core

Part of the Celebrated Mu-Rad Receivers

THE heart of the great sensitivity of Mu-Rad Sets, a marvel of a marvelous science, is the Mu-Rad Transformer. No loss by capacity effect. No eddy current or iron losses. A type for every stage. Ask your dealer.

Dealers Profit When Mu-Rad Apparatus Builds Confidence of Customers in Their Stores

Three Types

Type T-11 for the first stage 6.00

Type T-11A for the second stage $6.50

Type T-11B for the third stage $7.00

Write NOW for Proposition

MU-RAD LABORATORIES, INC.
804 FIFTH AVE. ASBURY PARK, NEW JERSEY

BUILD YOUR OWN RADIO

The Radio Specialty Company—RASCO for short—specializes in small orders; in fact, 50% of our orders are less than one dollar. 24-hour service guaranteed.

This Company specializes in small parts for radio, selling only the highest class of materials. This Company is aware of the fact that very high prices prevail in radio now. By buying material from us you not only save anywhere from 50 to 75% on the cost of the instruments, but you have the fun and instruction of making them yourself.

Our quick 24-hour service means satisfied customers. We have no Complaint Department. Hundreds of letters such as the following, unsolicited, are in our files:

41 Rodney St., W. St. John, N.B.
Dear Sirs:

Enclosed you will find one (1) dollar for which please send me 1 dozen binding posts No. 201 at $1.00 per dozen and oblige.

Geo. B. Ingraham

P.S.—Rasco Service is sure all it is cracked up to be. I have received three different orders from Rasco and I am still waiting for an order from another Company which was sent in before the first Rasco order.

Yours truly,
G. B. I.

64 page catalog

Our prices are low and all goods are shipped prepaid. You deal with the oldest and only Company exclusively manufacturing the small parts in their own two big factories. Our big 64-page catalog, No. 7, containing over 300 illustrations will save you money. This catalog also contains

75 Diagrams of Vacuum Tube Hook-Ups

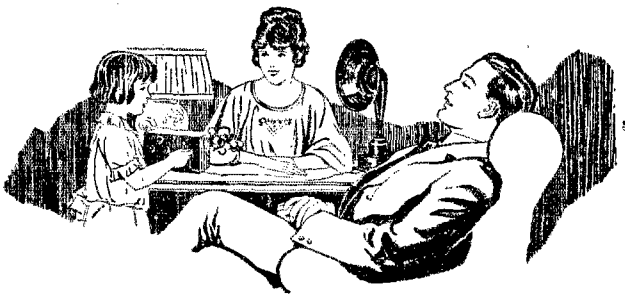
not to be found in any catalog, only found in expensive text books. This catalog sent only upon receipt of 15¢

Once you have tried the RASCO service you are a customer for life. 85% of our customers always come back.

Detector 50¢

Radio Specialty Co

98-100 PARK PLACE, NEW YORK CITY



Exide
BATTERIES

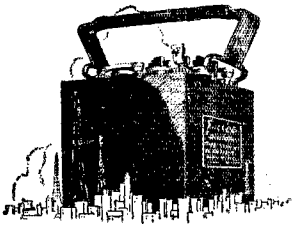
Uniform current cuts out the noise

EVERY radio amateur knows how disastrous battery noises are to clear receiving. You can avoid this annoying interference by getting the battery that insures a steady flow of filament current. That battery is the Exide Radio Battery.

This specially designed radio battery does its work uncomplainingly, and never requires much attention. The rasping, snarling noises often caused by fluctuating current in ordinary batteries do not exist in the Exide Battery. It delivers uniform filament current for every type of vacuum tube. You can count on the Exide for dependable, long-lasting service.

Exide Batteries are used in a majority of the government and commercial wireless stations and in every industry where a battery's response to the call of duty must not fail.

Any dealer in radio equipment will sell you an Exide Radio Battery, or you can get one at the nearest Exide Service Station.



THE ELECTRIC STORAGE BATTERY CO.
Philadelphia, Pa.

Service Stations Everywhere

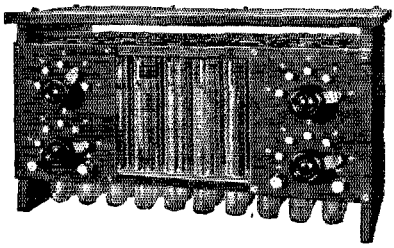
Branches in Seventeen Cities

"B" Battery with Panel Control

Storage Batteries

designed for

RADIO



KICO Storage "B" batteries are used by thousands of amateurs who understand radio and consequently buy nothing but the most efficient equipment.

A FEW REASONS

1. Alkaline type. Unlimited Life.
2. They eliminate noises caused from "Bs" that are rapidly deteriorating.
3. The switch control allows single cell variations from 12 volts up. (A critical plate adjustment is essential on your detector bulb for C.W. and Radiophone reception.)
4. Rechargeable from your 110 Volt A.C. line in connection with the rectifier supplied with each battery.
5. Will last from three to six months on a single charge while in the detector plate circuit.
6. NOT an experiment. All batteries sold with the privilege of receiving your money back if unsatisfied within a 90 day trial.
7. Neat, Efficient and Compact.

			(Plain)	(With Panels)
16 cell	22 volts		$6.50	
24 cell	32 volts		8.00	$12.00
36 cell	48 volts		10.00	14.00
50 cell	68 volts		12.00	17.00
75 cell	100 volts		16.00	21.00
108 cell	145 volts		21.00	26.00

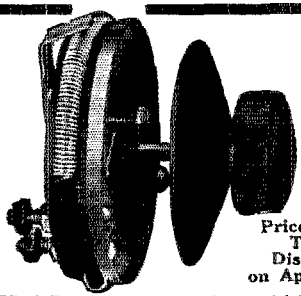
F.O.B. Buffalo, N. Y.

Literature gladly furnished

We distribute KING Chargers

KIMLEY ELECTRIC CO.

1355 Fillmore Ave., Buffalo, N. Y.



Price $1.00
Trade Discounts on Application

FILAMENT RHEOSTAT

Especially designed for filament control of detector and amplifying tubes. Adaptable to either panel or table mounting. Fine regulation

Sterling

RADIO DEVICES

Include

Portable Rectifiers
Filament Meters
Filament Rheostats
Twelve Point Rotary Switches
Audio and Radio Amplifying Transformers
Pocket Voltmeters

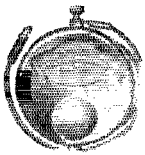
Use as Many Sterling Radio Devices as You Can to Complete Your Set and Be Assured of Successful Receiving.

Every device bearing the Sterling trade name means as much to the radio fan as Sterling does on silver.
Guaranteed to make good or we do.

The Sterling Mfg. Co.

2845 Prospect Ave., Cleveland, Ohio

The most dependable source of supply.



Every instrument carefully calibrated and not tuned up to read high

Types:	No. 33 0-3v (1/10v div.)	$1.25
	No. 34 0-8v (1/5v div.)	1.25
	No. 34A 0-16v (½v div.)	1.75
Trade Discounts on Applications	No. 34B 0-30v (1v div.)	2.25
	No. 34C 0-50v (1v div.)	2.75

Trade Discounts on Applications

POCKET VOLTMETERS

Is your battery always fully charged and fit?

Is it always toned up for best results, whenever friends happen in—throughout every concert?

Keep it at full strength and prolong its life—the simple, easy, inexpensive Tungar way.

Tungar—the go-between from house-lighting circuit to storage battery—attaches wherever there is a lamp or convenience outlet.

You don't have to move the battery. Just connect Tungar, and leave it—any time, day or night.

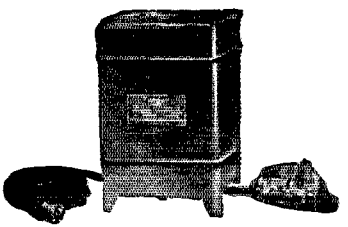
Tungar is *certain, clean, quiet.* No moving parts to get out of order or make noise.

Good for the auto battery too—the *same* Tungar.

See one at any good electrical store, or write for literature. Address Section Q5.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

Tungar Battery Charger. Operates on Alternating Current.
2 Ampere Outfits—$18.00
5 Ampere Outfits—$28.00
(Prices east of the Rockies)
Special attachment for charging 12 or 24 cell "B" Storage Battery—$3.00 —fits either size Tungar.



Charge 'em at Home, with

Tungar

BATTERY CHARGER

A GENERAL ELECTRIC PRODUCT

35A—96C

Here's a new one for getting DX —

Everybody is talking about how those UV 201 A tubes reach out like the long arm of the law. Little Omega Durham has tried 'em, too, and is right on the job with a super-extra High Resistance.

No. 201 A—2 to 10 megs

Special for UV 201 A Tubes

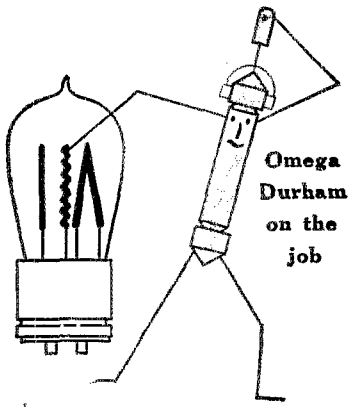
It's just as accurate and as easily handled as the other DURHAMS. And it sure puts a lot of space between the D and the X. Little Omega guarantees satisfaction.

Price 75¢ at your dealers

DURHAM & CO.

Radio Engineers

1936 Market St., Philadelphia



DURHAM Variable High Resistance

No. 100, 1,000 to 100,000 ohms for resistance coupling, etc.

No. 101, 100,000 ohms to 5 megs. for general tube use. —

They fit Dubilier Grid Condenser Clips

6OE **KGO** **6XR**

I Ship All Over the United States

"Everything Worth While In Radio"

AT

THE RADIO STORE

OF

PAUL FRANKLIN JOHNSON

560-562 East Colorado Street, Pasadena, California

THE RADIO SET OF THE FUTURE

IT cannot be foretold what combination of units will be used, or the circuits that may be employed in the Receiver of tomorrow. It is obvious, however, that today's conventional set will soon be considered crude and antiquated.

Little prescience is required to realize that the panel of insulating material, with its shielded background, is doomed to obsolescence. The use of a great mass of expensive insulating material to provide for "live shafts" was merely a temporary expedient. Progressive practice has eliminated the electrical difficulties connected with live shafts and also obviated the necessity for massive insulation.

Carrying primary leads to the panel, and the drilling of numerous holes for a switch, will cease because of the waste such labor entails. To make the tap-switch an integral part of the instrument is the expedient thing to do.

Knobs add nothing to the appearance of a panel, and will in time become a relic of bygone days. The concave dial and bar control, giving ease of adjustment without cramping the hand, is far more sensible and attractive.

