QST

A Magazine Devoted Exclusively to the WIRELESS AMATEUR

Organ of the American Radio Relay League

APRIL 1921 20¢

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The Spark Station Contest

THANK you, A.R.R.L. Men, for the gratifying response to our invitation to enter QST's Contest for practical spark articles. A goodly number of manuscripts were received and we are highly pleased in the feeling that the contest really succeeded in bringing out the kind of information we were looking for.

The judges found the studying of these manuscripts most interesting, but the determination of the winners rather difficult, for there was so much good in a number of them. Early in their study, all but seven of the articles were eliminated from serious consideration, but from there on much thought was required. It is now evident that we were a little inconsistent in choosing the title of our contest, for anything "ideal" straightway produces visions of Utopian conditions, whereas one of the main points was that the articles should be judged for their practical value in improving amateur operation.

WE, the Judges in QST's Ideal Relay Spark Transmitter Contest, hereby announce that it is our united judgment that the contestants named below submitted the best articles under the conditions and aims of the contest, and we award the prizes as follows:

First Prize
Mr. R. H. G. Mathews, 9ZN.

Second Prize
Mr. R. C. Denny, 6CS.

Third Prize
Mr. Sumner B. Young, 1AE.

Hiram Percy Maxim
F. H. Schnell
K. B. Warner

While we feel sure our readers will agree that the winning articles are excellent, none of them are perfect. Mr. Mathews', by receiving first prize, of course is voted nearest perfect, and indeed his article is filled with vital truths of amateur operation which make it a most valuable piece of amateur literature. Those principles which he advocates are ones which we ourselves have felt to be the best in amateur procedure. Mr. Denny's article, which will appear in QST soon, has a high value because of the very complete drawings and photographs accompanying it, making it of particular help to the man who "builds his own," and as such it surely merited a place among the prize-winners. Personally we do not agree with some of his likes and dislikes on the subject of transformers and voltages, nor do we feel that his aerial is an ideal one yet no amateur will read his article without resulting improvement in his own station. Mr. Young's article is almost purely an "experience story," describing his tribulations in making 1AE reach out, and altho the resulting good station is still far from anything we have in mind in speaking of an "ideal" spark transmitter, the manuscript must come in with the winners because of its "practical value in improving amateur operation"—the very splendid way in which the author describes how he discovered the defects in his set and went about remedying them will surely be of help to QST readers.

It will be seen that these three articles cover the ground from considerably varying angles. Careful study of them will do much to improve our stations, and we earnestly commend them to you. Mr. Mathews' article appears in this number, and the others will follow at intervals.

There was a certain unity of thought among many of the contestants, from which we can sum up the general sentiment as to what equipment the ideal station should have. The majority of the con-

(Concluded on page 11.)

The Ideal Relay Spark Transmitter

By R. H. G. Mathews, 9ZN

——FIRST PRIZE WINNER IN QST'S CONTEST——

THIS description, despite the title, does not attempt to cover the "ideal" transmitter. Ideals must always compromise with fixed and sometimes unfortunately solid facts, and in this case many compromises have been necessary, partly with mechanical construction, with manufacturing convenience and with many other things which must be taken into consideration.

From the experience, somewhat costly at times, which the writer has acquired from past efforts at relay work, the set that follows has been evolved as the most logical and practical relay transmitter within the reach of the average radio amateur.

Since this transmitter is to operate on or near a 200 meter wave, this fact must be kept in mind as it will influence the design tremendously. The low voltage—high capacity sets commonly used commercially are absolutely useless for our purposes, because of their actual characteristics. Accordingly we must start right at our power lines and carry our design through to the top of our antenna. That point is the one most important fact to be kept foremost as we build our set. We cannot copy a navy transformer, a Marconi land station aerial and an amateur condenser and get the results we want. We *must* maintain consistent design *throughout* our set.

One of the most important factors in radio design, and unfortunately one of the most neglected, is that known as power factor. Power factor is that quantity in an alternating current circuit by which the products of volts and amperes must be multiplied to obtain watts. In other words, multipying 110 (volts) by the current does *not* give you your energy in watts in an a.c. circuit, contrary to a popular hallucination. The formula is as follows:

$W = E \times I \times f$, where f = power factor.

We know that both current and voltage rise and fall separately in sine curves in our a.c. circuit. When these two curves are "out of phase" 90 degrees, we have the condition shown in Fig. 1. This is the most ineffective and undesirable condition obtainable, and in this case the actual power is nothing although the current may be quite high. In Fig. 2 is shown the best condition, where power is at a maximum, since voltage and current are exactly "in phase". In this case the current in amperes may be no greater than before, and in fact may be *less* for considerably *greater* power in watts. In other words, current is no indication of power, unless your power factor is at a high value. This value can be regulated by the amount of capacity and inductance in your circuit, and this applies to every circuit in your radio set.

In order that we should not handicap ourselves at the start, the power factor

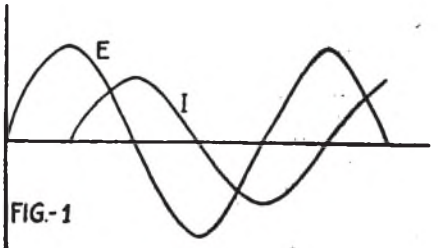


FIG.-1

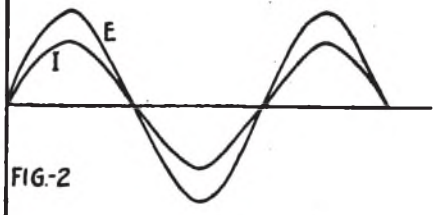


FIG.-2

of our power line should be as high as possible and the voltage drop over the leads as small as possible. The power factor can be kept at a comparatively high value by the installation of a special transformer and line and the voltage drop lowered by the use of heavy leads in the primary power circuit. A suggestion as to "blinking" lights may be in order here. Ordinarily the degree of this blinking is inversely proportional to the power factor. Now since power factor is always subject to regulation and is dependent on the inductance and capacity of the circuit in question, by correcting our power factor we can decrease the annoyance of flickering lights. Since inductance is almost always in preponderance in our power circuits, the connection of a large adjustable capacity as in Fig. 3 will bring the power factor to a better value, which will help solve our troubles with the neighbors. This capacity must be varied until the correct value is found, and may be as large as

20 or 30 microfarads. Ordinarily paper telephone condensers are very satisfactory for this purpose.

To protect our power line against kick-back, as much of the wiring as possible should be contained in grounded metal conduit. Conduit wiring is the best preventer of kick-back troubles known, where these troubles come from induction between the power lines and the antenna circuit,

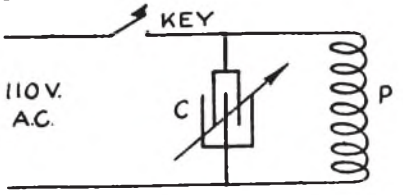


FIG 3

which is true in most instances. The connection of two resistance units in series across the line, with the center connection of the two grounded, is effective in eliminating such reaction as may occur in the transformer and will also help where conduit wiring is not possible. Sparks from steam radiators, etc., to other metallic objects may be eliminated by connecting all steam, gas and water pipes together in the basement at ten foot intervals with copper wire, soldering all connections and connecting all such wires to a good outside ground. This may sound like a reflection on water pipe grounds and it is fully intended as such; however, more on that later.

After our power line has been remodeled to suit our requirements we will pass on to the power transformer. Right here enters the old argument regarding high or low spark frequency. No attempt will be made to prove this point here, as this will be taken up in the paragraphs on gaps, but since this proof will show the low note to be superior, we will make that assumption here. Since we are to use a low spark frequency, a transformer of a type suitable for such spark frequency should be used. As a general statement, a transformer having comparatively great magnetic leakage should be employed with a low spark note. The old type United Wireless Co. "coffin" is very suitable for this reason and its performance under these conditions bears out this statement. Also, since our wave length is restricted, we cannot use a condenser capacity greater than .009 mf. and our transformer *must* therefore have a high secondary voltage. Unfortunately there is no really high voltage transformer on the amateur market today. Apparently transformer manufacturers are afraid to make them, either because of insulation troubles or because of prohibitive production cost. As a result no transformers are available with secondary voltage of over 25,000, which is not sufficient altho it can be used if nothing better can be procured. Again the old United Coffin steps to the front with its secondary voltage of 35,000. Many of us remember Mr. M. B. West's old pre-war station, 8AEZ. This station used a 40,000 volt transformer, while the writer used one of 43,000 at pre-war 9IK. With a high voltage—high leakage transformer and with our primary circuit power factor at as high a value as possible we are enabled to put something approaching our full 1 k.w. into the set, provided our condenser is correctly designed for our low note gap. In order to cover the point of power factor in the primary oscillating circuit, the condenser and primary inductance must be considered together. The gap will therefore be taken up next.

Although the quenched gap has been heard from to a considerable extent of late, the writer has never had much success with this gap on 60 cycle current, partly because of its delicate inductance adjustments which are thrown out by variations in current supply, and partly because of the low and rather wheezy note always obtained by the writer from such a gap, even when functioning properly. The quenched gap will therefore not be considered by the present author in connection with our "ideal set".

A straight gap is not worthy of much mention, of course, and this leaves us the rotary. The basis of nearly all argument in favor of a high spark frequency is founded on an antique and outgrown theory that the telephone is more sensitive to high frequency sounds than to those of lower pitch. This may have been true of the Indian-club shaped phones of our grandfathers and may be to a very small extent true of some modern phones but is certainly not the case with up-to-date mica diaphragm headphones, in which, if there is any preference, the low note has it. Our low note will also stand far more amplification on a regenerative receiver than a high tone, and with receivers of this type in use in practically every up-to-date amateur station this fact is of importance. It must be understood here that we are not speaking of high frequency quenched or synchronous rotary sets such as standard commercial 500 cycle transmitters. Our interest is in 60 cycle synchronous or non-synchronous sets.

Another antiquated argument which actual performance has disproved refers to the readability of signals through static and interference. A clear smooth low note can be read just as easily through interference of all kinds and as far as my personal inclinations are concerned, the low note is much more pleasant and easy to copy. Electrically, the argument is

again in favor of the low spark note. Many operators have tried out the two types of gaps and have discarded the lower note because of higher indicated antenna current as shown on the aerial ammeter. There is no greater liar than the aerial ammeter and this is one instance of its habits of prevarication. A hot-wire or thermo-couple ammeter measures only the *average* current and *never* the maximum because of its dependence on heating values for its indications. Consequently a high note will nearly always show a greater indication on the meter, simply because the *number* of "humps" or discharges is greater, although the maximum energy in each "hump" may be far less than with the low note; *and it is always the maximum energy in each individual discharge that counts, and never the average.* It should also be evident that if we charge our condenser for a long space (comparatively) and then discharge it quickly, the energy per discharge will be far greater than if we charge and discharge rapidly. So much for spark frequency. In designing our gap to conform with these conditions we must also consider quenching. A gap which allowed the total energy of the condenser to discharge in one spark and then broke instantly, allowing of no reaction between aerial circuit and primary oscillating circuit, would be perfect. We cannot reach this perfection and so must content ourselves with something as near to it as possible. We have proved that we need a low note in our "ideal" set, but this most certainly does not bar high speed of rotation. Quenching depends largely on the speed with which we get our movable point past the stationary elec-

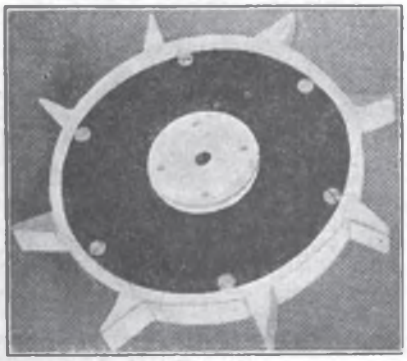


Fig. 4.

trode, so as to cut our discharge time to a minimum. To combine low note with high speed means that we must have a disc as large in diameter as convenient, to give peripheral speed, rotating at the highest safe speed with a small number of teeth. Our gap should have teeth narrow in the direction parallel with the face of the disc to cut our discharge time down further, and wide in the opposite plane, to reduce resistance at the time of discharge. The well-known thick saw-wheel disc with almost knife-edged teeth, having 6 to 8 points, rotating at 3500 r.p.m. and with a diameter of from nine to ten inches, is a good compromise between ideal theory and practical operating conditions. (Fig. 4.) Discs with round plugs having large surface area are obsolete and it is up to the users to convince the manufacturers of that fact. To further increase the quenching properties of our gap, metals having certain peculiar characteristics should be used. Tungsten points for both rotor and fixed electrodes are excellent, but since these are beyond the reach of most of us, we must look further. Experiment has shown that when an aluminum rotor is used with copper fixed electrodes certain inherent properties of these metals are brought out which greatly increase quenching under the heat of operating conditions. Brass is very poor and zinc is the worst metal which can be used on a rotary gap from this standpoint.

Heretofore we have been considering the non-synchronous gap. Exactly the same design may be followed with a synchronous gap. Synchronous motors rotating at 1800 r.p.m. are now available and either a four or an eight tooth wheel of the type described gives a low synchronous note which is exceptionally clear and agreeable to read. Greater efficiency is secured with the four point disc, since discharge occurs *only* at the maximum voltage. The eight point synchronous gap, giving the equivalent of a 120 cycle note, is more agreeable, and while the actual individual discharges are not as great, the efficiency is considerably greater than with any non-synchronous rotary and the strain on the transmitting condenser is less, which is of importance in constructing this condenser, to which our discussion has now brought us.