EISEMANN PARTS AND PANELS

Permit changing circuits and re-location of parts on panel, all units being interchangeable.

Make unnecessary the use of shielding—the metal panel itself accomplishing this purpose.

Eliminate mounting of tap-switches and soldering of primary leads.

Give the many advantages of concave dials—a natural position of the hand in tuning, added attractiveness in appearance and ease in packing for transportation.

Write for descriptive literature.

EISEMANN MAGNETO CORPORATION

William N. Shaw, *President*

BROOKLYN, N. Y.

DETROIT CHICAGO

EISEMANN

"ALL AMERICAN"

Sets World Record for Long Distance Radiophone Receiving

When WDAP CHICAGO Talked to S. S. BERENGARIA

The Signals Were Amplified Aboard-Ship Tara

"ALL-AMERICAN" AMPLIFYING TRANSFORMERS

WDAP, The Drake Hotel, Chicago, made history in radio, by talking day-by-day with the S. S. Berengaria, enroute New York to France. Miss Florence McDonald, a passenger, installed Standard Zenith Receiving Set in the steamship cabin, and, every evening during the voyage, WDAP talked to her and other passengers from Chicago, their voices coming clear and strong with the personality easily recognizable.

The set used by Miss McDonald is one of the regular Zenith Sets, manufactured by the Chicago Radio Laboratory, Chicago, Ill. It contained, as standard equipment.

"ALL-AMERICAN AMPLIFYING TRANSFORMERS

R-10—Radio Frequency (150-500 meters) $4.50 R-13—Audio Frequency (Ratio 10 to 1) $4.75
R-12—Audio Frequency (Ratio 3 to 1) 4.50 R-21—Audio Frequency (Ratio 5 to 1) 4.75

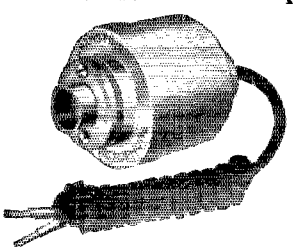
Send for our circular — "Cascading of Amplification". Also our Free Book of Radio Hookups.

ALL AMERICAN **RAULAND MFG. CO.** ALL AMERICAN

200 N. Jefferson St., Chicago, Ill.

RHAMSTINE*

Victophone
A New Loud Speaker



Price 7.50

Complete with Phone Cord

The Victophone is a correctly designed loud-speaking receiver—it requires no battery to operate it. Can be used with any type of horn but it is especially designed to be attached to the tone-arm of various phonographs.

It possesses these superior qualities:

1. **Adjustable poles.**
2. **A venturi opening in the cap correctly designed to increase volume.**
3. **Rubber gasket between the tone-arm flange and the cap to reduce metallic vibrations.**

The Victophone is nickel-plated and highly polished. It bears the name Rhamstine*, assuring you of satisfaction in your purchase.

Order yours today. Dealers write for discount.

Manufactured by

J. THOMAS RHAMSTINE*
2162 E. Larned Street, Detroit, Mich.

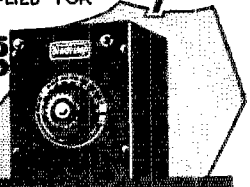
*Maker of Radio Products

TRADE MARK

Wave Trap

PATENT APPLIED FOR

The Missing Link in RADIO



Stops Interference!

Get that elusive DX station thru heavy QRM. With the "WAVE TRAP" you can do it and greatly increase your range.

It is installed in a minute by changing only one connection and is indispensable on any receiving set, with any type of antenna. It is mounted on a Formica panel in a handsome mahogany finished cabinet 6x5x6, and is a high-grade instrument throughout.

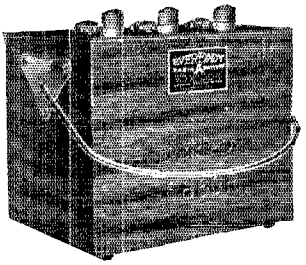
8.50 CHARGES PREPAID

Ferbend Electric Co.
23 E. SOUTH WATER ST.
CHICAGO

Circular on Request

RADIO

—"they last longer"



For Storage Battery Tubes use EVEREADY Storage "A" Batteries

For Dry Cell Tubes use EVEREADY Dry Cell Radio "A" Batteries

For All Vacuum Tubes use EVEREADY "B" Batteries

NATIONAL CARBON COMPANY, Inc.
Long Island City, N.Y.
Atlanta Chicago Cleveland Kansas City San Francisco

Insist on Eveready—Accept no Substitute

EVEREADY Radio Batteries
—they last longer

Cotogrip

"Built First to Last"

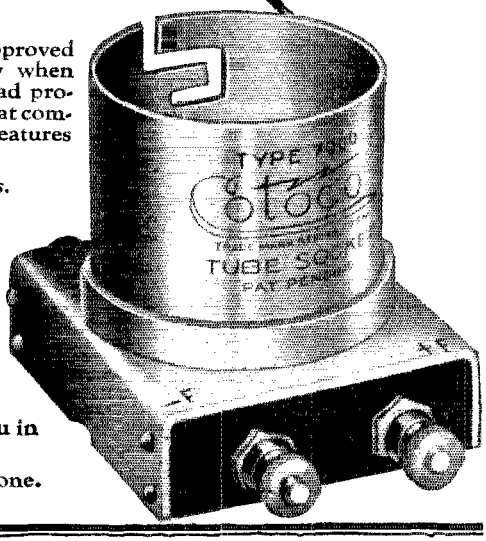
This little beauty was approved by our engineers only when convinced that they had produced the one socket that combines all the essential features of a good socket.

1. *Positive Cotogrip Contacts.*
2. *Hard Rubber Insulation.*
3. *Rugged Construction.*
4. *Compact Design.*
5. *Concealed Mounting.*

It is impossible to show the unique mechanical action of Cotogrip contacts in a photograph. It is different from any other socket you have ever seen. This socket will interest you in every way.

You ought to have one.

Ask Your Dealer



COTO-COIL CO. PROVIDENCE

PACIFIC COAST BRANCH, 329 UNION BLDG., LOS ANGELES.

How to make the NEW GRIMES DUPLEX SET

is told complete in our new Loose-leaf catalog. Circuit diagram, list of material needed, etc.

Build this receiver now and work right thru summer static.

Send 10c for your catalog today. It lists all the new apparatus. New inserts keeping it up-to-date, supplied free of charge.

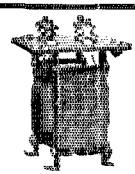
LYNN RADIO CO.
Sixth Floor Consumers Building
220 So. State Street, Chicago, Illinois

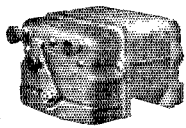
RADIO TRANSFORMERS

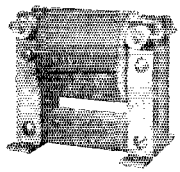
REAL MERIT is what you expect and what you receive when you use STANDARD Radio Transformers.

PERFECTLY SHIELDED by virtue of the design MAXIMUM AMPLIFICATION by proper impedance.

Silicon steel cores, insulation test on coils 1500 volts. Bakelite Terminal Board.


Type M


Type FL


Type MR

Type M—Ratio 9 to 1 ..... $5.00
Type MR—Ratio 4 to 1 ..... 4.50
Type FL—Filament Heating 8.00
Discount 10% for cash with order

Designed by Pilot engineers, a quality name in Radio.

THE STANDARD TRANSFORMER COMPANY
WARREN, OHIO.

Standard *of the* World
for professional and amateur use

DICTOGRAPH
Radio HEADSETS

We believe the Dictograph Radio Headset is the best in the world at *any* price. Thousands of letters from enthusiastic users in all parts of the world substantiate this belief. Read a few:

U. S. Marine Hosp. #43
Ellis Island, N. Y.

"The undersigned has for the past sixteen years been an amateur, commercial, and government operator, and has used every known make of radio receiver on the market. On April 21st one of your Type R-1 3000 ohm receivers was purchased and it can be safely said without dispute that they are absolutely the best radio receivers on the market today; bar none."

C. H. West, U. S.P. H. S.

Laporte, Ind.

'I wish to compliment you on the 3000 ohm Headset you now have on the market retailing at $12.00 (now $8.00). I have been experimenting with the radio game for the past year in my experience I have tried out 14 different headsets, including the ----- which I purchased for $16.50. I at last have found the ideal phone where tone quality excels, and harshness is eliminated, and I cannot express myself in words as to the wonderful results I have obtained."

J. T. Bachman.

Madison, South Dakota.

"We are using a Dictograph Headset, also Dictograph Loud Speaker. Both are O.K. In fact I would not trade my headset for any other I have ever listened through."

Dan C. Coutts, Radio Operator.

Havana, Cuba.

"In my long distance receiving set have four pairs of Phones, a 4000 ohm French make, two Pairs of ------ and a pair of your Dictograph 3000 ohm and I assure you that none of the others afford me the service I get from the Dictograph. The Dictograph gives me a truer clear tone than all the others combined. I use them in extremely long distance work (phone). I hear Chicago, Schenectady, Iowa and Frisco most every night with one detector and two steps of amplification using the standard regenerative honey comb set."

David E. Masnata.

Made by the makers of the world standard Dictograph Products—the marvelous "Acousticon" for the Deaf, the famous Detective Dictograph, the Dictograph System of Interior Telephones and the Dictograph Radio Loud Speakers for the Home.

Type R-1, 3000 ohms.

Go to your dealer's today and listen in with Dictographs. You cannot fail to be impressed by their superiority. Buy two or three sets and let your family and friends enjoy the broadcasting.

The new Dictograph Radio Loud Speaker is a revelation. Its Adjustable Air Gap permits perfect tuning under varying conditions and insures reception of excellence heretofore unattained.

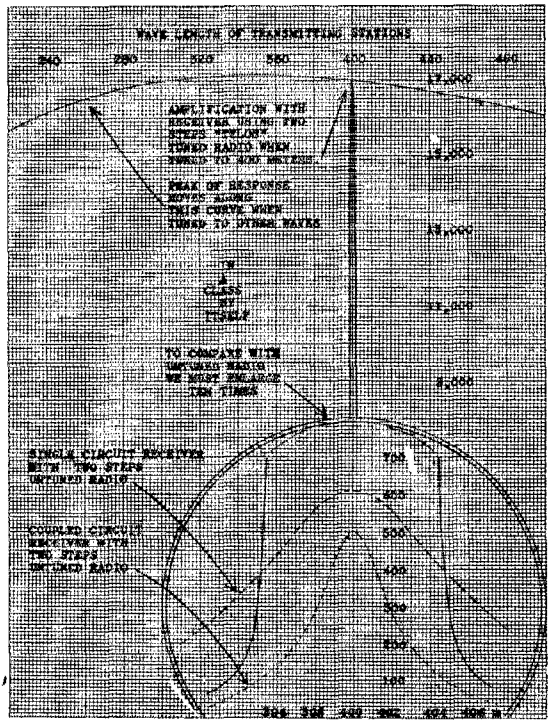
Always insist on Dictograph Products. They are fully guaranteed. If your dealer cannot supply you, write to us.

DICTOGRAPH PRODUCTS CORPORATION

Suite 1304, 220 W. 42nd Street, New York City

Branches in all principal cities

DEALERS: Order through your jobber or write direct for names of authorized distributors.



TELOS
VARIO-TRANSFORMERS

give selectivity and amplification as shown by this curve taken from the MELCO SUPREME RECEIVER

The base of the curve is magnified to permit comparison with two steps untuned R.F. No need for vario-couplers, tuning condensers or untuned R.F. transformers.

Write for **FREE** booklet

by Lester L. Jones

Formerly Expert Radio Aid U.S.N.

on TUNED RADIO AMPLIFICATION.

DANZIGER-JONES Inc.
143A Prince St., New York

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for C. W. Transmitters-

A special offer from "Chi-Rad" of Willard Miniature 8-Volt Threaded Insulation Storage Batteries.

For pure D.C. for C.W. Transmitters we recommend these batteries in preference to a generator. Batteries eliminate filter system and give all-around better results.

Special time limited price offer reduces cost of a complete set of batteries approximately equal to cost of generator. Batteries are brand new, dry until ready to charge.

In lots of 40 (320 volts) **$4.00** each

(Better price on larger quantities).

Only a limited quantity - - - order today!

Chicago Radio Apparatus Co.
407 S. Dearborn St. Chicago

BRACH
VACUUM RADIO PROTECTOR

ASK YOUR INSURANCE AGENT

Approved By National Board Fire Underwriters

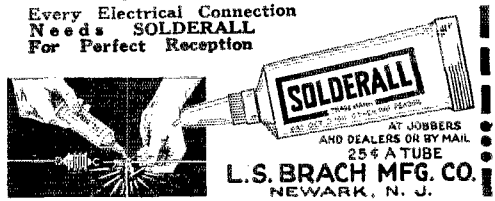
The Choice of the Foremost Engineers for over 17 Years

$3

SOLDERALL

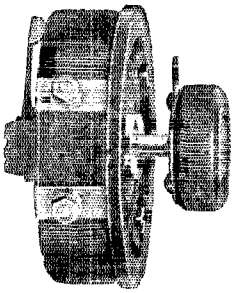
The Only Convenient Metal Solder.

Every Electrical Connection Needs SOLDERALL For Perfect Reception



AT JOBBERS AND DEALERS OR BY MAIL
25¢ A TUBE

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



Type 214
Rheostat

If---

You are using the new tube, UV-201A, you are a customer for a General Radio Co.'s 20 Ohm type 214 Rheostat.

It is a convenient, practical instrument, equally well adapted for experimental service and permanent installations. No unpleasant noises in the phones when you rotate the contact arm of a Type 214.

For UV-201A tubes 20 Ohms
For UV-199 tubes 50 Ohms

Price $2.25

For lasting satisfaction use a General Radio type 214, 400 Ohm, Potentiometer. Get your gas detector or that sensitive kink by fine adjustment of plate potential.

Type 214, 400 Ohm, Potentiometers, control regeneration in your radio frequency amplifier by a positive grid bias.

Price complete, (Specify whether for use in back of or in front of panel) $3.00.

For full description of these and other pieces of high-grade radio apparatus, write for free copy of Bulletin 912Q.

GENERAL RADIO CO.

Manufacturers of Radio and Electrical Laboratory Apparatus

Massachusetts Avenue and Windsor Street

CAMBRIDGE, MASSACHUSETTS

5819

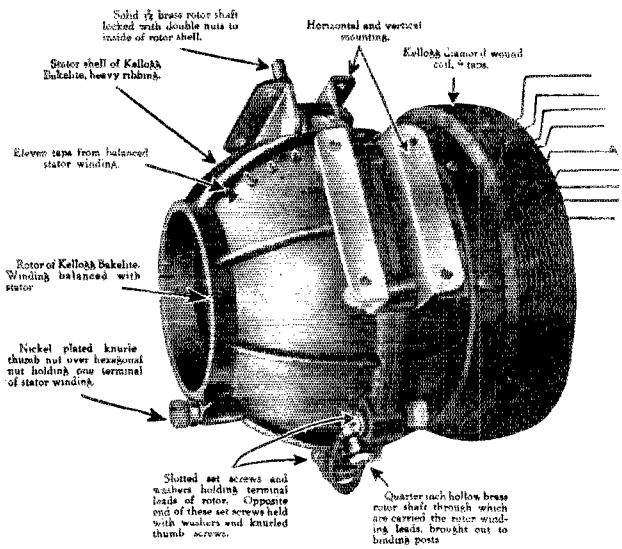
Kellogg Radio Equipment *for* Better Results

A better product of unusually fine workmanship

No sliding contacts

Nothing to wear

Will not produce tube noises



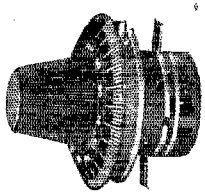
High induction and low distributed capacity

The No. 502 Diamond wound coil increases the wave length from 500 to 2500 meters

No. 501—Varicoupler $8.00 • With No. 502 Coil as shown above $12.00

KELLOGG SWITCHBOARD & SUPPLY CO., CHICAGO

The AMSCO COMPENSATING CONDENSER



is a special 3-electrode condenser for balancing the grid charge on the amplifying tubes. Stops all local oscillations without detuning the amplifier. Shielded against hand capacity disturbance.

A postcard will bring our literature—illustrating and describing our entire line.

AMSCO PRODUCTS, Inc.

Successors to MORTIMER RADIO CORP.
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FAIRBANKS BUILDING
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"What a clear tone"

The announcer's voice is distinct, the music as clear as a bell, because her radio outfit is equipped with the

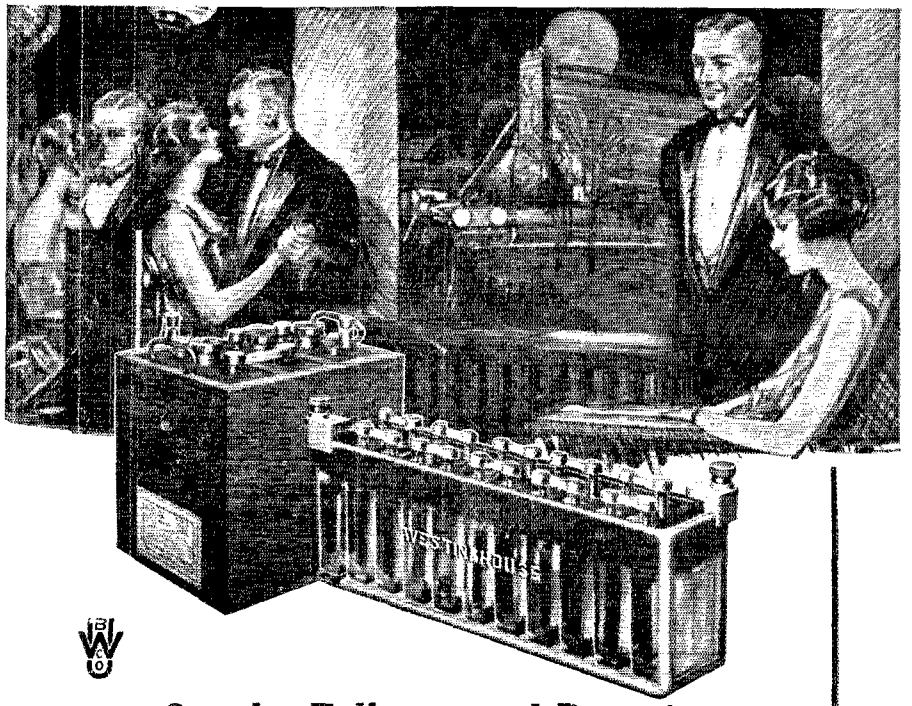
Stromberg-Carlson Radio Headset

Comfortable, quickly adjustable to any size head—cord permits use by two observers.

Backed by 8 years experience in the manufacture of radio apparatus and 28 years in high grade telephone equipment.

Order Stromberg-Carlson apparatus through your electrical dealer or write for free bulletin No. 1029-Q.

Stromberg-Carlson Telephone Mfg. Co.
Rochester, N. Y.



Steady, Full-powered Batteries

EVERY radio set has its own peculiarities—little niceties of adjustment at which best results are obtained. Battery voltage and amperage must be just so. And once adjusted, current must have sustained evenness and steadiness.

Get *good* batteries. They're the most satisfactory and economical in the end. Westinghouse Radio Storage Batteries will settle the problem practically for good. They last indefinitely and are easily and repeatedly rechargeable. Built by Westinghouse—you know they're *RIGHT*.

Westinghouse "A" Batteries are carefully constructed, full-capacity, slow-discharge, long-life batteries. Made in 4, 6 and 8-volt sizes with 5, 9 and 13 plates per cell, to meet various filament-battery requirements.

Westinghouse "B" Batteries. The Westinghouse 22-M G-2 (22 volts) is a marvel for steady, noiseless, full-powered service. Glass case; visible interior; sealed-in tops. Larger types, too; also 2-volt single cells for "C" batteries.

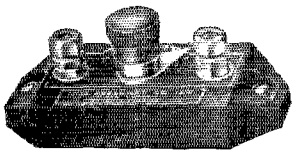
At radio dealers and Westinghouse Battery Service Stations everywhere. Write for illustrated folder, "Westinghouse Radio Storage Batteries."

WESTINGHOUSE UNION BATTERY CO.
Swissvale, Pa.

WESTINGHOUSE
RADIO "A," "B" and "C"
BATTERIES

FRESHMAN PRODUCTS—ACCURATE AND DEPENDABLE

VARIABLE RESISTANCE LEAK



With .00025 mfd. MICON Condenser Combined **$1** Without Condenser **75c**

Unbroken range—Zero to 5 Megohms—Clarifies signals, lowers filament current, increases battery life, eliminates hissing.

"MICON"
Tested Mica CONDENSERS

Size	Price
.00025	$ .35
.0005	.35
.001	.40
.002	.40
.0025	.50
.005	.75
.006	1.00
.01	1.50

Assure absolute noiselessness—clarity of tone—accuracy—constant fixed capacity.

Freshman products are standard and can be used with practically any circuit.

ANTENELLA

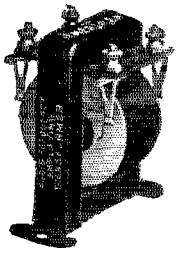
No antenna or aerial needed. Eliminates all the inconveniences in radio, operates from any light socket. Price only $2.00.