In condenser construction, mechanical strength and electrical efficiency must be combined properly in order to fit this important piece of transmitting apparatus for inclusion in our "ideal" set. A high voltage transformer naturally requires a condenser with a dielectric capable of standing that voltage, especially since the voltage in the condenser often builds up to a value four or five times the actual transformer potential. An oil immersed condenser or wax impregnated condenser is therefore a necessity in order to avoid excessive corona loss. For dielectric, plate glass or mica is excellent. There are on the market several varieties of transmitting condensers, but since the use of these with high voltage transformers requires a series-parallel connection, the cost is almost prohibitive. Accordingly we

will describe a plate-glass, oil-immersed type, which has proven very satisfactory and has held up under the strain imposed by a four point synchronous gap with a 35,000 volt transformer.

Plate glass for our condenser does not need to be polished. Therefore, by getting rough or unpolished glass we can cut the price per plate down to forty cents. These sheets should be not less than ½" (one half inch) thick and can conveniently be one foot square. A metal tank of any type may be used large enough to hold the assembled condenser. Most of the trouble with blown condenser plates is not actual electrical break-down of the plates but is cracking, due to mechanical strain, followed by electrical break-down. This is especially true of the packed type of condenser. Because of the charges existing on the opposite sides of any plate a mechanical strain results in the fabric of the plate. When the plates are clamped together this strain becomes cumulative and as a result one or more of the brittle plates are cracked, following which a spark jumps through between the metallic surfaces. To avoid this difficulty, the plates should be placed edgewise in a wooden rack in the manner shown in Figure 5.

This, of course, necessitates the use of metal on both sides of each plate, and we have never found anything other than heavy tinfoil satisfactory for this purpose. This may be applied by heating each plate in an oven, rubbing beeswax over each side, placing the tinfoil sheets on the beeswax-covered plates and rubbing down with soft cloth to eliminate air bubbles. Before application the tin-foil sheets should be carefully rubbed smooth on a piece of glass to destroy all wrinkles. When glass one foot square is used, tinfoil *circles*, which may be cut round a plate 8" in diameter, should be used. This circular form, avoiding all sharp edges and points, solves considerable of the troubles due to brushing or corona discharge. With plates of this size between 30 and 40 are needed to obtain the capacity necessary for best results with the gap and transformer described hereinbefore. When the beeswax has hardened, shellac may be applied at the edge of the foil to prevent the dissolving of the wax by the oil after immersion.

After all the plates have been covered, they should be placed in the wooden rack mentioned before and leads brought out. These may be provided by pieces of thin spring brass 1" wide bent U-shape at the bottom. Such leads may be slipped down between each pair of plates, alternate leads being connected together. The assembly should then be immersed in a tank filled with the best insulating oil available. If regular transformer oil is not at hand, light automobile lubricating oil will serve, although, of course, it does not equal transformer oil in insulating qualities.

The construction of the condenser being completed, its adjustment must be taken up, but since this can only be done simultaneously with the primary inductance, we will consider briefly the construction of this inductance next.

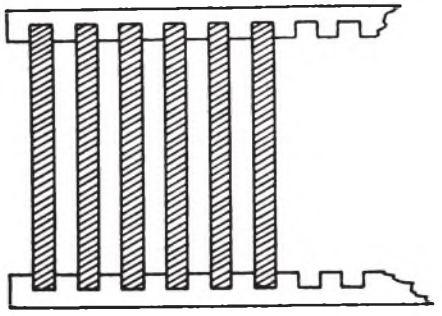


FIG. 5

The oscillation transformer primary is seldom given the proper amount of attention by the amateur constructor, and for that matter, by most manufacturers. The instantaneous current value in the primary oscillating circuit may reach a thousand amperes, but because of the momentary nature of this current, very little heating effect is noticed. Although heating does not result, the resistance effect of a small conductor in the primary is very noticeable on the efficiency of the transmitter. Accordingly, copper or brass ribbon two or three inches wide should be used, with clips to match, and the whole primary circuit should conform to this requirement. The pancake type of oscillation transformer is very convenient and is also the easiest to build. Provision should be made for variation of the coupling during transmission, as this adjustment can only be made intelligently under operating conditions. The secondary should not be made of less than 1" ribbon, and even heavier is desirable. In tuning our transmitter we will probably not use more than one turn of primary inductance and certainly not more than four turns. All above this should be removed to eliminate dead-end loss. The number of secondary turns is, of course, dependent on the characteristics of our aerial and therefore cannot be arbitrarily fixed.

With our transformer, gap, condenser and oscillation transformer completed we are now ready to tune our primary oscillating circuit, leaving our aerial and ground disconnected.

Before actually undertaking this tuning, however, a word on arrangement of the component parts of the set is in order. In

order to transmit efficiently on our low wave we must not waste our small inductance value in long leads. The total length of leads in the primary oscillating circuit should not exceed 18". If the various instruments cannot be so placed as to allow of such short connections, we should run our pairs of leads, to the condenser for example, parallel and as close together as possible without sparking, in order to reduce the effective inductance. With a little study, instead of the haphazard thrown-together design of the average amateur transmitter, an arrangement may be evolved which is attractive in appearance and effective in operation.

In tuning this circuit, we not only must consider wave length but again we run up against power factor. In other words there are numerous relative values of capacity and inductance which will give the desired wave length, but only one of these various combinations which gives the highest power factor as well. It may be considered that our set consists of three circuits each complete in itself but linked with the others. We have already "tuned" our primary circuit. In tuning our primary oscillating circuit we must try to so adjust our capacity and inductance as to maintain "resonance" with the primary power circuit as well as the wave length desired. A watt meter connected in our primary power circuit indicates the power we are actually putting into our transmitter. If we now adjust our capacity and inductance, starting with the comparatively large inductance value of our full four turns, maintaining the wave length constant by means of a wavemeter, cutting down this inductance very gradually and increasing the capacity correspondingly, and if we note our watt meter reading for each of these adjustments, the point at which this reading is greatest is our correct adjustment. In some circuits the characteristics are such that this resonance point cannot be reached because of the fact that either capacity or inductance would be at an impossible value at the resonance point. In such cases the largest capacity which can be used, keeping the wavelength at the value desired, will be found best. In these instances, the primary inductance should be cut to one turn and capacity increased until the desired wave length is reached. This point is the best compromise toward the actual resonance point.

With this adjustment made, we are ready to couple on our secondary or antenna circuit. Before doing this some aerial and ground constructional data should be considered.

By consulting Zenneck we find that the effectivity of an aerial is dependent largely on the form factor and radiation resistance. Without entering into the mathematical proof of the matter, a vertical fan antenna has been found best for transmitting, with a flat-top T type runing a close second. A vertical fan aerial suitable for 200 meter work may be of the type and dimensions shown in Figure 6.

The vertical wires should be brought together at the lead-in insulator. A T type aerial 100 feet long and 50 feet high with four wires is also satisfactory for 200 meter work.

These aerials should, of course, be satisfactorily insulated and for our fan three 10½" Electrose insulators in series in each supporting cable (*not* in the aerial wires) should be used. Stranded copper or phosphor bronze wire, while very little

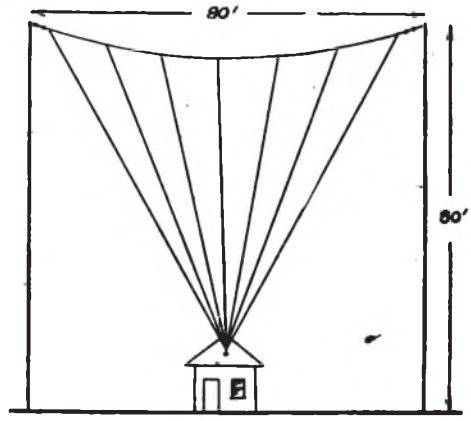


FIG 6

better electrically than solid wire, is considerably stronger mechanically and should be used if possible.

Our ground should be the next thing considered and here is where most of us fall down. A good ground is an absolute essential to a good transmitter and all our efforts to construct an efficient set have failed if we slip up here. An "outside" ground consisting of buried plates is excellent, when the plates have sufficient surface and are buried in moist earth. A contact ground of this type is not effective in dry ground or sand. For ordinary conditions a combination ground consisting of plates as well as wires radiating fan-wise from the station works very well. As much of this ground system as possible should lie directly beneath the antenna. If outside grounds are not available, water pipe connections may be used, but this type of ground is *never* desirable when any type of outside system can be installed. At 9ZN a composite system is used composed of six sheet iron plates, each 4' x 6', buried 6' deep end to end, in a semi-circle about the station, in addition to 50 wires varying in length from 50' to 150' buried at an average depth of 2 feet.

A common mistake is made in connecting to a good outside ground and then, with the intention of making further improvement adding a high-resistance high-inductance ground such as a water pipe. The result is a decrease in radiation which cannot be corrected by re-tuning. The difficulty is that because of the different characteristics of the two grounds there is a phase difference between them and the resultant is less than the original. Ground connections with different characteristics should therefore be avoided. Counterpoise grounds are sometimes better than either of the types mentioned before, but since our ideal set is intended to operate under average conditions, we will not consider the counterpoise here. *

With our primary tuned and our aerial and ground ready, we will now tune our antenna to resonance. A hot-wire or, better yet, a thermo-couple ammeter should be connected in the ground lead and the secondary inductance varied till maximum antenna current is secured, keeping the coupling at not less than 4 inches. The secondary should then be pulled away from the primary as far as possible; the indication will then drop considerably. Holding the key down, the secondary should then be moved slowly toward the primary, the readings of the ground ammeter being watched closely.

The indicated current will gradually rise but will reach a point at which it remains constant for a small distance. Further coupling causes a rapid increase. *The point just before this second increase is the proper coupling adjustment.* We should not be deceived by this second increase. While it indicates current flow, it does not mean maximum current flow *on any one wave length.* In fact the energy radiated on the wave to which we are tuning is ordinarily much less than before this increase, even though the meter shows greater current. An hydraulic analogy of this may be found in the fire hose. Without a nozzle we get a great flow of water, but being scattered out over many different "waves" or one "broad wave" it gets nowhere. However if we put a nozzle on our fire hose we get a thin sharp stream corresponding to our sharp wave. Undoubtedly the "radiation" is not as great but it gets someplace since it is all on one sharp wave.

In one of our previous paragraphs we mentioned the three circuits evident in our radio transmitters. We have mentioned power factor in connection with two of these circuits but have not done so in connection with the antenna circuit. The idea of correcting our power factor from the power line clear through to the aerial is a new and novel one. No method of conveniently and intelligently adjusting the capacity and inductance of our aerial to correct the power factor is evident at the present time. Unquestionably such means will be found, but in the meantime we must satisfy ourselves with power factor correction in our first two circuits, merely tuning the aerial circuit to resonance in regard to wave length and decrement.

Many of the points emphasized in this article may seem of insignificant importance. Regarded alone they *are* unimportant, but a successful radio set can only be built by close attention to all such details, which taken together form the real essence of radio design. The difference between the long distance amateur and the operator of the 1 k.w. station which cannot work beyond his city limits lies primarily in the attention and study which the first has given to the correct design and coordination of the component parts of his equipment, and unless such attention and study is given, our unsuccessful 1 k.w. man never will be able to catch up with his more astute neighbor and likewise will always wonder why.

*We do not believe that the ground system described by Mr. Mathews is on a par with the remainder of his article. The "round ground" originated by Capt. H. W. Round and originally described in QST for February, 1919, is in our opinion the best ground system. It is expensive to install, but our "ideal" station should have it. Failing that we would recommend a symmetrical arrangement of buried wires radiating in all directions from the station to a distance at least 1½ times the height of the antenna.—Editor.

THE SPARK STATION CONTEST

(Concluded from page 5.)

testants agree on a vertical aerial, a buried radial ground system, a glass-plate oil immersed condenser of variable capacity, a high-voltage high-leakage transformer, synchronous 60-cycle gap, pancake oscillation transformer with very heavy ribbon; and they pay considerable attention to the adjustment of the closed circuit for best power factor. For receiving a separate single wire is advocated, running at right angles to the transmitting aerial, making break-in operation possible; and the receiving equipment in favor is a variometer regenerator with two stages of a.f. amplification. (Nobody suggested radio-frequency amplification, but with present tubes we suppose that is still a little too "ideal" for amateur work.) Some of the aerials described were altogether too long for 200-meter work and some of the O.T.'s were afflicted with too many turns, and probably these errors in constants account for some of the tunes we hear on the air these nights.

We are sorry that there could not be prizes for all the entrants. Many of the articles that did not win prizes are very good, especially on certain topics, and from these we shall publish excerpts from time to time, with due credit to the author.

Converting Motors for Synchronous Gaps

By F. F. Hamilton, 9ZJ.

IT has long been the dream of citizen radio operators, that if only they could get a synchronous motor to run their gap everything would be about perfect. The great advantage of a synchronous discharge of a condenser over non-synchronous discharge is almost obvious. A synchronous discharge allows the condenser to be worked at a much higher average voltage. With a non-synchronous discharger there are times when the condenser is full of energy and cannot discharge anywhere except across the safety gap, because the gap electrodes do not happen to meet at just the proper instant. This we call the time-phase relation between the gap electrodes' meeting and the charging voltage to the condenser. The proper way to use a condenser is to discharge it at just the instant before it jumps the safety gap. This is working the condenser at its maximum working point. If there are one hundred and twenty maximum charging points of the condenser per second there should be one hundred and twenty meetings of the electrodes of the gap to discharge this condenser before the safety gap operates. Now if the gap electrodes are so adjusted that there can be two meetings per condenser charge we can discharge the condenser at half charge. This will give two hundred and forty discharges per second and is similiar to the synchronous gap tones heard almost any night. An eight electrode rotor is run at 1800 r.p.m. synchronous speed and the electrodes adjusted so that the charge of the condenser, which is one hundred and twenty times a second, is just evenly split in half. Under these conditions the condenser is worked at half charge, or fifty per cent of the maximum charge which would operate the safety gap at one discharge for each half cycle. Obviously the next thing to do is to raise the charging voltage of the condenser to twice its former value. This will then give the same power discharge as before, with a better tone.

Any induction motor of the squirrel-cage type may be easily converted into a synchronous motor. The writer has just completed five different ones, all operating differently, some on sixty cycle and some on two hundred. Some motors make better synchronous motors than others. This is due to the kind of iron used in the rotor.

A motor must have a proper winding for easy conversion into a synchronous motor. The best winding is one that gives definite pole magnetism with the greatest flux density at the center of the pole. In most standard motors this seems not to be the case and the rotor will hunt or slip back and forth in synchronism due to this fact; i.e., the pole strength is not at the center but on both sides of the center which makes the rotor rock, so to speak, back and forth. This will cause a wail in the gap tone.

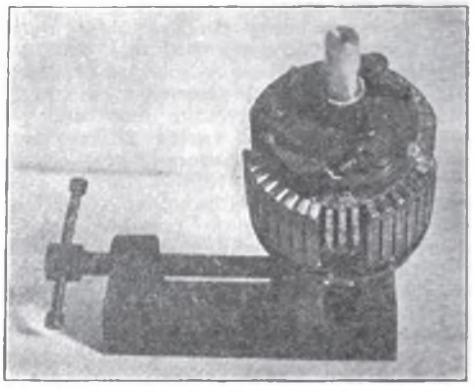


Fig. 1.

In an 1800 r.p.m. induction motor used on sixty cycle supply there are four poles on the stator. The wire is wound in slots. The best winding for conversion to a synchronous motor is where the winding is so wound in the slots as to leave one vacant slot per pole, which vacant slot is between the poles and not at the center of the pole area as is so often the case. This method of winding gives a decided four pole winding. If one slot is left open at the center of each pole area it should be filled with a piece of soft iron. Another way to construct the winding is to graduate the winding; i.e., put more turns near the center of the pole area and fewer in the outer slots. However, all this is not necessary to get a motor that will work in synchronism and handle an ordinary radio gap for one or two kilowatts of power.

On sixty cycle supply and 1800 r.p.m. synchronous speed there are four poles on the stator. These are alternate north and south around the stator at any instant. Each pole becomes north sixty times a second and south sixty times a second. This rapid reversal of magnetism induces in the rotor bars and iron a like change of polarity which opposes the poles of the stator. This causes the rotor to lock in position and give out a decided sixty cycle

growl. To start the rotor revolving another winding is put on the stator called the starting winding. It is wound so its polarity is just between the running poles just described. The starting winding is not made to have near the strength of the running winding; it gives a weak pole just half way between the main poles. The poles then induced in the rotor by the running or strong winding are weakly attracted by the starting winding poles. As these weak poles are a few degrees around the stator from rotor's induced poles there is a weak pull on the rotor parallel with the direction of rotation. This weak pull starts the rotor to revolving and the rotor finally gets up some speed. As it speeds up there is another action that comes into prominence, due to the rotor bars cutting flux from the stator. This cutting of flux gives the rotor polarity which opposes the starting winding; therefore the starting winding is not needed after the rotor gets up some speed. Usually the starting winding is cut out by an automatic switch, at about two-thirds synchronous speed.

Now the power developed by the rotor is proportional to the amount of flux cut by the rotor bars and iron, to some extent. If the rotor is almost at synchronism there is very little torque being developed. When the motor is running idle the rotor will slip in and out of synchronism and can be detected by a slow changing of the hum given out by the motor. As load is applied the rotor slows down to the point where the flux cut will develop enough torque to overcome the load.

Now to make this motor hold in synchronism. We have just said that the bars cut flux and result in a torque on the shaft. If the rotor is held in synchronism there will no cutting of flux by the bars and therefore no torque and the rotor slips out of synchronism in order to get enough

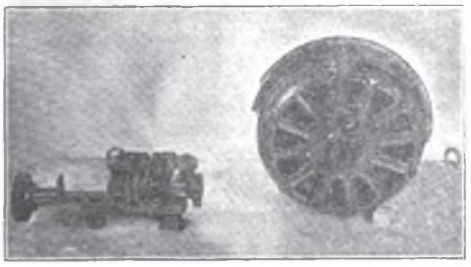


Fig. 2.

torque to overcome friction losses. Now the scheme is this. Remove the rotor from the motor frame and have four slots milled in the rotor about one quarter of an inch deep and five-eighths to three-quarters of an inch wide, on the quarters. See Fig. 1. Replace the rotor and immediately it will snap into synchronism and if enough counter torque is applied it will again run as a non-synchronous motor. The milled slots are milled out at the rate of one for each pole, six for a six-pole motor and two for a two-pole motor. Two-pole motors, however, don't work as well as four or six-pole. Running in synchronism, an entirely new action takes place in the rotor. Four definite or silent poles have been made on the rotor and thse poles want to run in synchronism with the rotating field of the stator. As was said before, the bars cut no flux and now should have no effect; this is not al-

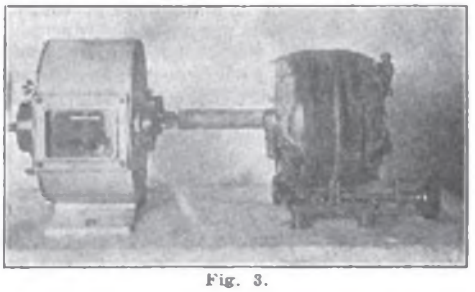


Fig. 3.

together true. The iron in the rotor now is practically the sole supporter of power for the rotor. The reluctance of the iron causes definite poles to be developed in the rotor. It can be seen readily that the more magnetism the rotor develops the greater the power in synchronism. Therefore for the best results, iron that has high reluctance must be used. In most cases the average motor will develop a little over half the power in synchronism that it does running non-synchronously before slotting. No general rule can be given for this, as different makes of motors differ.

Another feature develops, however. Sometimes the motor will not start, and one has to turn off the supply and turn the rotor a few degrees, whereupon it will start when the supply is again turned on. To obviate this difficulty the rotor is again taken out and copper put in the slots to replace the removed iron and copper. This will also cut down the windage losses. Now the rotor will start easily. This copper will also make the rotor hold into synchronism readily and cause the rotor to develop a little more power due to an opposing current flowing in these large bars, making more definite the polar regions on the rotor.

One experiment in which the motor was tried for synchronous speed with and without copper bars showed that it took twenty-five per cent less voltage to hold the motor in synchronism with the bars out than it did when they were in. This proves that the copper has some effect when the motor is running in synchronism.

Another feature developed: the motor

will heat very badly because the iron is overworked. To overcome this a large amount of iron is necessary in the rotor for the amount of power desired. That is the reason why synchronous motors are so large for the power wanted. About a one-half H.P. frame is necessary to get proper cooling and power for a one-quarter H.P. motor. However, for the intermittent duty any old motor will do for a radio gap ordinarily requiring about one-sixth H.P. One can buy a cheap quarter H.P. single phase, split-phase-starting, induction motor for about twenty-five dollars and make himself a synchronous motor that will answer all purposes. One can even rewind the stator without much trouble and the knowledge gained thereby will be well worth the trouble.

Figs. 2 and 3 show a synchronous motor and method of attachment and adjustment for a gap whose stationary electrodes cannot be rocked. In order to get the condenser to discharge at the proper time the electrodes have to meet at the proper time. It is advisable to adjust electrodes for synchronism on low power, for it is easy to blow a condenser when adjusting a synchronous gap. To accomplish the adjustment with non-rocking stationary electrodes it is easiest to rotate the motor stator and frame in some manner as shown. Here the motor base has been slotted and a pinion with rack attached so as to give very close rotational adjustment to the stationary electrodes with reference to the movable electrodes and the peak of the charging voltage wave. Many other methods can be evolved by the industrious citizen radio enthusiast.

A Midnight Visit to T. O. M.'s

By Gilbert E. Mears

I HAD just about decided to close up shop for the evening when a high clear note busted in and nearly cracked the diaphrams on the cans. Wow! Hastily laying the fones on the table I grabbed a pencil and proceeded to copy. Whoever it was was calling me and signed off "OM." Shoving over my switch I answered and then waited developments. The msg was this:—"Cum over to my place right away. Address is—(I was sworn to secrecy on this point)—73 sig O.M."

Much mystified I put on my hat and coat and dashed down to crank up the old fliv. Proceeding to the address given I rang the doorbell and waited. With a buzz the door swung open and from the distance I heard a faint voice call, "Come on up." With a here-goes-nothing attitude I climbed the stairs and presently to my nostrils was wafted the odor of tobacco smoke, burned rubber and sulphur dioxide. Following the odor I came to a large room at the rear of the house. Peering in I saw a most wonderful collection of wireless junk, of a quantity and variety to make any ham's mouth water. At the table was seated a fellow in overalls who turned and beckoned to me to enter.

"Sit down and wait a minute. I just found a hole in the ether that I think I can shove a message through," he said.

Finding a convenient packing case in the middle of the floor I sank down upon it, not knowing what to expect next. Looking around in an awed manner I noticed that the room was literally crammed with wireless apparatus; all types and sizes of sending and receiving sets, cases half unpacked, and bits of wire strewn all over the floor.

Suddenly he ceased his mad pounding of the key and swung around to face me. I could hardly describe his face nor his

"Suddenly he swung around to face me."

build for I could barely see him through the haze of tobacco smoke, coming from the enormous pipe he had in his mouth. I did notice, however, that he was wearing large blue glasses.

"Well, young man I suppose you are wondering why I sent for you to come here tonight, and who I am and so forth. I am known as The Old Man and I send in a contribution to QST once in a while.

This is my studio and workshop, and first of all I want you to swear that you will never reveal my address."

I solemnly swore that I would not and as I realized just who I was talking to, my mind began to travel at triple speed and I resolved that before I left I would ask SOME questions. I had just opened my mouth when he began to speak again.

" . . . . has a habit of staying out and talking to his friends.'"

"Now I sent for you because you happened to be close by here and from all I can find out by listening to your spark you have a *little* intelligence. No, don't thank me. I want you to do something for me. Ask the questions that you think any amateur would ask about me and I will try to answer them. Then you can write in to QST and maybe that will stop so many fool letters from reaching them about me."

"Wwwwhy do you wear those blue glasses?" I began timidly.

"To keep the glare from the audions from hurting my eyes. Next."

"Where is your cat? Can I see him?"

"I just sent him to the drug store for some pipe cleaners. He probably won't be back before four o'clock as he has a habit of staying out and talking to his friends instead of paying attention to business, drat him."

"Is your CW set finished yet? I heard that you were going to build one."

"No, I am undecided whether to build one or not now. I find that nearly every ham in the U. S. A. is building such a set and just leave it to them. They'll have a decrement to CW before they are through. I know it, I feel it in my bones. I have a great hook-up for CW, though, and if I can get a license to send on 90,000 meters, I may try it out."

"Gee, let me have that hook-up, will you?"

"No, young man, it wouldn't do you any good. Only Marconi, Tesla and the Editor of QST could understand it."

"Don't you think that it is rather inconsistent to have that big sign up there, PEASE DO NOT SMOKE, when you are smoking that old pipe yourself?" I was growing bolder now.

"Oh that sign isn't for visitors, that is just a gentle hint to the motor generator on my telephone set, when I try to work the Pacific coast."

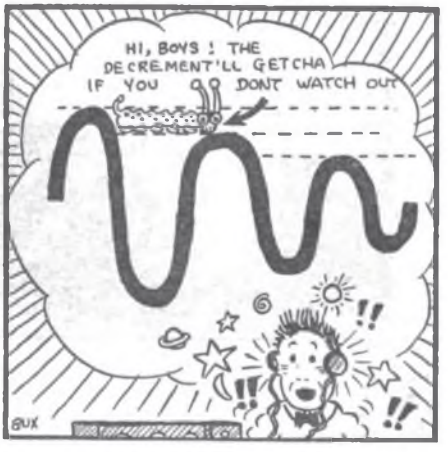
"Speaking of smoke, didn't I smell rubber when I came in here?"

"Most likely, I threw the eraser at the cat a short time before you came, and it landed on the quenched gap. I did not have time to take it off as I found a chance to get another one off the spindle at that moment." And he pointed at a huge spindle on his desk. It was about three feet high and was filled with messages.

"Did you get all those messages in the last few days?"