At your dealer's—otherwise send purchase price and you will be supplied postpaid.

$2

CHAS. FRESHMAN CO., Inc.
106 SEVENTH AVE., NEW YORK

In Any or All Stages
of audio frequency amplification
The AMERTRAN



Price $7
Ask your electrical dealer, or sent carriage charges collect. (Wt. 1 lb.)

can and should be used. It is made in only one type and one ratio. Its flat-top amplification curve precludes the possibility of distortion on the part of the transformer when used in any or all stages. It will give the same clear-toned distortionless amplification with all tubes which are approximately alike in A.C. Impedance and Amplification Factor, such as

WD-11
UV-201 UV-201-A
C-301 C-301-A

Its amplification in one stage is 38.6; two stages 1490.

American Transformer Company
Designers and builders of radio transformers for over 20 years.
176 Emmet St., Newark, N. J.

PANEL SERVICE

We offer to the amateur and dealer

REAL PANEL SERVICE

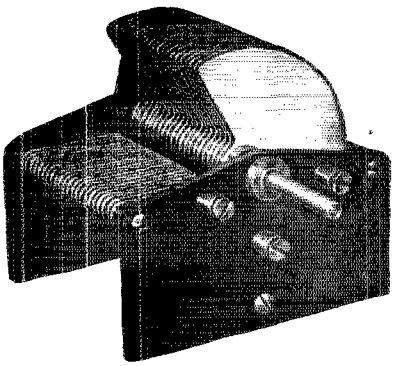
Our panels are cut to your order. Only genuine Condensite and Formica used.

1/8″ per square inch $0.02
3/16″ per square inch .02½
1/4″ per square inch .03

We also carry a complete line of radio essentials. Dealers will find it profitable to have our latest price list and discount sheet.

PITTSBURGH RADIO AND APPLIANCE CO., Inc.
"Pittsburgh's Radio Shop"
Desk B
112 Diamond St., Pittsburgh, Pa.

HERE'S A PAIR OF WINNERS



THE WIMCO CONDENSER

Made to meet a demand for quality — highest efficiency, 3 plate, 23 plate and 43 plate sizes.

Very low resistance and very low zero capacity. The phase angle does not depart from 90° sufficiently far to be detectable. Highly recommended for the fine tuning necessary in amateur apparatus.

THE CARCO COUPLER

Just the thing for the popular receiving set. Bakelite tube and rotor, silk covered wire, perfect contacts. Designed and developed by an amateur for the amateur.

Guaranteed to produce superior results. Range 150 to 700 meters. Not just "a coupler" but the real coupler—peer of all, the Carco.

We invite Dealer and Jobber inquiries.

Send for literature and prices on the

WIMCO SOCKET FOR WD-11 TUBES

THE WIRELESS MANUFACTURING CO.

CANTON, OHIO

Manufacturers—Distributors

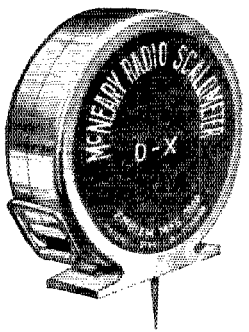
THIS INSTRUMENT ACCURATELY MEASURES THE DISTANCE OF D-X CALLS

Science again has come to the aid of the radio fan. Here is a wonderful little instrument that tells you the exact range of your set and instantly indicates the distance of every call that comes in.

Mc NEARY

RADIO SCALOMETER

& OFFICIAL RADIO MAP



Isn't it thrilling to hear a human voice hundreds of miles away? But how much more thrilling it is to know the exact distance the voice traveled in reaching you.

The McNeary Scalometer will tell you instantly. All you have to do is to place the Scalometer on the official radio map which comes with every scalometer. You look for the station—takes but a second—and there you have it—printed in legible type: the exact distance in miles.

No more guess work necessary! Keep the McNeary Scalometer handy and you'll always have a valuable friend to tell you quickly—correctly the distance of every call you receive.

The McNeary Scalometer is a wonderful, precise instrument in a beautifully finished aluminum case. See it today!

$1.00 COMPLETE

SCALOMETER AND RADIO MAP

Authoritative, up-to-the minute, showing broadcasting stations time zones, radio districts, cities and towns of the United States and Canada.

BROADCAST DIRECTORY

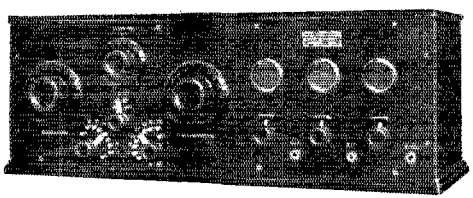
In handy booklet form with all broadcasting stations alphabetically arranged by call letters.

See this SCALOMETER at any radio shop

IF YOUR DEALER CANNOT SUPPLY YOU SEND ONE DOLLAR TO

EMBLEM MANUFACTURING CORP.
259 MIDDLE CITY BLDG., PHILADELPHIA, PA.

Tuska No. 227—The model used by Station 1RU when he heard across the sea.



Tuska Radio—
First to reach across the sea

A Tuska set was used by the amateur officially credited with first receiving British amateurs in the trans-Atlantic tests. Station 1RU, Hartford, Conn. received a British operator on a Tuska as reported on page 15, February issue of this magazine.

And in France, Leon Deloy with a Tuska using only one stage of audio frequency amplification, heard a number of American stations.

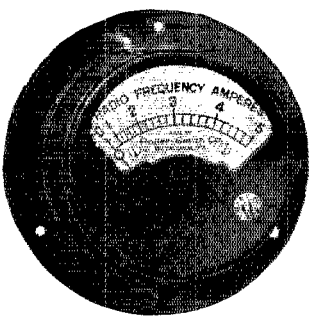
Yes, truly, she's "some set." Will do anything any other set will do, and a whole lot more besides.

Perhaps you'd like to see a catalog showing all the models we build. Write for Catalog No. 18-A.

The C. D. Tuska Co.,
Hartford, Conn.

TUSKA TRADE MARK RADIO

TUSKA RADIO



How Many Amperes Are You Radiating?

A Roller-Smith type TAW Thermal Ammeter will tell you accurately and it will *continue* doing so. These little 3½" instruments have demonstrated their reliability in the Government service. You can't make a mistake when you use them. Bulletin No. AG-10 is yours for the asking. Send for it. This Bulletin also describes a most complete line of ammeters and voltmeters for *all* radio work.

ROLLER-SMITH COMPANY
16 PARK PLACE, NEW YORK

Offices in principal cities in U. S. and Canada

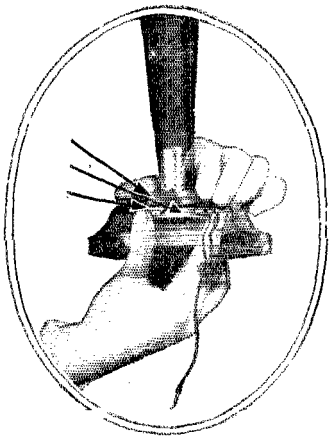
A Real Musical Instrument

Actual Re-PRODUCTION of the artist's music, as broadcasted, is at last attained in the Atlas Amplitone Loud Speaker, without blast or distortion. The artist's personality breathes again in the full, natural, vibrant tones of the Amplitone Re-PRODUCTION. Musical critics and radio fans, who have heard the Amplitone, agree that, at last, the musical superiority of even the finest phonographs has been surpassed. Embodies exclusive acoustic principles including the marvelous double diaphragm.

Atlas AMPLITONE LOUD SPEAKER

No loud speaker is perfect, unless it can be adjusted to your own individual set. The Atlas Amplitone is adjustable to any set.
Complete with connecting cord.

$25.00



Amplitone Unit

The Atlas Amplitone Unit, (without base or horn), with Grafonola Attachment, for use with your own horn or base or to convert any phonograph (except the Brunswick) into a loud speaker, (with attachment.)

$13.50

Write for Amplitone Booklet

Write for illustrated booklet and the name of your nearest **Amplitone** dealer. No other loud-speaker can take the place of the **Amplitone.**

Multiple Electric Products Co., Inc.

11 Orange Street **Newark, N. J.**

Federal Standard Head Sets are made with 2200 Ohms and 3200 Ohms resistance.

Federal Standard
RADIO HEAD SETS

FOR durable efficiency, clearness and wide distance-range Federal Standard Head Sets have no superiors.

Made of specially treated steel with permanent magnets, scientific wiring and adjustment, and precision machining of metal parts, these Head Sets have achieved a well deserved universal recognition and endorsement by Radio experts.

To secure professional efficiency from your receiver insist on having Federal Standard Head Sets: Federal Standard is the product of over twenty years' experience in the manufacture of communication apparatus.

Ask you dealer for Federal Standard Head Sets. If out of stock he can get them from our nearest office. Accept no substitute.

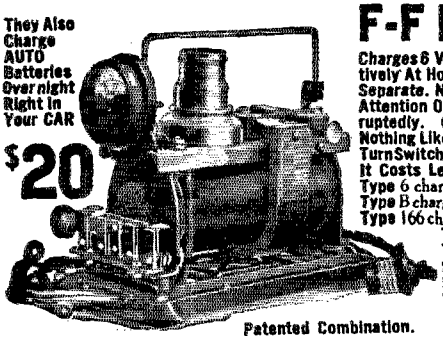
Federal makes a complete line of Standard Radio apparatus—all reasonably priced. Write for latest catalog.

Federal Telephone and Telegraph Co.
BUFFALO, N. Y.

RADIO "A" & "B" STORAGE Batteries CHARGED at Home For a Few Cents Overnight with "The PATENTED FULL WAVE" 100-130 Volts 60 Cycle A. C. Magnetic Taper Charge Design

They Also Charge AUTO Batteries Overnight Right in Your CAR

$20



Patented Combination.
CHARGES "A&B" RADIO & AUTO BATTERIES.