"Oh no," he said calmly, "I believe that the msg. on the bottom there is dated November, 1919. Some day before I die, I hope to have that spindle clean."

At this point we were interrupted. He spun around and began to pound the key again. I listened to the click of the key and heard him madly calling a seventh district station. The next moment he was telling ACX to "Pse QRT QRT ur decrement is rotten. R. I. will be after you." He listened intently and then with a howl tore off the receivers and strode up and



Editor's Note: We bet "ACX" knew what a "decrement" was art. after T.O.M. came back and explained!

down the room, tearing at his hair.

"Wow! Blankety dash blank blank!—Can you imagine that. He called me five times, signed off nine times, gave me a million R's and asked if he came in QSA

now. And then he, he, he—"

"Yes, and then what?" I asked breathlessly.

"And then he said 'What is a decrement OM? I don't use one at this station.' "

I stood silent in the face of his fury. Quickly he crossed to the sending panel, removed the fuses and bridged them with No. 4 wire, shorted his transformer, and before I could stop him pressed the sending key. A roar filled the air, blue flames shot across the room, and with a terrible crash—

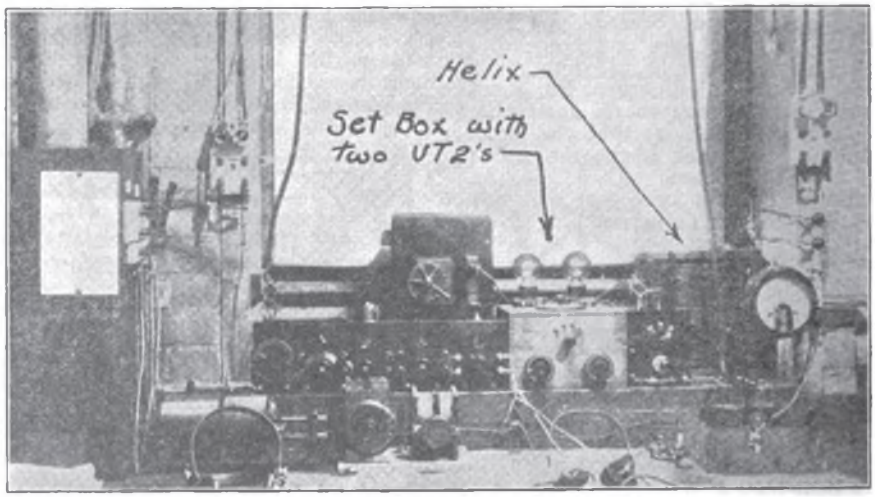
I picked myself up from the floor and rubbed the back of my head where it had hit the edge of the bed, and then unlimbered the old "mill" to write of my visit to the OM before I forgot it.

Here it is. Some nightmare. Do you think there is really any chance of ever meeting the OM under better conditions than that? I *would* like to see what he looks like.

Some Simple C. W. Sets

1XX, the Radio Club of Brown University, at Providence, R. I., has a little home-made C.W. set which has been heard at many places up to 900 miles distant and which is extremely simple in its construction.

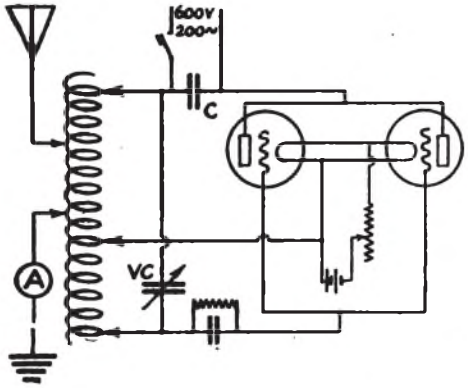
This is an alternating current C.W. set, the plate supply being 600-volt 200-cycle, obtained from an 8-pole alternator by driving it at abnormal speed. The emission, then, is I.C.W., but probably best receiving results are received by heterodyning the signal.



The aerial at 1XX is a flat-top T with a spreader in the center which is shorter than those at the ends, making it fan out and incidentally putting the capacity where it belongs. It is hung between a steel tower at one end and the ridge of one of the halls at Brown at the other, but unfortunately the snap-shots we have of the aerial and the generator are not good enough to reproduce.

The circuit is shown in the schematic diagram. The high voltage is connected across C, a ½ mfd. paper condenser. If this condenser be much larger it will draw a heavy current from the line, and ½ mfd. seems the best value. The helix is the ordinary type with edgewise-wound copper ribbon, about 8 in. in diameter. About ten turns are used. VC is an ordinary .001 mfd. maximum capacity air condenser. Two VT-2's (Western Electric 5-watt "E" tubes) are used in parallel, their filaments heated from an 8-volt storage battery. Mr. Learned of 1XX points out that it is necessary to be careful in using such tubes in parallel to make sure that the current paths to grid and to plates are the same for each tube, so that they may be sure to oscillate at the same frequency The grid condenser is an ordinary .0005 mfd. paper receiving condenser, and the grid leak a 5000-ohm graphite potentiometer segment. It would be better to bridge the leak from grid to filament than across the condenser as shown, since in its present position the high potential is still able to find its way to the grid thru the leak.

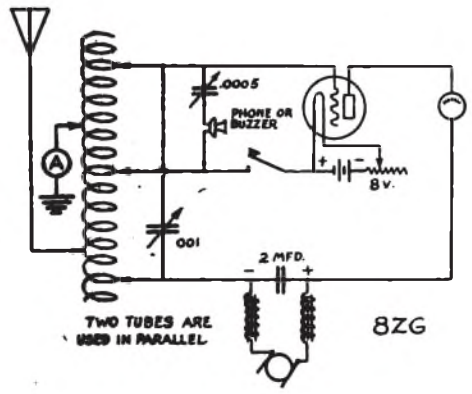
"E" tubes are rated at 375 volts but in a set like this where but one side of an alternating potential is used the tubes are idle approximately half of the time the key is pressed and of course cooling off all the time the key is up, so that a considerably higher potential may be used. However, if the helix is not adjusted correctly the variable condenser will break down



and the tubes will overheat, so in first adjusting it is best to use a lower potential, say 200 to 300 volts, and carefully watch the plates and grids and stop at once if they get red hot, as the VT-2's are not as rugged in this respect as the G.E. tubes. It is generally best to connect the antenna and ground clips to that portion of the helix forming the plate inductance rather than to the grid coil—the hookup shows the idea. The set will work on any wave length within the range of the inductances and capacities but greatest antenna current (1.5 to 2 amperes)is obtained with a wave length just a little higher than the fundamental of the antenna.

8ZG, Salem, Ohio.

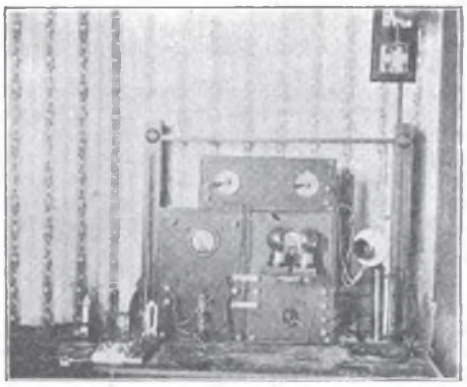
8ZG is another of the 10-watt sets that has been doing phenomenal work. Rev. Manning's circuit will be seen to be almost identical with that of 1XX. The main inductance is a 28-turn helix of No. 6 copper wire, 5 inches diameter, while the generator is an ⅛ h.p. 220 v. D.C. motor driven at 3000 r.p.m. and delivering about 400 volts. With two VT-2's, 8ZG has been heard in Portland, Me., and Port Arthur, Tex., 1060 miles, and is regularly handling traffic direct with New York City.



Such a set as this is simplicity itself, and with the photograph and the circuit diagram we do not see a thing more that might be said in explanation. We feel that such sets as this prove that anybody can build and operate a C. W. station with less fuss and more results than any other equipment.

7OD's Cigar-Box Set.

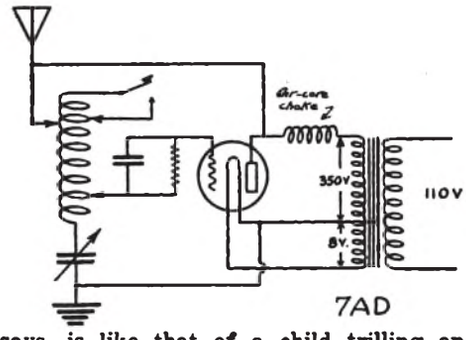
Recent mention has been made in the Operating Department's columns of the CW set of 7AD, F. J. Brott, in Seattle, which was kicking up quite a commotion in that territory. The queer thing about this set was that in spite of the noise it made it was completely contained within a cigar-box. Altho it has since slightly outgrown the c.b., it can still be put in one a little larger.



A snapshot of 8ZG.

Here we have the Colpitts circuit, with the plate supply secured by stepping up the 110 a.c., and signaling done by compensated telegraphy. Only one tube is used, a VT-2. The small transformer is closed core of 1 in. cross-section, with 770 turns of No. 24 wire for the 110 volt side and 2450 turns of No. 30 to give 350 volts for the plate, and 56 turns of No. 19 to give 8 volts for the filament. The tuning coil is 3⅜ in. diameter wound with 40 turns of No. 14 D. C. C. shellaced, with two sliders that make contact with any desired turn. The ground condenser is a .0005 (max.) variable with the plates spaced a little wider than usual, while the grid condenser is fixed, consisting of two metal plates ⅝"x1¼" clamped tightly on either side of a piece of .005" mica. The choke coil is an L-750 honeycomb. The grid leak is a piece of red fibre 1" wide

and 2" long with heavy pencil lines on it, the adjustment of the resistance value being very critical. The key shorts 3 turns on the unused end of the coil and gives a working wave 8 meters lower than the compensating wave. The antenna current is 0.46 amp. and the note, Mr. Brott



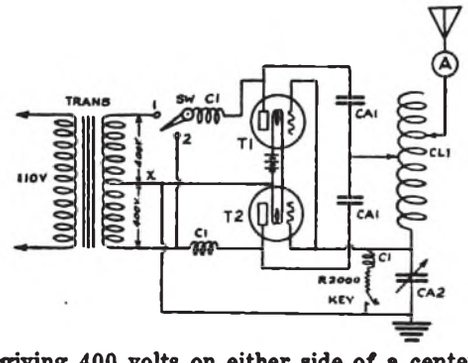
says, is like that of a child trilling and is pleasing to hear. The starting switch is arranged so that the filament is heated before the voltage is placed on the plate, which prevents the filament from "caking" and so shortening the tube life.

Signals from this set have been copied by 6OH at Ukiah, Calif., distance from 7AD 600 miles.

As a probable improvement on the circut shown we would suggest that the grid leak should run from grid to filament instead of across the grid condenser, and the ground from filament should be taken from the center point of the filament-heating winding rather than from one terminal.

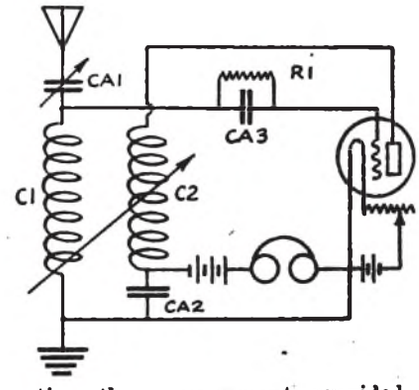
An A.C. Transmitter and a Receiver

Mr. Roy S. Copp of Dayton, Ohio, describes his C.W. set to us in the diagram herewith. This set also operates from stepped-up a.c., and uses one Marconi V.T. on each side of the cycle, the transformer



giving 400 volts on either side of a center tap. As here shown the set is designed for audio (non-oscillating) reception. The drawing is almost self-explanatory. Main inductance CL1 is 30 turns of No. 14 bare wire on a 4" diameter tube, spaced, with two sliders. The blocking condensers CA1 each consist of 20 sheets of mica 2"x4", with slightly smaller foils. (Any capacity above .002 mfd. that will stand the voltage will do.) The air-core chokes C1 are important, to prevent the r.f. backing up thru the transformer. They consist of 200 turns of No. 28 cotton or enamel-covered wire on a 2" spool. CA2 is an ordinary 43-plate variable and the grid leak for the set described is 2000 ohms, altho it would better be variable. Note that another C1 choke is inserted in series with the grid leak. This oscillating circuit is also the so-called Colpitts, and the arrangement is very similar to that described in the December QST.

The switch SW, on Point 1 utilizes a half of each cycle on each tube, while on Point 2 the tubes are paralleled and during one half-cycle both tubes function and during the succeeding half-cycle both are idle. Point 1 therefore gives a tone double that on Point 2. We wish to reiterate, however, that for non-oscillating



reception the arrangement provided by having the switch on Point 2 is much more satisfactory. The use of both halves of the cycle is superior, we consider, but not for audio reception. Its use is for heterodyne reception, since as explained on page 52 of February QST, the insertion of a choke in the center tap as at X will so flatten out the supply voltage that the output from the two half-cycles will overlap. That is our idea of how to do it—our idea, in fact, of the way to operate a C.W. set on A.C. Use this scheme of supplying voltage where there is a separate tube (or tubes in parallel) for each side of the cycle, and then introduce a large choke in the common lead so as to flatten the input wave to produce overlapping. Altho still modulated at the supply frequency to some extent, it will nevertheless heterodyne beautifully. It should be borne in mind that there will be a considerable voltage drop across an adequate iron-core

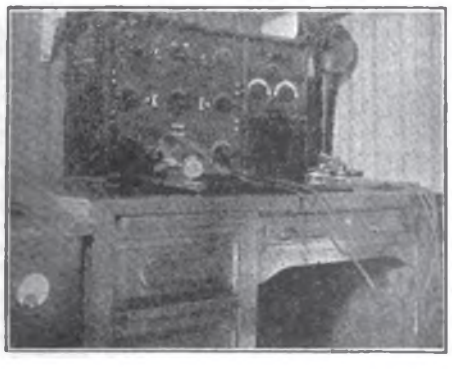
choke coil and the initial voltage across each side of the transformer should be made high enough to compensate for this. For an experimental set the secondary of the transformer could well be tapped to give various voltages.

The average regenerative receiver is hard to adjust to receive C.W. signals and so Mr. Copp gives us a description of his very simple regenerator which works with remarkable ease in heterodyne reception. The set described has a range of 175-600 meters, which of course could be increased by increasing C1 and taking off taps. C1 as used by Mr. Copp has 30 turns of No. 24 DCC wire on a 3½ in. tube, and C2 is of 30 turns of similar wire on a 3 in. form rotating within C1. C2 of course is a tickler. Tuning is accomplished by the 43-plate variable CA1, and aside from this there is but one adjustment—the tickler coupling. CA3 is the grid condenser and CA2 is a by-pass, in this case a duplicate of CA3.

The Amrad Transcons

ALONG about midnight when the DX owls climb on their perches and hoot, did you ever hear a message prefixed "AMT" come pounding through on that indefinable synchronous note? Mebbe you did and mebbe you didn't but whether you did or didn't the explanation of that innocent little 'gram is now running at large in every district. It seems that the Amrad people have been operating a little private transcontinental line all their own. And any message prefixed "AMT" travels only on the Quenched Gap Limited.

It wasn't that the Amrad Gap men caught a bad case of Transcon-fever during the A.R.R.L. relays; not that. They tell us that the first spikes on the Amrad Line were driven in last fall and it wasn't until the middle of February that the Limited was really fixed up and sent pounding across. Report has it that the first westbound Limited, scheduled to leave the Atlantic terminals on January 25th, never pulled out of the shack at 2PL. The



Operating Table at 2PL.

hostlers to receive her at Cleveland and Chicago were out on strike for more juice plus a bonus of 2 Dubilier Condensers for eight hours overtime. (They got the juice but still await the bonus.)

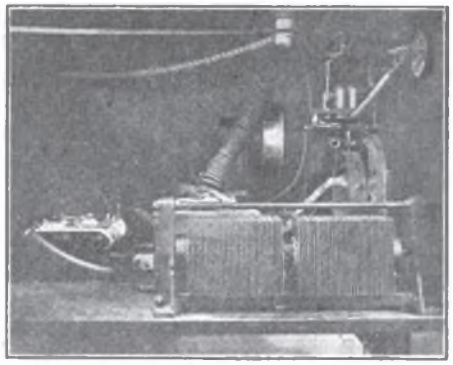
The Eastbound Quenched Gap Limited on January 25th fared better, pulling out of the Roebuck terminal at Santa Barbara on schedule time 12:30 P.S.T., taking water at Douglas, Ariz., and Roswell, N. M., before shrieking into Stromsberg, Nebraska, ten minutes later. Here the effects of a

Transmitter Cabinet—2PL.

sympathetic strike were encountered, Nyquist's power being cut off for 20 minutes. 9AFX "hunted" for an eastern Amrad station but as none could be found gave the AMT to 9VA who passed to 8FT. Meanwhile, 2PL tore a hole into the West in search of the derailed East-bounder and after consulting 8KM and 9BP, switched to 8FT who forwarded the following messages from Roebuck at 6:10 a.m. E.S.T.—"Sixth district stations show higher audibility when using quenched gaps."

This ended the first run of the Amrad Quenched Gap Limited—towed into port by two rotaries after forging across two thirds of the continent in fast time. "Never again!" said the Eighth and Ninth District strikers, who hustled back to their keys without requesting an armistice. Nor did two heavy onslaughts of demon static coming on test nights Two and Three shake their determination to fire the Limited to the last pound of steam.

On February 15th, at 2:00 a.m. E.S.T., 1XT, 2PL, 3VV, 8ML, 9PV, 9AFX, 5ZA, 6GI, 6DK and FD were dancing on their



2PL's Transmitter.

keys and between pauses in QRM conducted the three Quenched Gap Limiteds from ocean to ocean. 2PL passed the first Westbound AMT #15 to 9PV who passed to 9AFX, to 5ZA, to FD. The elapsed time was 28 minutes to be exact. 1XT passed also to 8ML who passed to 9PV. Coming East, the Limited travelled via 6GI, 5ZA, 9AFX, 9PV to 2PL, a second section stopping momentarily at 8ML, curious to know how he got that tone. Heavy drifts of static east of Chicago did not seem to impede the Limiteds in their course.

The Amrad Transcontinental Line having made its debut and won its spurs, will take its place in organized Citizen Radio. Additional stations are being appointed, branch routes are in process of formation, monthly Amrad tests are already scheduled and it would almost seem that a lusty grandchild has been born to the bearded A.R.R.L.

What will the Old Man do to his cat when he reads that half a dozen comparatively obscure spark stations boasting 60 foot aerials and 700 watts input, put over a transcon with quenched gaps under average QRM conditions?

Tuning Honeycomb Coils

By Anthony D'Amico, 2QW

AFTER reading Mr. A. Novice's article in the January QST calling for more information on honeycomb coils I decided to give to the amateurs through QST my data that I had collected after months of careful experimenting and sitting up late at night. The honeycomb coils manufactured to-day I must admit are very good indeed for long distance receiving on long wavelengths, but for amateur work or receiving on short waves I advise the user to bury them and use them as a ground, for they might be efficient as a ground.

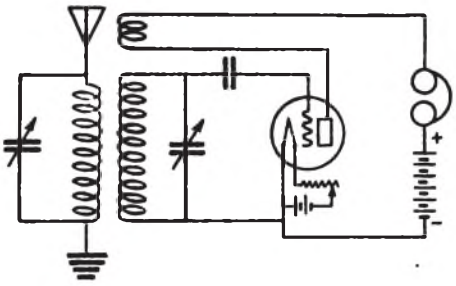
I have read Mr. Groves' article in the March 1920 QST several times and I must give him very much credit for designing a receiver with which his marvelous results were obtained as he stated in his article on honeycomb coils.

With the aid of my partner and coworker, Mr. Joseph Murray, I designed a simple receiver utilizing the tickler coil and using honey comb coils for tuning. We are not doing much transmitting here but we devote most of our spare time to receiving.

Our antenna is medium size, consisting of two wires 90 feet long and about 75

Station	Wave Length	Primary Condenser Reading	Secondary Condenser Reading	Primary Coupling	Tickler Coupling	Primary Coil, L	Secondary Coil, L	Tickler Coil, L
FL (1)	8000	20°	26°-27°	¾"	1½"	600	750	1000
NPM (2)	9500?	50°	40°	1¼"	4"-5"	400	750	1250
POZ (3)	6500?	48°	25°	1¼"	1"	400	750	1000
POZ (4)	12600	40°	18°-19°	1¼"	½"	750	1250	1000
BZR	5000	10°	3°-4°	¼"	very close	600	750	400
NAT	5500	22°	12°	1¼"	1¼"	600	750	400
NBA	7000	0°	28°	1½"	1¼"	600	750	400
NPL	9800	10°	10°	¾"	1¼"	750	1250	1000
NPL	9800	20°	62°	1¼"	4"-5"	400	750	1250
IDO	11000	0°	12°	1¼"	1"	750	1250	1000
LCM	12000	0°	21°	¾"	very close	750	1250	1000
YN	15500	0°	32°	2"	very close	1000	1250	600
NZR	11000?	40°	12°	¾"	½"	750	1250	1000
WSO	12000	40°	20°	¾"	1½"	750	1250	1000
NSS	16900	50°	52°	¾"	2"	750	1250	1000
LY	23410	60°	70°	¾"	very close	1250	1500	1000

feet high, and is L shape. For tuning we use two .001 mfd. condensers, one in shunt with the primary coil and across the secondary. Rheostat, potentiometer, honeycomb coil mounting and a Moorhead tube complete the receiver. We have a two step amplifier which is used for amplifying weak signals. I will not go into further



details on the construction of the receiver as I have written this article especially for the amateurs who have gone astray on the use of the coils. With our one tube set we have copied NPM, a distance of approximately 6,500 miles, and all the European and American arcs, with ease and readable. We give below the circuit used by us and a list of the most important long wave stations we receive. We also show the primary and secondary condenser readings, the size coils, and the amount of couplings used.

It must be kept in mind that when receiving arc stations on long waves there are always two points on the secondary condenser where a station will be heard. I have given the reading where signals came in best and free from QRM.

I would like to hear from amateurs who make use of the above information.

Notes to Chart

(1) I found that using a larger tickler signals came in a little louder. FL works BUC (Budapest) between 7:30 and 8:30 p.m., 75th Meridian Time.

(2) NPM works NPN btween 2:30 and 3:00 a m.. 75th Meridian Time.

(3) POZ sends press in English on his 6500 meter wave. He can easily be distinguished, for when sending "px" he repeats each word.

(4) POZ sends all his traffic on his 12600 meter wave. Can be easily recognized by the following preambles—"Bln" for Berlin; "Dzg" for Danzig; "Bmn" for Bremen. For example: "rg 465 Bln, to WSO", etc.

QRM and The Relay Game

By J. F. Scholtes, 9AR

HERE it is again, the eternal subject of QRM and regulation of traffic. Fellows, this is getting to be a serious proposition and one which must be regulated in the very near future. Nowadays a fellow can hardly start to clear any traffic before 1 or 2 A.M., all because of QRM, most of which is unnecessary. Is it necessary to call DX stations ten or fifteen times without an interval? Or to call stations a thousand or more miles away when you know it is an impossiblity to carry on successful communication any length of time with him unless it happens to be 4 or 5 in the morning?

The following is an idea of perfect relay station operation The place: Chicago, because of its central location, and therefore one place where an outsider would think the worst QRM in the country must be experienced. The outsider does not know and seems you can't convince them that there is absolutely no local QRM after 10 P.M. I recently had an out-of-town radio man at the station about 11 P.M. one night and he remarked to me how quiet the air was and asked "where are all the Chicago radio men tonight? How is it that 9AU is the only one transmitting tonight?" When told that the rest were standing by waiting for 9AU to clear, he could hardly believe me. "How do you do it," he says; "out in the town I come from everybody transmits at once". "Yes", I said, "and hardly any of them ever clear any traffic". That's just what's wrong with most of the large cities in the United States—they simply have no co-operation among the local stations. Getting on the job in Chicago at say 10:30 P.M., what is heard—possibly a local station calling or working some DX station, and dozens of other stations in the first, second, third, fourth, fifth, eighth and ninth districts. Most of these stations have no traffic for relay; they are on mostly for pastime and enjoyment in establishing communication with a distant amateur, and thereby are causing quite a bit of QRM to stations who have traffic to relay. If we eliminated the stations that have no traffic, the relay stations would increase their efficiency at least 50%. Of course we do not want to eliminate these stations, but why can't we set aside special hours for the operation of stations who take no active part in relay work—say from 9 P.M. until 11 P M. for

stations to experiment in distance work, no relay traffic to be handled, and after 11 P.M. for relay work **only**? Why not have a set of rules adopted as used in Chicago? These rules certainly have proved a great success for the regulation of local traffic why, then, cannot national traffic be regulated likewise? Wouldn't it help matter if we had two periods of DX hours—say from 9 until 11:30 P.M. first period, and from 11:30 P.M to 6 A.M. the second period, all stations working the first period being asked to QRX the second period and vice versa? This certainly will greatly help matters and reduce QRM in a great degree.

How about the "Chicago Plan", as it is called? Why not have a set of rules drawn up for the whole country with an A.R.R.L. Board as the Executive Council? You undoubtedly know of the great success of the Chicago Plan, and this system of local traffic regulation is being put into use in a large number of cities throughout the country. What was Chicago a year ago? QRM from morning until night, with hardly a chance to clear any traffic unless you sat up until 4 or 5 A.M.—and now? Local QRM is entirely eliminated, and I am not afraid to say that Chicago today has the finest organization of amateurs of any city in the world.

Now that the local QRM has been taken care of the question of DX QRM is before us. Considerable trouble is being experienced with QRM from DX stations. How are we going to eliminate this? A broad wave is one of the main causes of this QRM. Many who were at the St. Louis Convention heard a fine talk on the advantages of a sharp wave. Why not make your wave sharp? Is the primary of your oscillation transformer nailed to the secondary? Why not pull 'em apart? Even though your antenna current drops, it does not mean your range is less. You will be surprised at the results you will get using 8 to 12 inch coupling where you used to have only 3 or 4 inches (between pacakes).

Another thing we want to get rid of is the CQ signal. Is it necessary to send out a long string of CQ sigs. every night? Many a time while copying a msg. QRM will come in from one of those long drawn out CQ's. If it must be done, why not make it snappy? Also in calling another station don't keep on calling for five minutes at a stretch; give your transformer a chance to cool off.