F-F RADIO RECTIFIER

Eventually You Will Buy An F-F RECTIFIER. Why Not Now? The Sooner You Buy It: The More You Save. It Charges 6 Volt "A" & Auto: & up to 120 Volts Of "B" & Loud Speaker Storage Batteries in Series Inductively At Home Overnight; Disconnecting & Multiple Connections Unnecessary. Charging Circuits Separate. No Chance For Grounds Or Short Circuits. Nothing To Slop Over, Be Filled, Burn Out, Need Attention Or Cause Trouble. Infusible Rectifying Brushes Maintain Constant Efficiency Uninterruptedly. Complete Portable Automatic. No Skill Required. AMMETER Eliminates Guess Work. Nothing Like It Made. Lasts Lifetime. Screw Plug In Lamp Socket; Snap CLIPS On Battery Terminals; Turn Switch & Battery Is Charged In Morning. Charged Batteries Mean Fewer Expensive Replacements. It Costs Less To Buy An F-F RECTIFIER Than To Be Without ONE. 7 Types. POPULAR PRICES. Type 6 charges "A" 6 Volt Battery At 6 amperes $15 Type 12 charges 12 Volt Battery At 5 amperes $15 Type B charges Radio "B" Batteries Up to 120 Volts $15 Type A-B is Combination Of Types 6 & B $20 Type 166 charges 6 Volt Battery At 12 amperes $20 Type 1612 charges 12 Volt Battery At 7 amperes $20 Type 1626 is a Combination of Types 166 & 1612 and Charges Both 6 & 12 Volt Batteries $28 The 3 Lower Types are recommended for heavy Batteries, or where time is limited. SHIPPING WEIGHTS Complete with AMMETER & BATTERY CLIPS 11 to 15 lbs. Purchase from DEALER, or Mail Check for Prompt Shipment. Include Postage and Insurance Charges for P. P. Shipment, or Write us to Ship Type desired C. O. D. Order Now, or WRITE Immediately for FREE Descriptive BOOSTER Bulletins 31 & 31-A.

THE FRANCE MFG. CO., CLEVELAND, OHIO, U. S. A.
Canadian Distributor THE JACK V ELLIOT COMPANY Hamilton, Ontario, Canada.

"EURACO" PRODUCTS
(Guaranteed)
Compact — Interchangeable
Most Efficient — Accurate:

60 Cents per Unit

60 Cents per Unit

Mica Condensers — Grid Leaks
Mountings:
Interesting Proposition for Dealers
EUROPEAN RADIO CO.
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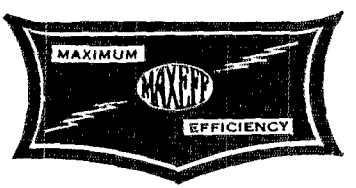

MAXEFF RADIO PARTS are unequalled in eveness of operation. Of high grade construction—absolutely reliable. Ask your Dealer or write for circulars and prices.

THE HIGGY-AVERY CO.
Manufacturers MAXEFF *Radio Apparatus*
1199 Franklin Ave., COLUMBUS, OHIO

Federal Is A Large User of Formica

THE Federal Telephone and Telegraph Company of Buffalo is a large factor in the radio industry and has an excellent reputation for the quality of its product.

It is a very extensive user of Formica insulation not only in the complete sets which it produces but in the radio parts, variometers, variocouplers, head sets of which it is a large manufacturer.

A list of the users of Formica reads like a directory of the leading independent radio manufacturers. So many of the best informed radio men in America cannot be mistaken in their opinion that Formica is most uniform, the best looking, and the most efficient radio insulation.

Dealers and amateurs can safely follow these great concerns in selling or using Formica. Formica dealers can supply you promptly with panels in all standard sizes. They can also supply special sizes when you want them.

THE FORMICA INSULATION COMPANY

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CINCINNATI, OHIO

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FORMICA
Made from Anhydrous Redmanol Resins
SHEETS TUBES RODS

Holtzer-Cabot No. 2 Universal

The Latest Achievement in Radio Head Sets

After exhaustive experiments and actual manufacturing experiences we have produced a receiver which, for tone quality, has no equal.

It is tested, not by "listening-in," but by a specially designed scientific instrument which gives its true tone quality by actual sound measurement.

Our new head bands are covered with flexible rubber, making them comfortable and sanitary.

Weight, only twelve ounces

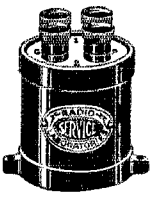
Price $12.00.

The Holtzer-Cabot Electric Co.

Boston and Chicago

THE NEW R T-8

Radio Frequency Transformers are specially designed by the **Radio Service LABORATORIES** for maximum efficiency when used with any low current consumption tubes on the market.



For Audio Frequency the new RT-A2 will give you 100% Tone Quality and High Amplification without distortion. For best results on both tone and distance, use Radio Frequency RT-S (for all stages) in the black case, retail price $6.00, and Audio Frequency RT-A2 in brown case, retail price $6.50. For sale at all reliable electrical or **Radio** Stores. If your dealer cannot supply you, order direct. Order by type number, accept no substitute, and remember that all **Radio Service Laboratories'** Transformers are individually triple tested and unconditionally guaranteed.

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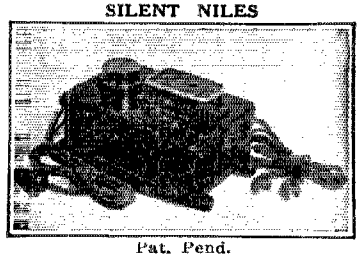

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THE BATTERY CHARGER SUPREME

Keeps your battery in prime condition and your receiving set always in service by charging at home from electric light socket.

AN ASSET TO EVERY RADIO BATTERY OWNER—PAYS FOR ITSELF.

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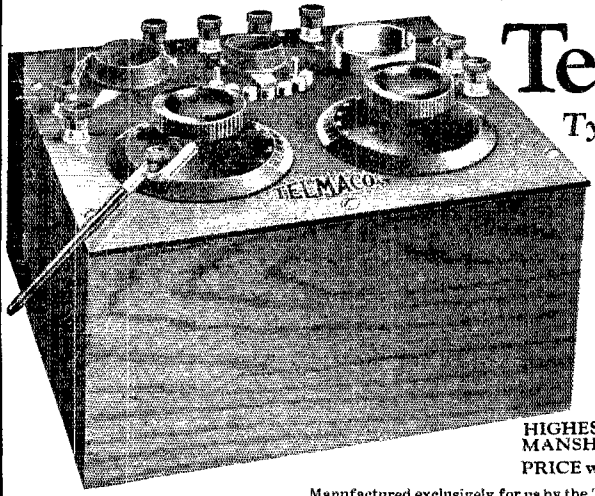


Telmaco

Type B-R Receiver

fully meets the requirements of the discriminating purchaser because of the following features:

EFFICIENCY OF OPERATION: Securing volume, distance (1500 miles with single tube is not unusual), selectivity. Broadcasting stations one-half mile distant are tuned out by a slight turn of condenser dial.

EASE OF OPERATION enabling the novice to secure satisfactory results.

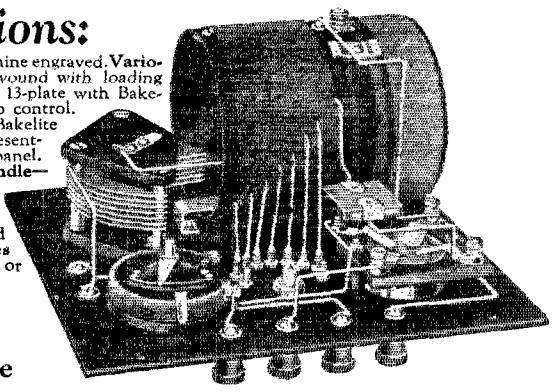
HIGHEST QUALITY OF WORKMANSHIP AND MATERIALS.

PRICE within the reach of everybody.

Manufactured exclusively for us by the Tri-City Radio Electric Supply Co., licensed under Armstrong U. S. Patent No. 1113149, October 6th, 1914.

Specifications:

Panel—Formica, grained and machine engraved. **Vario-Coupler—Telmaco** special silk wound with loading inductance. **Condenser**—Special 13-plate with Bakelite ends. **Rheostat**—Single knob control. **Socket**—Highly nickeled shell, Bakelite base. **Dials**—are polished, presenting pleasing contrast with dull panel. **Telmaco Adjustable Vernier Handle**—secures extremely fine tuning and entirely eliminates body capacity effects. **Workmanship**—manufactured according to **Telmaco's** rigid specifications. **This Guarantees Your Satisfaction.** Either 6 volt or 1½ volt tube may be used.



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TELMACO Type B-A Two Stage A. F. Amplifier

Matches the above in size and construction. The greatest Amplifier value on the market. Price $20.00.

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REMEMBER—OUR ORGANIZATION WITH YEARS OF PHENOMENAL EXPERIENCE AND SUCCESS IS BEHIND EVERY STUDENT WHO ENROLLS! COMPLETE INFORMATION FOR THE ASKING

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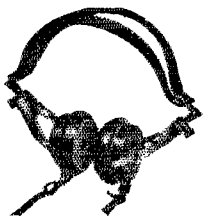

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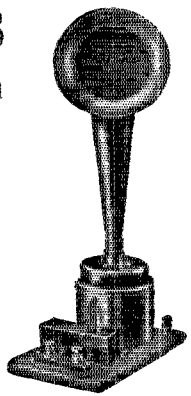

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500 volts, 125 watts, equipped with ball bearings, $30.00 each. Parts only, $14.00 each.

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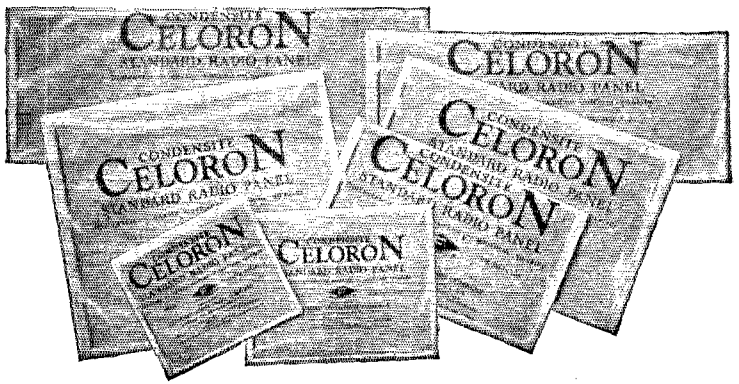

One of these panels fits *your* set

YESTERDAY you would have had to wait while the size was cut from sheet stock. Today you can get the panel you need immediately. Celoron Radio Panels come in standard sizes, one of which will be right for any set you may build.

Each Celoron Panel is already cut and wrapped ready for you to take home. Full instructions for working and finishing are on the glassine paper around every panel.

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2.—7 x 9 x $\frac{1}{8}$
3.—7 x 12 x $\frac{1}{8}$
4.—7 x 18 x $\frac{3}{16}$
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7.—12 x 14 x $\frac{3}{16}$

Also comes in sheets and can be cut in special sizes when desired.

Condensite Celoron, the material used for these panels, has high insulating qualities, high dielectric strength, and low dielectric losses. It is used by many of the leading manufacturers of radio equipment. It is easily machined and can be sawed, drilled, turned, or milled.