Here is a question to think over fellows: What causes QRM? And here is an answer: Practically all QRM is caused by the operator not **thinking** before transmitting. Think it over, fellows. How many of you when sitting in some night hear a DX station call "CQ"? The minute this man puts the last dash on the "K", you start right in to call him, without **thinking** of the many things you should think of before going ahead. Many and many a time has QRM been caused by the failure of the operator to think properly before he starts to transmit.

Talking about conditions in general all over the country, I was handed a copy of a Baltimore local publication called "The Radio Condenser", and here are a few lines contained therein: "The Radio Condenser could be filled with articles on interfering, jamming, local QRM, etc., but what could we do and how far could we get? With the gang of local QRM hounds in Baltimore we could start nothing short of a baby revolution—bolsheviks over night." Is it that the fellows **do not want** the traffic regulated or is it lack of organization? In my opinion it is the latter. I can't see why any sane person should object to certain rules which would make local and DX conditions 100% better. Say you were in a city containing a hundred or more large amateur stations, and had no traffic rules, no organization, everyone transmitting at the same time, and no one doing anything but making a lot of noise. Would you prefer those conditions to that of a well-regulated city where even though there are a hundred stations each and every one of them gets his chance to work and no local QRM is caused?

Let's get the gang together; we have national organization in the A.R.R.L. why then cannot we have a National Executive Council, for the making and administration of national traffic rules for the amateur, the rules to be drawn up by the council, and to be rigidly enforced by A.R.R.L. men all over the country? This is a serious proposition and with the coming of hundreds of new men into the field day by day it must be handled carefully.

To Ships' Operators

The Bureau of Standards radio laboratory would like to receive from ships' operators, information as to signal fading and also as to "dead spots" at sea. The information to be valuable should state positions, time of day or night, wave length, strays, date; also, if possible, the particular station heard. General comments are, however, not out of order.

Some very excellent information of this type has been received from Mr. M. B. Lowe, formerly of the "Copponame" of the United Fruit Company, now of the "Ellis" of the same line.

The Bureau is particularly anxious to receive data on signal variations, etc., when both the transmitting and receiving stations are ships and there is no land within

many miles of any point of the path traversed by the waves. There is practically no information available on radio transmission which is entirely unaffected by land conditions.

Letters should be addressed to "Radio Laboratory, Bureau of Standards, Washington, D. C."

April QSS Schedules

FOLLOWING is the transmitting schedule for the April Fading Tests, taking place every Tuesday and Thursday night on 200 meters, starting times being shown in Eastern Standard Time:

10:10 1AW Non-sync. spk.
10:20 3XF I.C.W. (Note 1)
NSF I.C.W. (Note 1)
10:30 9ZN 60-cyc. sync. (Note 2)
9ZN 500-cyc. quen. (Note 2)
10:40 9LQ 60-cyc. sync.
9ZJ 210-cyc. sync.

(Note 1: The I.C.W. of 3XF and NSF will differ in pitch and tone qualities. Note 2: 9ZN will operate two sets synchronously on the same wave, each having its own antenna.)

All stations are asked to co-operate by policing the air for absolute quiet during these tests. Remember, there is an observer near you.

Records

IN amateur history pre-war 2PM, New York City, is popularly credited with having been heard on three consecutive nights in Los Angeles shortly before we entered the war, but we have never been able to verify this. Pre-war 2AGJ at Albany is likewise credited with having been heard by a ship off Lower California, Mexico, probably a greater reach. Since the reopening numerous Central Division stations have worked ships off northern South America, but of course all such records fail before 2RK's Algeria and Pernambuco achievements. However, it is very interesting to note that in recent months many of our stations are getting out across distances right in our own country which are decidedly unusual. We do not believe that such records foretell the handling of relay traffic over vast jumps, but they are a commentary on our individual progress in transmitter and receiver efficiency.

Just to put it down in black and white for history to see, we wish to chronicle the following recent records which have come to our notice:

6EA, Los Angeles, heard by 2KF, Irvington, N. J., Jan. 4.

6ER, Los Angeles, heard by 8ZY, Defiance, O., during February.

6GO, Oakland, Cal., heard by 2KF, Irvington, N. J., Jan. 4.

6JD, Los Angeles, heard by 8ZL, St. Marys, O., Jan. 17.

6ZK, Sunnyvale, Cal., heard Jan. 15 by 8ZY, Defiance, O., and 2TT, New York City, and on Feb. 17 by 2KF, Irvington, N. J.

6ZR, Burlingame, Cal., heard by 8ANK, Pittsburgh, on Jan. 16, and by 8FQ, also Pittsburgh, on Jan. 29.

7CC, Moscow, Ida., heard at 8ZY during February.

7ZJ, Vancouver, Wash., heard at 8ZY during January.

8XS, Lansing, Mich., copied by 6AK, Walnut Grove, Cal., Jan. 20.

8ZR, Mansfield, O., copied Jan. 19 and Feb. 24, respectively, by 6EJ and 6AK of Walnut Grove, Cal., and on Feb. 12 by 7ZJ, Vancouver, Wash.

8ZS Wilkes-Barre, Pa., reported Jan. 18 at 6AK, Walnut Grove.

9EL, Council Grove, Kan., copied Jan. 27 at 6EC, Anaheim, Cal., on one bulb and aerial 25 ft. high.

9ZJ, Indianapolis, copied on QSS test by 6AK, Walnut Grove, Jan. 27.

Old Loose-Couplers as Regenerative and Autodyne Receivers

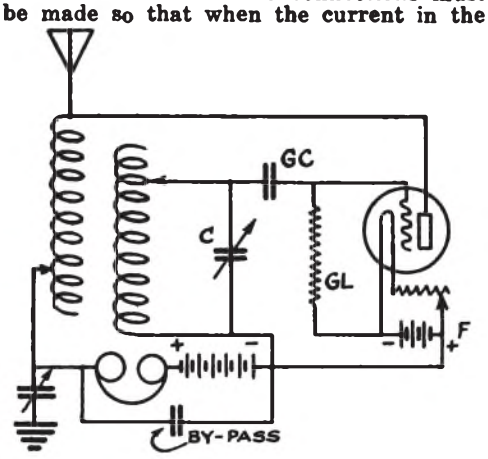
By R. R. Ramsey.

PERHAPS it may be of interest to those who have old apparatus and who do not have the time to build or the money to buy more modern receivers, to call attention to the fact that the old fashioned two coil slide tuners can very readily be used with a bulb as a regenerative receiver, as an oscillator, and therefore as a self-heterodyne receiver for C.W. telegraphy and wireless telephone. The accompanying sketch will show the connections.

"Pri" and "Sec" are the primary and secondary coils, respectively, of the "loose-coupler." The terminals of the secondary are connected to a variable condenser, C. One side of this condenser is connected to the grid terminal of the tube. A grid condenser G.C. may well be inserted, with the grid leak, GR. The other side of the variable condenser is connected to the filament of the tube at F. The negative terminal of the B battery is also connected to the filament at F. The positive terminal of the B battery is connected thru the telephones to one terminal of the primary coil, (ground terminal, say) and the antennae terminal of the coil is connected to the plate of the tube. A by-pass condenser is placed around the telephones and B battery.

The primary coil is made to do double duty, both as primary coil proper and as

"feed back" coil. The connections must be made so that when the current in the secondary coil runs towards the grid of the tube, or rotates clockwise in the secondary coil, the increased current of the plate circuit will rotate anti-clockwise in the primary coil. The right connections are determined by experiment. If the tube will not oscillate, interchange the connections to the primary coil so as to reverse the direction of the current through the primary coil. The circuit oscillates best when the primary and secondary circuits are tuned to the same wave length. The degree of coupling can be determined by experiment.



While using a home made coupler, maximum wave length 1500 meters, and two tubes, I have heard at Indiana University 2XJ phone and a conversation between 2HKI and KQO, all three phones being very distinct.

A Chance To Help Your A.R.R.L.

Fellows, this A.R.R.L. of ours is going to raise forty five hundred dollars in hard, cold cash by May 1st to pay off the bonds that were sold to get our QST started two years ago. We've got a good-sized chunk of it in hand right now of course, and we're asking our advertisers and newsdealers to help us by paying up their bills promptly, but it's going to be a pull and we want you to help. If every member of the A.R.R.L. will get just one radio bug who is not a member to join the League, the ready money that will come in will do the business at once.

So the general order for the first half of April is "Every member get a member." Your quota is **one.** Will you go out and nail that neighbor of yours for the A.R.R.L. and send in his application on the blank below? It will be a big help that will be much appreciated.

If you purchase QST on the newsstand and aren't a member of the League, send in the blank and join, and QST will come to your home every month.

USE THIS COUPON

American Radio Relay League,
Hartford, Conn.

For my quota in the A.R.R.L. April Drive I enclose $2.00 for which please enter for membership (including QST) for one year.

.....

(Name) **(Street or Box)** **(City and State)**

Secured by.....

EDITORIALS
de AMERICAN RADIO RELAY LEAGUE

Help the Cops.

IN several cities, notably New York, Dallas and St. Louis, information is being broadcasted nightly concerning stolen automobiles, and surrounding amateurs are earnestly requested to aid the scheme by copying the data and transmitting it to their local Chief of Police. We told about this in our February issue, and since then the transmitting stations in these cities have been banging 'em out every night. Are you doing your part to make this idea a success? The effort will be small and if we deliver good snappy service on this thing we will bring Citizen Radio further into public appreciation.

In New York in particular we have an opportunity to make an impression. There the police's own station, KUVS, sends out the broadcasts at 7:30 and 11:30 nightly on 400 meters. The police in all the surrounding towns have already been advised to watch out for reports coming via Amateur Radio, and they are waiting—patiently. Some evening one of these Gotham stick-me-up's is going to rake in a bushel or so of diamonds that don't belong to him and depart in a westerly direction in somebody else's chariot. Then the alarm will go out, and if Amateur Radio can do its part, the cops will be thick as flies in every surrounding town, and our friend will be picked up before he gets very far. There will be a little personal glory in this too, if that counts. Will you be the one? Help the cops.

Going Down!

HOW'S your wave length by now? Do you wish we would stop talking about it? We'd like to, but really we can't as long as the situation remains as serious as it is. Although 3DH is still the outstanding example of how long a wave not to have, many stations have succeeded in dropping theirs, and things look much better. 1XM and 2RK are actually moving traffic on schedule between New York and Boston on waves of 199 and 209 meters, respectively, where QRM on the average amateur tune of around 240 makes it impossible—nobody else home on 200.

Who is it so busy these days logging amateur wave lengths? Somebody is, and on some eventful day of days that little bit of information, including the logs that every Navy station keeps, will be read into the record as evidence of how we amateurs obey the law. It will be the truth probably, and there's just one way to offset it: get busy right now and between this day and that, whenever it may come, get all our waves down where they belong so that we can present a clean front on the day of judgment.

Do your part—get down yourself.

Conventions.

WE are in an era of radio conventions. One who has been unable to attend one can not appreciate how fine a thing they are. There is nothing that so spreads the cement of fellowship as getting together with the bunch and meeting personally the men you have known only by their sparks. There's not a one of us without dozens of friends made thru the air, and we tell you that it is certainly a pleasant feeling to meet these chaps face to face. So let's have more conventions, and more. They are fine.

And don't forget the big national one in Chicago this coming fall—the First National Convention of the A.R.R.L., our dream of years. We'll be there from every state in the Union, and it will be worth a year of your life to attend. Detailed announcements will appear soon in QST—save your money.

QRX for QSS Tests.

THE fourth and final series of Bureau of Standards—A.R.R.L. Fading Tests will be held on the Tuesday and Thursday nights of the month of April, beginning at 10 p.m. E.S.T. and lasting a little over an hour. We again request all our friends east of the Rockies to stand by during these periods in order that the important data can be logged for study. There are observers within your QRM range, and your transmission will surely "bust" them, so we ask that you keep your transmitters silent during these periods.

During the January tests there were several instances where records were spoiled but it always turned out that

the interference was unintentional, the "offenders" either not knowing or forgetting that QSS Tests were going on. So pass on the word, fellows, and let's have a perfect score for our Bureau this time.

The January tests were very successful, several new kinks being introduced. The most important was the division of the recorders into two groups, with the transmitters sending synchronously in pairs on different wave lengths, each group of recorders copying a particular station. This gave records on simultaneous fading on different wave lengths, a feature not covered by the earlier tests. In the coming series the two-group scheme will be used again, but this time the transmissions will probably be on about the same wave, tone variations being depended on for reading. And it is expected that a real 200-meter wave will be used. (Take a good look at it, some of you!)

The records secured in these tests are being analyzed by the Bureau of Standards and each series covers certain new angles of the problem brought to light by study. When the work is completed we can expect that the Bureau can tell us (and incidentally the world at large, for the whole scientific world is watching us) just what makes our signals fade. We are doing a good piece of scientific work, and we are proud that we can assist the Bureau. Let that knowledge be your compensation while you QRX for the April Tests. We thank you.

The Third District.