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For charging Batteries
Used in Wireless Operation
We have developed a complete line of MANY SIZES.
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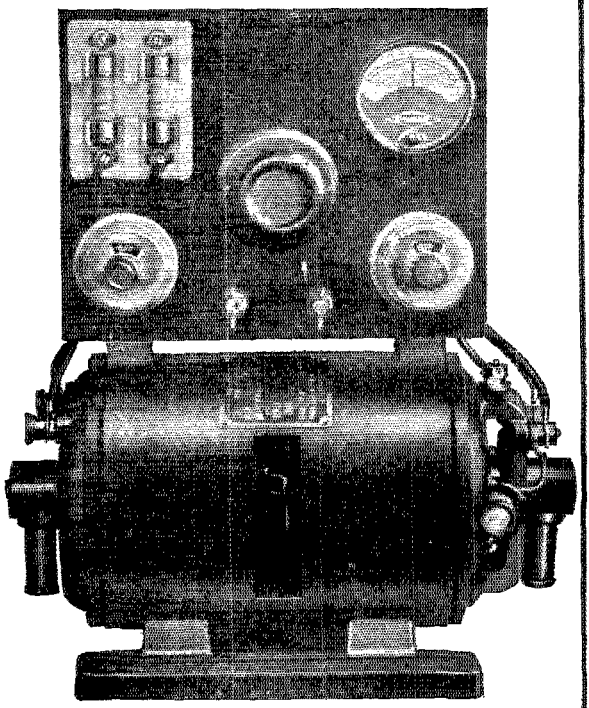
"ESCO" QUALITY thruout. You KNOW what THAT means.
Ask for Bulletin 242.



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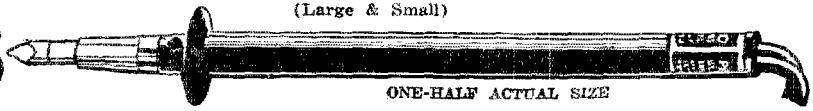

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A THOUSAND CRYSTALS IN ONE

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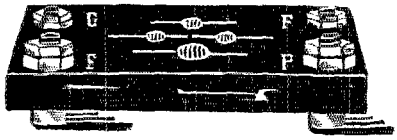

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Holds tube firmly.
Makes Perfect Contact

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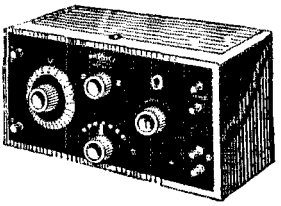

ACE Model V
$20
Formerly known as Crosley Model VC.

This one tube receiver is astounding the radio world with its wonderful achievements. Stations more than 1000 miles away are being regularly copied on this set. In comparison to its price, there is no receiver on the market today to equal it in performance.

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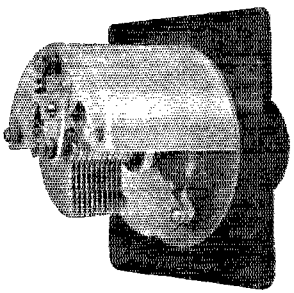

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ALDEN L. McMURTRY, License

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B-1	Capacity .001045	Mfd.	$7.50
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D-2	Highest Grade 4" Dial.		1.00

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The "POSACO" condenser has made for itself an enviable reputation. It is a real instrument. The single knob controlled vernier is an absolute necessity for efficient tuning in radio frequency, super-regenerative and re-generative circuits. The regular variable is unexcelled for use in circuits which do not require a vernier adjustment.

MATERIALS used in the manufacture of these instruments are the finest obtainable.

WORKMANSHIP, the best. CONSTRUCTION and DESIGN, electrically and mechanically correct. Absolutely rigid. Minimum of dielectric loss.

Each instrument is tested before leaving our factory.

GUARANTEED to give satisfaction and to be free from any defect in materials or workmanship.

If your dealer or jobber cannot supply you, send us your order direct, together with his name and address.

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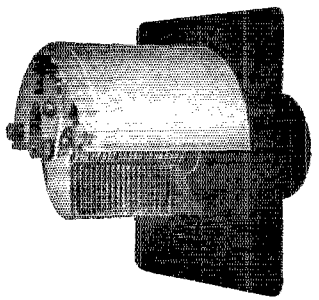

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REGULAR

A-1	Capacity .001	Mfd.	$4.50
A-2	" .0005	"	4.00
A-3	" .00025	"	3.50
A-4	" .000045	"	3.00

POSACO RADIO

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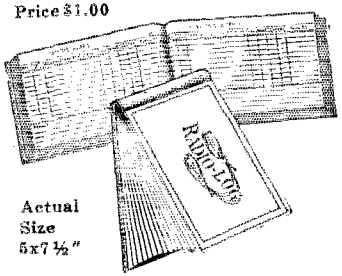

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Enables you to keep record of stations heard, worked, programs and other data. Over 100 pages ruled for stations, date, wave length, time, static, weather; with ample room for remarks.

In addition has two color map (24x36) with complete list of stations, wave length, districts. Morse and International codes, Abbreviations, w. l. table, wind scale, Arlington Time signal, U. S. radio laws, radio dictionary and cash account. Also chart for obtaining long distance with simple crystal set.

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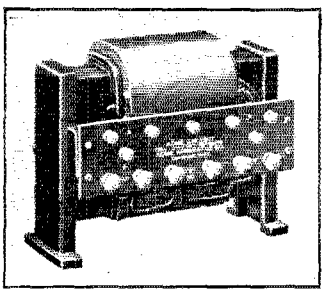
In the recent Trans-Atlantic Tests four out of five who succeeded used ACME

IN THE Trans-Atlantic Tests between amateurs in the United States and Europe conducted by the American Radio Relay League, December 11th to December 30th, out of a group of thirty-two successful amateurs, twenty-six use Acme Apparatus. It is fitting that such is the case. For Acme has always kept in close touch with the development of amateur radio, and seeing the advent of C.W., was the first manufacturer to have apparatus available in the transition from Spark to Continuous Wave Transmission.



Acme C. W. Power Transformer --75, 200, 300 and 600 watt

Amateurs desiring to enter the next series of tests or those who have entered previous ones without success, are welcome to write to this company, explaining their intentions or difficulties in detail. Our engineering department will be glad to aid them in any way possible. The coupon below is for the convenience of those who desire to familiarize themselves with the newest Acme Transmitting Apparatus. The Acme Apparatus Co., Cambridge, Mass., Branches, New York, Cleveland, Chicago, Kansas City, San Francisco.

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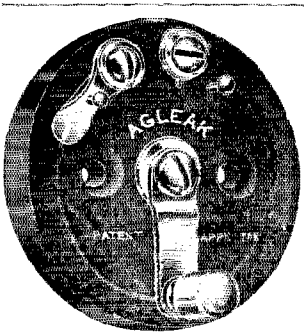

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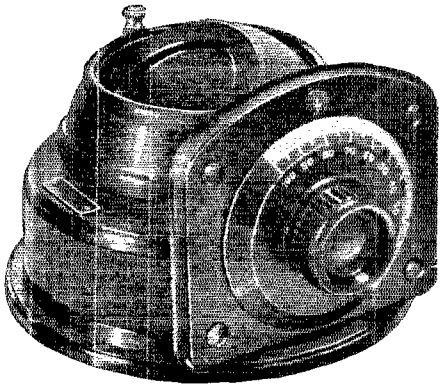

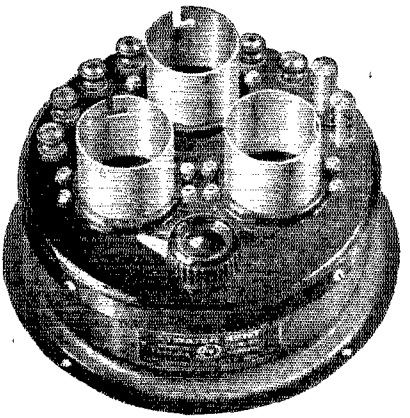

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And then it is a permanent material, one which cannot warp, is non-absorbent, resists high temperatures, does not fade, and it never loses its high dielectric strength. These properties are found in both molded and laminated phenol-resin products—obtainable only under the trade marks, Bakelite-Condensite-Redmanol.

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Address the Divisions

Bakelite, Condensite, and Redmanol are the trade-mark names for the phenolic resin materials manufactured by the several Divisions of the Bakelite Corporation. Each Division maintains a research laboratory which will gladly coöperate with manufacturers in the working out of new applications.

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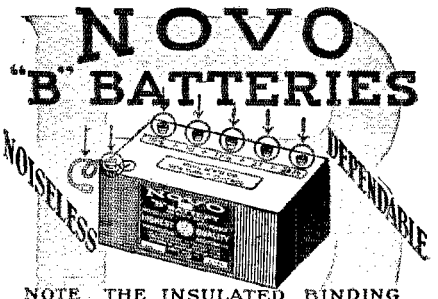

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WHERE radio apparatus, like a professional entertainer, must meet the test of satisfying really discriminating people, a Magnavox Reproducer and Power Amplifier (as shown above) are certain to be installed.

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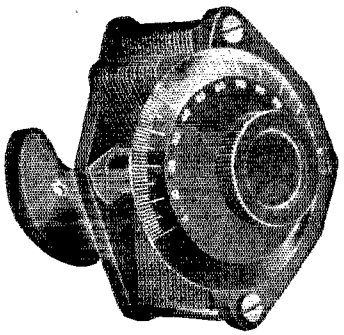

No. 3

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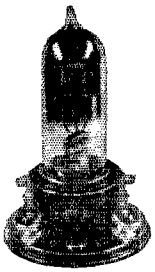
RADIO PRODUCTS **NA-ALD**



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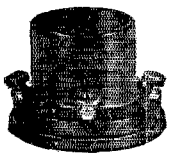

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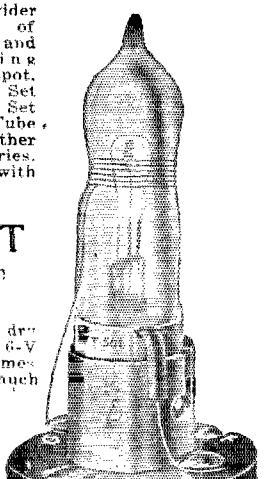

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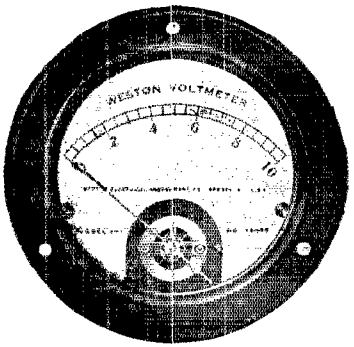

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TO DECREASE our stock, we offer UV-200, $4.15; UV-201, $5.35; Burgess "Bs" $3.00 size at $2.00; R-3 Magnavox, $29.50; R-2 Magnavox, $50.00; UV-201-A, $7.75; Detector and two step audio amplifier in 7x12 cabinet, $27.50. Money refunded if not satisfied. Chesaning Elec. Co., Chesaning, Mich.

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FACTORY BUILT Universal Regenerative Receiver and two-stage amplifier. Similar to Kennedy Universal. Worth $300 Sell for $88. Detector-Two-Stage amplifier, $20. Factory-built DeLuxe two-stage amplifier. $20. $55 Firth adjustable-reed Vocaloud, $34. Everything WORKS. Palmer Craig, 3401 Glenmore Avenue, Cincinnati, Ohio.

TWEET LOOP ARRANGEMENT—No Radio Frequency. Good long-distance reception on detector only. Proportionately better with Audio Frequency Amplifiers. Both coasts have been worked from here on detector and two stages Audio Frequency. Description and diagram for One Dollar. T. J. M. Daly, Little Rock, Ark.

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SELL: Half Kilowatt spark complete. Mounted. $20. Wm. Dorival, Caledonia, Minnesota.

FOR SALE: General Electric Dynamotors

Driving Voltages	Plate
8	400 volts D.C.
12	550 volts D.C.—150 milliamps.

Equipped with a Dubilier mica condenser filter system emp'oying 2—¼ MF.—1800 volts mica condensers At 8 volts motor side draws approximately 7 amperes. Ball bearings—Made for the United States Army Air Service. Price, $35.00; United States Navy Radio telephone transmitting and receiving sets. Type C.W. 936, made by the Western Electric Company. This is an ideal low power Radiophone broadcasting outfit. Radius 200 miles. All new. Complete United States Navy Battleship long wave tuners Range 1000-10000 meters. Type C.N. 240 built by the National Electric Company of Washington, D. C. for the Bureau of Steam Engineering. At present in use on all large ships in the Navy. Condition perfect. Navy short wave tuners; type S.E. 143 better known as I.P.500, made by Wireless Specialty Apparatus Company of Boston, Mass. Radio Corporation list $595. Range 250-6800 meters. Condition perfect, $200; Type S.E. 176A tuner, range 200-300 meters, made by the Wireless Improvement Company for the Bureau Steam Engineering. New—$85.00; Navy 2 stage Audio Amplifiers, type 125A, made by the Wireless Improvement Company, Price, new—$80.00; 2 Navy Marconi Wavemeters, type 21, range 100-4000 meters. Fine condition, Cost, $600.00; Price, $150.00; Wanted Western Electric tubes; state price, type number, and quantity. Station type. Ideal for laboratory use. Eksaf Trading Company, 1515 Eastern Parkway, Brooklyn, New York.

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FOR SALE: Regenerative receiver and one step in oak cabinet complete wih tubes, batteries and phones. All new parts, $70. S. Goldsmith, 323 Richard St., Dayton, Ohio.

RADIO REPAIRING—anything but tubes. Send us your apparatus that won't work. We'll make it "percolate" or charge you nothing. Prices quoted for your approval before we begin work. Rates reasonable and satisfaction guaranteed. Only shop in the U. S. doing guaranteed general radio repairing and wiring. Repair Dept., Radio Panel Shop, Junction City, Kansas.

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DISTANCE—Greater than usual guaranteed on new circuit. Successful combination of regeneration and radio-frequency amplification. Sounds like one-step audio on regular birds. Circuit and instructions, 50¢. L. W. Hatry, Port Arthur, Texas.

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EDGEWISE WOUND COPPER Ribbon $\frac{3}{8}$"x$\frac{1}{8}$"x8$\frac{1}{2}$" also 9$\frac{1}{2}$" for Oscillation Transformers 16 and 17¢ per turn any number of turns in one piece. Flat Ribbon 8¢ foot. George Schulz, Calumet, Mich.

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QRA 9DBM Maurice E. Kimmel, DuQuoin, Ill., QSL by card.

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TRANSFORMER AND REACTANCE, five K.W., 500 cycles, Wireless Specialty Co., also duplex relay transfer panel for same. Excellent condition. One hundred dollars prepaid. Kubiac, 54 Burtis St., Cradock, Va.

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SELL OR TRADE 1KW spark transmitter. What have you? 9CUF.

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WANTED: Half Kilowatt spark transformer. 9DQU, 1538 N. Edward, Decatur, Ill.

FOR SALE: Canadian 3OH's 10 watt C.W. transmitter, DX—31 states worked.

FOR SALE: New Grebe CR9 Receiver 30% off lowering the price to $91.00. Sent C.O.D.—Radio 9EER.

FOR SALE: Amrad regenerative tuner, beauty, $30.00; Acme 200 watt 750v. trans., 10v., filament windings. Center taps, $15.00; Jewell 0-3 meter, thermocouple, slightly used $10.00. R. Oppenheim Sta. "E", Arlington, Md.

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WIRE YOUR SET WITH COPPER BRAID instead of solid wire. Has extremely low resistance at radio frequencies. Makes "cushion" contacts that never work loose. Never breaks, easy to work with, does not require soldering. Air dielectric has no distributed capacity. No. 16 contains 96 No. 36 bare copper wires. Six feet for 25¢. Radio Panel Shop, Junction City, Kansas.

AMRAD 100 WATT coil 32 volts $12.50. Amrad ¼ K.W. quenched gap $5.00. Roller-Smith ammeter 0-2.5 four dollars. Murdock O.T. two dollars. Murdock aerial switch two dollars. 3 sectioned Murdock molded condenser, two dollars each. Radio Supply Co., Weedman, Illinois.

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TWO NEW RCA UV1714 radio frequency transformers, $3.75 each. Trade for CW apparatus. Forest Reine, Brooten, Minnesota.

FOR SALE one Benwood CW and phone Transmitter never used. Radio Supply Co., Richmond, Ky.

WILL SELL: Murdock rotary gap excellent condition $9 also Packard ½ K.W. mounted $10. Ralph Beard, 16 Belmont St., Warren, Ohio.

BARGAINS: 1/10 Horsepower Universal Motor 110 Volts, Aluminum case $7.50. Used Direct Current Motors ¼, ½, 1 and 2 horsepower 115 volts can be used for generators. 25 amp. adjustable arc lamp, Pony Relay Giant Sounder and Key. Stamp for particulars. George Schulz, Calumet, Mich.

H.R. & H.Z. $25 each. Radio parts for sale cheap, all standard makes, New, Box 511, Denver, Colo.

SACRIFICE—Unused CR9 for $98.50, unused RORN Radio Frequency Amplifier, $46.50, slightly used CR5, $62.50. Accessories for above 25% off. Money back guarantee. Cash in on this chance to get a high class set at the right price. John Richards, Carrollton, Ohio.

TRANSMITTER-CW-936 Navy Sub Chaser Sending and Receiving Set made by Western Electric Company. Heising system; voice or straight CW; two 5-watt tubes for sending; detector; two audio; three step amplifier; horn; generator and switchboard. New. Bargain $250.00. No tubes. DX Voice 75, CW 600 miles. H. B. Scott, R. R. No. 2, Dayton, Ohio.

GREBE CR3, two step, amplifier, with tubes $65.00. 9ABV, 607 East First, Hutchinson, Kansas.

FOR SALE: eight unused British Army receiving tubes, $3.75 each. Sent C.O.D. Write for particulars. J. G. Shaw, 14 Madison, Hamilton, Canada.

9CGX Panel mounted 10 watt C.W., Phone, MB, set used one month, TC ammeter, Milliammeter (0-300) Tubes, Kellogg Microphone, Power supply, Buzzer panel, etc., Guaranteed, DX 1000 miles. First 70 dollars takes it. David Simonton, Beardsley ave., Elkhart, Ind.

OMNIGRAPH outfit for sale very cheap. J. A. S. Pittsburg, Okla.

RADIO APPARATUS Repaired, all makes, except tubes, sets built to order, sets rewired. Work guaranteed or no charge. 10 years electrical and radio experience. Bramble T. Smith, 88 Optical Ave., Geneva, N. Y.

FOR SALE—$24.00 Edison 22 volt storage B battery. I will furnish you with 30 famous chrome nickel plates, 15 containers, separators, wire, etc., nothing to buy extra. Complete with all instructions for assembling, charging, etc. Prepaid for $3.15. All orders shipped same day received. H. B. Smith, Jr., 31 Washington Ave., Danbury, Conn.

WANTED Half Kilowatt spark transformer. 9DQU, 1538 N. Edward, Decatur, Illinois.

CAN. 4BV is P. Socolofsky, Loreburn, Sask. Pre QSL OM only few states left.

AMATEURS: Are you troubled with noise in your receiving set due to loose connections on your storage battery? If so try a set of Sure-Grip connectors. They are non-corrosive, easily attached and make a contact that will not jar loose. Price 25 cents per pair prepaid anywhere in U.S. or Canada. Southern Specialty Co., 2007 Everett Street, Houston, Texas.

NEW JEWELL Voltmeter 0-500 DC, $12.75. 2AJC.

5LG NOW Kenneth Tatum, Alamogordo, N. Mex.

SELL: Paragon RA6, $25; Homcharger, open type, $10; together $30. Fred Timper, 3238 Steuben Ave., Bronx, N. Y. C.

FOR SALE: Slightly used vario-coupler, two variometer and condenser tuner and Detector including tube. B battery, aerial and new 6v. 80 amp. Willard A Battery. Phone heard two thousand miles. Price $75 cash. Donald Tucker, Greencastle, Indiana, R. 8.

MUST SELL: Three tube, universal wave-length receiver for $50. Used one month. Victor Vogel, Glenrock, Wyoming.

SELL: 450 Watt Thordarson power transformer, 9OT.

PARAGON 2-5-V Radio Phone transmitter for only $40. The Radio Club, 17 Union Ave., Irvington, N. J.

QRA—8OT—Ex-8OT—W. J. Wiseman, 1119 Vliet St., Milwaukee.

QRA of 9AKN, Horace Wahl, Victor, Iowa.

INVENTORS: Protect your invention through A. M. Wilson, Inc., Washington, D. C. Over 25 years of efficient, expert, confidential service. Skilled in Radio-Electrical, Chemical, and Mechanical fields. Our latest illustrated Patent Book, giving much necessary and very useful informaton which every inventor should know, will be sent free upon request. Prompt and careful attention. Highest references. Moderate fees. Send sketch or model for our careful opinion and preliminary advice. Write today to A. M. Wilson, Inc., (Radio 3ARH) 310-16 Victor Building, Washington, D. C.

Edison "B" BATTERY UNITS one positive and one negative plate for 10¢. 18 sets will make a 24 volt battery. Wilkinsburg Wireless Shop, 711 Penn. Ave., Wilkinsburg, Pa.

QRA—1AYE, Stuart Williams, Glastonbury, Conn.