A NOTABLE piece of amateur business was accomplished at the Philadelphia Convention in the adoption of a plan for organizing the district to secure effective co-operation among the various interests. It was our pleasure to be present at the discussions leading up to the adoption of the plan and from the admirable spirit of co-operation shown by everyone we are confident of the success on the plan. In addition to purely amateur matters such as a division of hours, it will provide for the appointment of certain good amateurs to act as Deputy Radio Inspectors, assisting the Department of Commerce in the enforcement of the laws. This is a duty which we amateurs have long volunteered to undertake and by which we feel that we have much to gain. The institution of such arrangements in the Third District amounts to a trial of the scheme, and if it is successful we may expect that it will be taken up in the other inspection districts. We therefore urge good A.R.R.L. men thruout the district to give the plan their heartiest support when it comes up for action in their territory.

Our Goat.

EVERY now and again somebody says something that gets our goat. It happened again the other evening when a poor benighted creature disclosed the appalling fact that he had never heard of our A.R.R.L. He did not know that amateur wireless was anything but a toy for a few boys in short trousers. He had heard of George Washington, Napoleon Bonaparte, Mr. Marconi and Al Jolson, strange to relate, but he had not the slightest notion that private citizens were communicating with each other across the country by means of amateur radio. Our great Trans-Continental Relay was seriously doubted by him, and when we got hot and made him listen to the whole story of A.R.R.L. he was amazed, and wondered why the newspapers did not mention such wonderful things.

We do not appreciate what big things we are doing, fellows. It requires an experience like the one mentioned above to thrust it home upon us. That Trans-Con was a mighty big thing. Not only was it a most wonderful thing to have sent several messages across the continent and had the answers back in from six and one-half to twenty-three minutes, but it was also a very wonderful piece of organization work. Just think of what we did that eventful night! It seems hard to believe. All of you fellows co-operated and stood by while the few stations selected to do the job went ahead in clear air and put it over. Think of getting clear air all the way from Hartford to San Francisco and Los Angeles! But that was what we had. It was simply thrilling, that night, to sit in and realize that 1AW was talking with 9ZN, just as though he were on the other side of town, and that 9ZN was doing the same with 5ZA at Roswell, New Mexico, and that the latter was doing likewise with 6ZK and 6JD on the Pacific Coast. Schnell was at the key at 1AW and before he started the messages he wanted to know positively that each station was QRV all the way across. Matty at 9ZN was heard to ask a few fellows to please QRX for the Trans-Cons and we heard each fellow say "OK OM will QRX". We could not read 5ZA, although we could hear him at 1AW, and he evidently was doing the same. On the Coast they were doing likewise, probably, for in a few minutes Matty came back in his nervous staccato, "OK QRV all the way across OM SHOOT". Schnell shot a smile at the writer and Mr. Maxim and let the first one go. Matty gave a snappy "R" and immediately was slamming it to 5ZA. Not a sound disturbed the ether during this and the messages which followed, and we

(Concluded on page 47)

The Operating Department

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

A GRAND total of 9793 messages is *reported* for this month, but there are many hundreds of stations that have not sent in their reports. New York City with its great number of amateur stations is not among those present, and we feel more than confident that this city alone has handled at least a thousand messages which should be included in our report. Efforts to have the New York amateurs turn in their reports seem futile. Perhaps they are so busy handling traffic that they have no time to make out reports. For the third time in succession the honor position goes to a Central Division Amateur for handling the greatest number of messages, and reporting them.

MR. J. W. KAUFFMAN
8IK—Central Division
302 Messages.

C.W.

C.W. is already playing the part that was predicted for it. When spark stations fail to come thru the QRN, the C.W. stations are moving traffic without very much difficulty. One of the most reliable routes we have from Boston to the west is via 1AE, 2ZL, 8ZV, 9XI, and 8ZG. After traffic reaches the middle west, it is further distributed via 9XM, 9ZN, 9PQ, 9XZ and 9ZB. 2ZL is probably the most powerful of the C.W. stations and works to the south and southwest with ease, while our sparks struggle along thru the QRM.

Results are so promising that the time is here when we must have C.W. transcontinental routes. Accordingly, we earnestly request information on C.W. stations who desire appointments for this work. Apparently this will be our solution for summer relaying. Here is an opportunity for you if you have a C.W. station. Many of you will doubt the consistency of these C.W. stations, but it is only because you do not listen for them. Spare the spark for an evening and listen in about 9:30 p.m. E.S.T. and be convinced. Do not forget that it is necessary to have your tubes in the receiver oscillating to achieve results.

Alaskan Division.

For the first time in a long while we have a report from the Alaskan Division. Surely there are stations in Alaska that will eventually handle traffic from the States. We appeal to those amateurs in Alaska to communicate with their division manager, Roy Anderson, Box 206, Ketchikan. Mr. Anderson has some very interesting news for you.

The reports follow:

ATLANTIC DIVISION.
C. H. Stewart, Mgr.

Regret to advise that again no report has been received from the Northern Section (N.Y. and N.J.) except that a carbon copy of report of Dist. Supt. Southern Jersey has reached the Division Manager, and is herein incorporated. This state of affairs is one that cannot continue to exist, and must be corrected, and with that end in view will receive the early attention of the Division Manager.

Mr. M. Frye, Dist. Supt. Southern Jersey, reports that traffic is being handled in his District in better shape that at any time during the past year. Branch Line "A" (Philadelphia to Shore resorts) is in active daylight operation. A number of new and efficient stations are in operation, and almost without exception the older stations have greatly improved in efficiency and reliability. Traffic from Atlantic City and Shore resorts is delivered in Philadelphia almost invariably within 24 hours.

The following official stations have been appointed:

3FB—Wm. Jordan, Atlantic City, N.J.
3FH—Messrs. Phillips and Densham, Collingswood, N.J.

and these stations have done very excellent work during the past month.

The total traffic handled by League stations in this District was approximately 225 messages. The following stations are worthy of mention for having done excellent relay work: 3ACM, 3EH, 3AAN, 3BA, 3FB and 3NB.

Daylight communication has been established by several stations in this District with Wilmington, Del. Tests have been

carried on by the station of the Dist. Supt. to establish daylight communication with stations in Central Pennsylvania and Southern N. Y., but to date no consistent connection has been made, although several stations have reported hearing the test signals and likewise several stations have been heard at the station of the Dist. Supt.

Report received from the Western Pennsylvania District shows that the following stations have been added to operating personnel since the last report was made, viz: 8ACF—Washington, Pa.; 8PN and 8HY—Vandergrift, Pa.; 8VG—Freeport, Pa., and 8HA at New Castle, Pa. The latter station has broken the long distance record for official stations in this District.

Stations 8DV and 8RQ were out of operation the larger part of the last thirty day period. Altho 8RQ handled 138 messages last month most of which were between 300 and 800 miles. Mr. Carson connects up with Chicago—Boston—New York—Washington—and Toronto Canada, mostly thru 9UH and 8FT. 8MT at Uniontown, Pa., has not been heard for several weeks. All other stations in this District are handling traffic regularly. At Washington, Pa., 8JQ is again on the job and is working DX regularly.

After many months of waiting we have at last hooked up with a station between this District and Central Penna. Headquarters, namely, 8XE, State College, Pa., with whom several of our stations have been working night, though experiencing bad fading, which was the same trouble which was had with signals from 8BQ and 3ABD. On account of this fading 8XE works western traffic through 8WY at Cambridge Springs, Pa., and Pittsburgh traffic is then passed down Trunk Line No. 2. 8WY is handling north-bound traffic to Cleveland and Buffalo regularly, thus affording a reliable connection between Trunk Lines "A" and "B" A few more good stations north of 8WY or north of 8HA (New Castle, Pa.) could be used to good advantage, and stations capable of handling traffic are requested to communicate with the Dist. Supt.

Reports of messages handled are meagre, but 8ZD reports 182.

District Supt. Central Penna., Mr. H. M. Walleze, Milton, Pa., gives a very clear idea of the conditions in his District. 3ABD is getting in trim for real work, having been forced to relocate his station several times. 8BQ, the station of the Dist. Supt. at Milton, Pa., hopes to be able to reach out. Operator Rile of 8XE has been doing some excellent work, and has recently handled a great deal of traffic in all directions except to the south, in which direction he seems to have trouble, although he has been able to connect up with 3EN at Norfolk on numerous occasions. It is important that a station be lined up between 8ZD (Pittsburgh) and 8XE, as the fading conditions in this section of Penna. are peculiarly bad. The necessity of such intermediate stations is emphasized by the fact that on account of State College being closed during the summer months it will be hard to keep Trunk Line "B" open during the summer over the distance between Milton and Pittsburgh on account of the fading conditions. mentioned. Good reliable stations are needed in both Harrisburg and Sunbury, Pa., particularly for the purpose of connecting up to the Northern and Southern routes of Trunk Line "B" which it has all along been the intention to establish, so as to give two routes through Pennsylvania, and a possible alternate connection to Baltimore and the South.

The Dist. Supt. for Eastern Penna. reports that he is without a report from the Traffic Ass't in charge of the northeast section, and on this account is without information as to progress in that section. In this Dist. the following official stations have been appointed:
3HX—Roy S. Fisher, Tacony, Phila., Pa.
3BG—Paul C. Peterson, Folcroft, Pa.
and both of these stations have done excellent relay work, and are valuable additions to the relay system. Official station 3WX (Lancaster, Pa.) reports communication with 3ABP (York, Pa.) and also with 3ACS (Whitford, Pa.). 3ABP is QSO Harrisburg, thus establishing reliable communication between Phila. and Harrisburg, via Philadelphia and suburban stations to 3ACS, 3WX, and 3ABP to Harrisburg. The Dist. Supt., Mr. Place, is in search of a City Manager for Philadelphia, as that city is an important one inasmuch as it is on Trunk Line "D" to the South and is the Eastern terminus of Trunk Line "B".

Little activity is reported from Delaware with the exception of 3OB at Wilmington which is the only station there doing DX work at present. It has been reported that signals from 3OB have been heard in Baltimore, but no active or consistent work has been carried on, and this is another point that must be worked into shape for a reliable route into Philadelphia and from there to the south.

Since the last report Mr. E. B. Duvall, formerly Dist. Supt. Eastern Maryland, (3909 Cottage Ave., Baltimore, Md.) has been appointed Assistant Division Manager in charge of the Southern Section of this Division, comprising Pennsylvania, Delaware and Maryland and the District of Columbia, taking the place formerly held by the present Division Manager. For the present Mr. Duvall is still acting as

Dist. Supt. Eastern Maryland, but is considering the appointment of a successor. He also has in mind the appointment of a City Manager for Baltimore City.

Baltimore has now a fairly perfect DX working schedule, with traffic control stations on each night. The schedule is arranged as follows, and Phila., Washington, Richmond and Norfolk stations are requested to please note and co-operate.

Traffic Control Stations
On watch 10:30 p.m. to 2 a.m.

Sunday	3AHK	Wednesday	3AHK
Monday	3AA	Thursday	3UG
Tuesday	3GO	Friday	3HG

Saturday 3HG and 3EM alternate

Local work up to 10:30 p.m. DX work after 10:30 p.m. This schedule subject to slight changes, and notices of such changes will be broadcasted and published. Such an arrangement shows that an earnest effort is being made to eliminate some of the QRM which formerly existed in Baltimore, and allow of the operation of the several classes of stations.

Baltimore's best station for DX work is 3HG, Diechmann, and excellent work has also been done by 3AHK, 3UC and 3GZ. No reports have been made of the number of messages handled and stations on the DX schedule who have done such efficient work should make these reports to the Dist. Supt. on or before the 20th of each month.

The report of Mr. Francis Baer, Dist. Supt. for the Dist. of Columbia, shows that there has been considerable advance made in the last few months in Washington, as was evidenced also by the large attendance of Washington amateurs at the recent Third District Convention in Philadelphia.

There are four stations that have been working DX regularly during the past month, namely, 3KM, 3XF, 3IW and 3ALN, and considerable traffic has been handled. DX communication has been carried on in all directions without difficulty, including Baltimore stations, and it has been a pleasure to note that hardly a single night has passed recently that some one in the District has not worked DX. During the period Jan. 20 to Feb. 20, 3KM did the most consistent DX work. 3XF has been in daily communication with 8RQ since the early part of the last month with few exceptions, and has handled messages with a number of stations beyond a radius of 175 miles. While no definite DX schedules have been established with Washington, traffic has suffered very little delay by reason of its stations failing to be "on the job".

Total messages, 628.

ALASKAN DIVISION.
Roy Anderson, Mgr..

At present there are only three licensed amateur radio stations in Alaska: 7EP, Unga; 7IP, Klawock; and 7IT, Ketchikan. 7EP's location makes it impossible for him to communicate with either of the other two until more stations are constructed to form a route or trunk line. 7IP has a dandy quarter k.w. with which he should be able to communicate with 7IT, who contemplates puting in a half k.w. spark or C.W. Should communication be established between these two stations, it is believed that it would not be a difficult matter to establish a route extending thru southeastern Alaska, at least. The thought uppermost in the amateurs' minds, however, is communication with the "states." Were there stations in British Columbia, it would not be a difficult matter to get a message thru, but as far as the writer knows, there is no such station. It is therefore necessary for some southeastern Alaska station to construct a set capable of doing at least seven hundred miles, in order to reach Seattle. This can probably be done, although it may only be possible in favorable seasons.