FOR SALE: 10 watt C.W. & phone set $100. Long wave set $10. Regenerative set, detector and 2 steps A.F. amp. $100. VT1's $7.00; UV201's $5; UV-201-A's $6.50; Westinghouse Chopper motor, $10. A. H. Wood, 1578b Beacon St., Brookline, Mass.

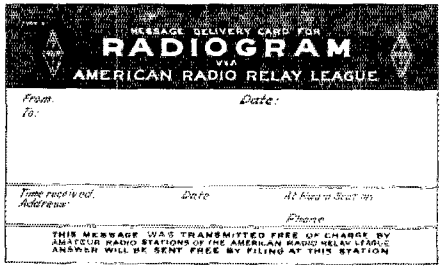
A RECOGNIZED RADIO ENGINEER who is a college man, has been associated with the radio industry for 10 yrs., is a competent research and radio sales engineer, has knowledge of electrical engineering, has designed and constructed commercial and radio broadcasting stations, desires a position with a reliable firm. Address, N. E. Wunderlich, 4533 N. Sawyer Ave., Chicago, Ill.

SELL: One two step Radio, detector and two step audio amplifier, General Radio and Radio Instrument parts, used—inquire for further description; sell cheap. One single circuit detector set in 7x19 cabinet, $24.00. Arthur L. Walser, Chesaning, Mich.

DRY BATTERIES recharged for about 5¢. Guaranteed Formula 25¢. E. Z. Manufacturing Co., East Dedham, Mass.

SELL: 3 circuit tuner, detector, 2 step, Remler parts, Acme transformers, all controls vernier, beautiful cabinet, with tubes, $79.50; Reinartz one tube, $22.50; Magnavox, $29.75. All guaranteed, excellent condition. A. Obenland, Pomeroy, Wash.

SELL: Plate Voltage Motor-generator. Induction Motor Hundred Ten Volts to Four Hundred Direct. 100 Watts. $35. Ralph E. Smith, College Station, Texas.



NOW IT IS EASY TO DELIVER THAT MESSAGE!

Here is something that has been needed for a long time—a message delivery card. Eliminates fussing with envelopes, stamps, folded message blanks, and saves expense. Printed on government 1¢ postal cards, ready to be filled out and dropped in a mailbox without extra postage.

A.R.R.L. traffic regulations require official relay stations to forward by mail, direct to addressee, any message which cannot be relayed by radio within 48 hours after receipt. Here is the easy way to do it. Excellent, too, for local delivery to parties who can't be reached on the telephone. A supply of these cards will give your station a dignity and a degree of efficiency of which you can be proud.

Any Quantity—2¢ each—Postpaid Anywhere

American Radio Relay League
Hartford, Conn.

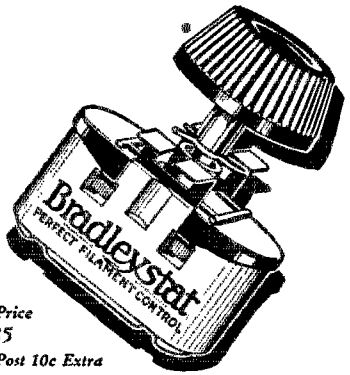
—FOR YOUR CONVENIENCE

QST'S INDEX OF ADVERTISERS

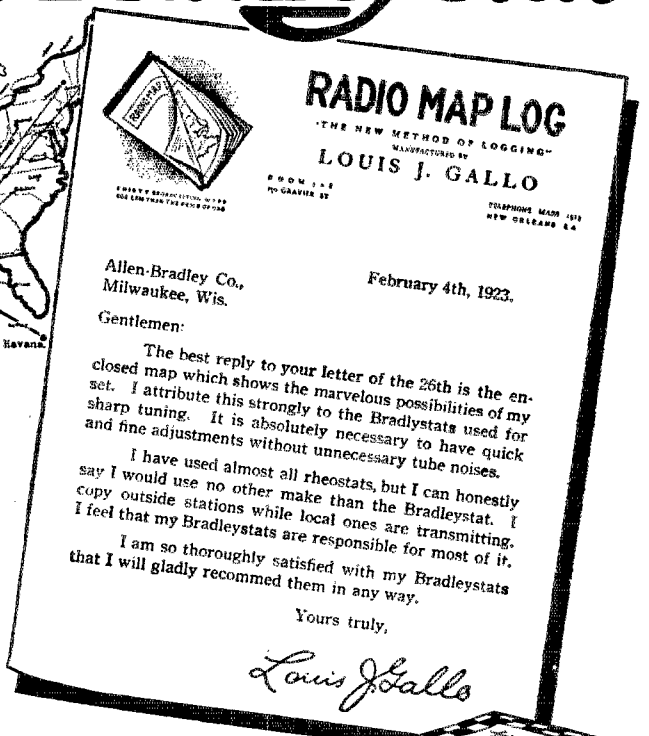
IN THIS ISSUE

ALWAYS MENTION Q S T WHEN WRITING TO ADVERTISERS

From Cuba to Canada with the Bradleystat



Retail Price
$1.85
Parcel Post 10c Extra



RADIO MAP LOG
"THE NEW METHOD OF LOGGING"
MANUFACTURED BY
LOUIS J. GALLO

Allen-Bradley Co.,
Milwaukee, Wis.

February 4th, 1923.

Gentlemen:

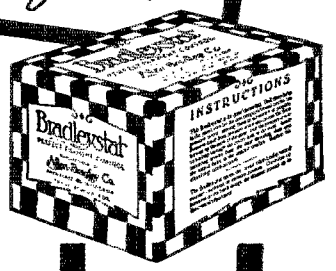
The best reply to your letter of the 26th is the enclosed map which shows the marvelous possibilities of my set. I attribute this strongly to the Bradlystats used for sharp tuning. It is absolutely necessary to have quick and fine adjustments without unnecessary tube noises.

I have used almost all rheostats, but I can honestly say I would use no other make than the Bradleystat. I copy outside stations while local ones are transmitting. I feel that my Bradleystats are responsible for most of it.

I am so thoroughly satisfied with my Bradleystats that I will gladly recommend them in any way.

Yours truly,

Louis J. Gallo



Other Radio Products!

The Bradleyometer is a perfect potentiometer for critical radio circuits. It is made in 200-ohm and 400-ohm sizes and gives precise voltage control without steps or noise.

The Bradleyadapter is a high-grade adapter for WD-11 tubes and will fit every standard radio socket. The contacts are silver plated.

Send for Latest Bulletins on Perfect Radio Products

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

Bradleystat

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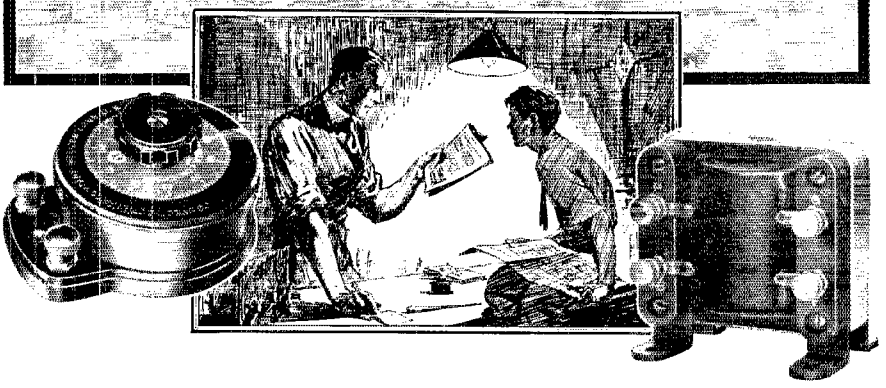
PERFECT FILAMENT CONTROL

CONNECTICUT RADIO



The Secret of a Successful Set

Is as much a matter of buying the best units, as of the proper wiring of your circuit.

Knowing that quality of materials and character of workmanship have as much to do with the effectiveness of an instrument as the excellence of its design—

We not only maintain one of the most complete Radio Research Laboratories in the country, but require our production department to follow the same specifications, work to the same standards, and meet the same exacting requirements as govern our engineers in their development work.

So, in considering Connecticut Radio, if you find some slight difference between its cost and that of the ordinary kind, just remember that there are all kinds of a difference in the results it gives.

For instance in the
CONNECTICUT VARIABLE CONDENSER
You find these advantages

Compactness
Long scale (350° against 180°)
Low losses—less waste of signal energy—due to small quantity and high quality of insulating material
Slight capacity change with a given dial movement
No rubbing contact from shaft to bearing
No balance required to make it stay put
No short circuits—impervious to jars or rough handling
Perfectly shielded from outside fields—absence of body capacity when tuning
Resistance—0.2 ohm

Portable Type J-107 $6.00
Panel Type J-108 $5.00

And in the
CONNECTICUT TRANSFORMER
The following superiorities

Highest grade silicon steel core (such as used on largest power transformers) to secure efficiency
Designed to match and give the best results with amplifier tubes; windings impregnated to keep out moisture, have a turns ratio of 4.25 to 1. Carefully shielded to prevent stray fields
Convenient terminals, well spaced, mounted on CETEC insulating materials
Low losses, due to carefully tested windings and best grade of materials
Perfect balance between input and output circuits

Audio Frequency Type
J-121 $5.00

If your dealer cannot supply you, write direct. Booklets on request.

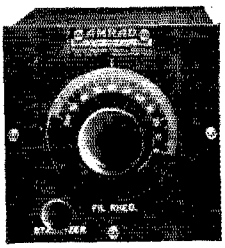
RADIO DIVISION

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
MERIDEN CONNECTICUT

AMRAD

The Recognized Symbol of Superior Performance

V. T.
Radio Frequency
1-Stage Amplifier
3290



V. T.
Audio Frequency
1-Stage Amplifier
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Amplifier Units That Settle Your Amplification Problem

THESE 1-Stage Amplifiers, Radio and Audio, were designed for AMRAD Receivers, but they are applicable to any standard equipment or to the receiver you have built yourself. Use these perfectly balanced Units, encased in solid mahogany cabinets, and settle once and for all your amplification problem.

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If your desire to build your own Amplifier, the Parts used in the AMRAD Units are available—Parts that are the result of years of research and development in our own laboratories, and represent the best money can buy.

These Parts, which are one of the basic reasons for AMRAD efficiency in amplification, include the Amrad Ampliformer and Radiformer—two amplifying transformers in a class by themselves as repeated comparative reports have proved; the Amrad Midget Potentiometer—the very latest in control devices for radio frequency circuits; and the Amrad Filament Rheostat.

Order AMRAD Amplifier Units or the Parts from your Dealer. If he isn't stocked, place your order with him, and he will fill it quickly. Insist upon AMRAD because in the long run you will only be satisfied with the best.

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