It is the writer's belief that there are amateurs in Alaska who operate receiving stations only, there being no one in their vicinity with whom they could communicate. An attempt is being made to get in touch with these amateurs, in order that some half k.w.'s, at least, will be making Alaskan amateur radio traffic a realization, and not an ambition, as it is NOW.

This report is, necessarily, short and shows general inactivity on the part of Alaskan amateurs, but it is hoped that only a few more of this type will have to be made.

NEW ENGLAND DIVISION.
G. R. Entwistle, Mgr.

Johnson (1DY) of Lynn reports everything going well in his section except for the persistence which some of the strictly local men keep calling the DX stations. There is a queer sort of QRM in Lynn which sounds like a static machine which goes all evening until twelve midnight. 1DY handled 220 messages with a total of 2410 words, relaying mostly thru 1PAW, 1RV, 1DAC and 1FF.

1HAA handled 147 messages.

1CK handled 160 messages and 1CY, Oliver, of Braintree, who was handling most of CK's traffic during the week, relayed about 200 messages.

Mr. Furlong (1FF) reports conditions around Boston as favorable for the month of February.

1BV, using a small tube transmitter and not much over half an ampere in the an-

tennae, has been able several times to break thru and handle traffic with the Second District.

Boston amateurs came in for a great deal of publicity during February, 1FF enjoying the sensation of seeing his set and himself on the front page of a local paper, the Boston Traveler. This newspaper is now running a column devoted to radio, keeping local men posted on all matters of interest.

1FV of Portland is handling most of the traffic for his section with Boston.

Mr. Pollard of Burlington, Vermont, reports 1RAY, the station of the University of Vermont, as handling a great deal of traffic for the northern section, clearing thru 8QJ, 9FN, and 1FV.

1TS has been able to clear some traffic from the Canadian stations, 3BP, 2CI, and 2AK during the past month. 3BP in particular is very strong there.

Total messages, 1223. Busiest station, 1DY, 220 msgs.

ROANOKE DIVISION.
W. T. Gravely, Mgr.

Relaying in the Division slackened up to some extent during the past month, but interest is very keen, and we may expect a revival in traffic for the next few weeks to come.

There are several points in the division which have failed to develop as the manager had hoped, and as a result, our daylight line is still in the making—not yet an existing fact. However, with a little extra effort here and there we may be sure that the daylight routes will be worked out during the coming months. The summer affords the ideal time for experiments along this line, for as a rule QRN holds sway during the hot sultry nights, and operation is almost impossible, whereas, in the day the ether is comparatively quiet and in addition QRM is usually nil.

The best work of the division during the past month has been done by those stations on the Virginia Seaboard, with the Northern West Virginia Stations a close second.

Reports from Mr. F. L. Bunker, District Supt. North Carolina, are very encouraging. He says there is a new station at Sanford, N. C., which is being operated by Mr. R. O. Holland; another at Asheville, which is being operated by Mr. E. A. Jackson, and others under way.

Mr. White, City Manager, Norfolk District, states that Mr. Kubiac, 3VV, in spite of a burnt out transformer and rotary gap, has been carrying on with a home-made quenched gap and a borrowed transformer and has been handling traffic with this temporary equipment.

Messrs. Hopkins and Buskey of 3GO have handled quite a lot of traffic this month. They are working on a synchronous gap. There are now three operators at 3GO, Mr. Hopkins, signing "LH", Mr. Buskey, signing "CP", and Mr. Rosenthal, signing "BZ", with his perfect fist.

Mr. Gilpin of 3AB has been spending his time in perfecting a synchronous gap, and hasn't handled much traffic during the past month. Mr. Herndon, 3FG, has had his hands full with his duties as Chief Inspector for the Independent Wireless Tel. Co. at Norfolk, and has had very little time to devote to his set. Mr. White, 3EN, has been going regularly, and has handled a number of messages, but less than the preceding month.

Mr. Wohlford, 3CA, District Supt. South-West Va. District reports progress in his section, with some traffic being handled.

No report from Mr. Blair of the Central Virginia District.

3BZ has been at the key very little since the 1st of January, due to the pressure of business affairs and physical disability, but at that, a number of messages have been handled.

Mr. Heck, 8EF, Mannington, W. Va. states that 8SP is still the star in his locality, handling most of the traffic going through Northern West Virginia. Mr. Heck reports many new stations under way, and is very optimistic over his daylight line down into Virginia.

Link up fellows, for the summer operation.

Total messages, 150.

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

The past month has probably been the best for relay work that the Ontario Division has ever had. It has been marked by the large number of new C.W. stations coming into operation, as well as the successful attempt to increase efficiency on the part of the spark stations.

In the Toronto district, a very interesting development has taken place. Newcomers in the wireless field, in graduating from the spark coil stage to more powerful apparatus, have installed C.W. sets in place of the usual spark equipment, with very satisfactory results both to themselves and to those who must perforce listen to them. The great difficulty from a relay point of veiw now seems to be that border stations do not as a rule listen for C.W. stations and hence it is almost impossible to get in touch, for traffic.

Southeast Ontario seems to be booming along with possibilities for good work from Kingston, Belleville, and Peterboro. Quite a volume of traffic is being handled between Kingston, Napanee and Belleville. A one-way service has been established at set times each week between Toronto and

Napanee, for the forwarding of relay traffic. A similar service will likely be established with Brantford, and possibly Windsor.

EAST GULF DIVISION.
E. H. Merritt, Mgr.

The progress being made with traffic toward Florida is the outstanding feature this month. 4FD has been taking traffic going south and giving it to 4AM who is working 4DL, 4CS and 4BI. There will soon be a station in Key West, 4BO, and with the addition of a few more good stations we will have a fairly dependable route. A good station between 4FD and 4AM is badly needed and one in Jacksonville would surely help out in that respect.

Old 4AT, now 4ZN, has at last shown signs of life and is working hard to get the Florida stations together. Mr. Gulledge is D.S. of Florida and has appointed Mr. Winford Brown, 4BI City Mgr. of Miami, and Mr. R. M. Robbins, 4AW, City Mgr. of West Palm Beach. Mr. Gulledge would like to hear from good stations in Tampa and Jacksonville.

South Carolina still answers roll call with one station, 4EG. He has been unable to do transmitting recently on account of power troubles. He reports that there will soon be another station in Woodruff.

Mr. McIlvaine, D.S. of Alabama, reports a little more progress made in his district. Two good stations have been opened in Birmingham. It seems an impossibility to get Alabama stations to answer letters. Have all the licensed amateurs lost interest and quit the game? There are stations being erected in Montgomery and Marion but no definite word has been received from the yet. 5XA is doing good work and is still the main station in the state. They have never been able to clear traffic to or from Georgia stations.

For Georgia, only reports from 4XC, 4FD, 4AG and 4YA have been received. 4XC has been doing the best work in the state lately. 4FD is a new man but is rapidly becoming known and is in a position to clear occasionally to Florida. He is the ONLY man we have found that can work the Florida stations at all. 4YA has been on the line for a few nights this month and has made a very good showing. 4AG is still doing good DX work but is still unable to connect with Atlanta and other close stations.

Total messages 157.

DELTA DIVISION.
J. M. Clayton, Mgr.

The weather during the past month has been rather adverse for good work; however, traffic has been going thru the division in its usual style. 5YH, 5ZP, 5EA, 5JD, 5JE, 5YE, 5ZK, 5ZS and 5DA continue to be practically the only stations in the division doing DX work. Thru the forced absence of 5ZL, 5YH has had more than his share of the burden of traffic, having handled something approaching 300 messages for the month.

5EA and 5JE continue to reach out in good style, and 5JE is batting them out like an old timer. Over 5JE's oscillation transformer hangs a slogan "We Never Sleep" and deBen 5ZP says that he never sleeps for the messages coming from 5JE "To: Grace—, signed Francis". At least we know they aren't the "greetings-via-wireless" kind, for there are too many of them. 5ZS has been rather silent during the past month, but every now and then comes on and works a few. Come on, Anthony, get back to that set like you used to.

Tulane University, at New Orleans, has a station under construction and will be ready for work in a short time. This station will be used mainly for research work, but will take part in intercollegiate communication and relay work.

5ZP continues to bust 'em out, and lately has been working up a C.W. set.

5DA has not been heard from in some time, either via radio or mail. It is presumed that business pressure has kept 5DA away from the set.

5YE, University of Mississippi, has started a steady schedule with several operators on which, and is handling considerable traffic.

A new station at Arkadelphia, Arkansas, 5MA, has just been opened up, and already has worked several DX stations.

It is VERY important that ALL stations in the Division send in their reports of traffic to Traffic Chief Greenlaw by the 23rd of the month, at the latest. As stated before these reports should include a list of stations heard from the 15th to the 15th; a station report showing the three most consistent stations heard in each district and the three loudest stations heard from each district, and a report of the total number of messages sent and total number of messages received. It is very important that these reports be sent to the Traffic Chief, as the Division Manager gets none of this information and if the Division is to be counted in in the total number of messages handled thruout the country, the Traffic Chief's report is the only means we have of being represented. It is also important that each station sends in his report to the next official in the Division so that the Monthly report for QST may really be informative of the work being done in the division.

Busiest station, 5YH = 300 msgs.

NORTHWESTERN DIVISION.
J. D. Hertz, Mgr

The D.M. has just completed a short trip thru the Puget Sound district, visiting several of the DX stations in that part of the country. An enjoyable day was spent in Seattle, and another in Tacoma. The later included an auto trip to station CL1 at Camp Lewis, and to 7YS at Lacey, thru the courtesy of Miss Dow, D.S. at Tacoma. Among the other stations visited were 7AD, 7BK, 7BC, 7CB, and 7CE.

Canadians 5CP and 5AK are reported QSA in Seattle, and the D.M. had the pleasure of listening to 5CP's 360 cycle synchronous spark at 7BK. This spark is not uncommon at Canadian stations, and aboard Canadian ships. It seems to be a spark that would go well in short wave work. Mason, D.S. at Seattle says, "Now that we know there are Canadian amateurs on the job, all that remains is to connect up with them." And he assures us that every means available will be taken to accomplish this end.

A radio association has been organized in Seattle. This is a re-organization of the pre-war Puget Sound Wireless Association. Technical matters rather than matters pertaining to operation will be discussed at the mettings, for the most part.

Two routes are now open thru Montana, one of these being via 7YA to 9YW, and the other being via 7CC to 7ZG or 7EX to 9WU or 9EE. Both of these routes are handling an ever increasing amount of traffic.

7CC reports that 7MA of Spokane, using a DeForest phone, is heard at Moscow, and should prove to be a very valuable relay station in opening up this district which to the present time has been "dead to the world".

7IN has been doing about the best work of any of the stations up the Willammette Valley. He is luckily situated in that he is able to work Seattle and Tacoma stations, which is very difficult from Portland. 7GQ of Eugene is reported good in Seattle, and 7CN is QSA there, but neither of these stations are heard with regularity in Portland. Both of these stations get south fine.

Portland is represented by some ten or a dozen stations, the more notable ones of the past month being 7ED, 7DS and 7JW on short waves, and 7ZI and 7ZB on long waves. 7DA, 7BP and 7ZB have gone out of commission temporarily.

Vancouver is well represented on short waves by 7BJ and 7ZJ, while 7ZK and 7ZJ hold down the long wave end of the ether. 7ZK, 7ZI and 7ZB have worked 9YW. 7ZI and 7ZB held a test over a period of a week with a ship bound from the coast to the Hawaiian islands. The operator writes back from Honolulu saying that he believes that were it not for the NPM arc "mush", he would have been able to have heard both stations all of the way to the dock in HU harbor. As it was, they were heard a distance of a little over 1900 miles.

Total messages 331. Busiest station 7CC =256 msgs.

DAKOTA DIVISION.
Boyd Phelps, Mgr.

Since the Transcons relaying has increased to a larger amount than ever before. Traffic over the Northern Route has been moving in large proportions which makes it necessary for the few stations covering the jumps to be on the job all night nearly every night. 9WU at Ellendale, N. D., handled 172 msgs in the last fourteen days and traffic is still increasing. Mr. Leavenworth, 9WU, deserves a grat deal of credit for sticking to his job every night until the hook is cleared and often works into daylight. He clears west with 7ZG mostly but at times with 7CC, 7EX, KDIB, 6WV, 6ZH, and 9YW. Part of his eastbound traffic is cleared south and part to 9XI, 9HM and 9ZT, depending on conditions. Another good station in North Dakota is 9EE who unfortunately is also in Ellendale but who runs 9WU a close second.

We are safe in announcing at this time that any quantity of traffic can be handled to Winnipeg, Manitoba, if routed so as to reach either 9WU or 9ZC. A new station OFN at Pembina, N. D. has been handling traffic between 4BG and 9AGN so constant communication is assured. We welcome your Canadian traffic.

We note with great rejoicing the springing up of stations in the smaller towns scattered about the Division. District Superintendents are working to get these stations lined up for branch routes and plans are being made for the routing of summer traffic. A great effort will be made to keep traffic moving in shorter jumps all summer. Stations who have not yet heard from their District Superintendents should write him and find out his plans for relay routes as there are still large areas where no stations can be located. Any station owner in doubt as to which district he is in or who to write to should write directly to the Division Manager whose address for mail is 3344 First Ave., So., Minneapolis, Minn.

Total msgs 706.

WEST GULF DIVISION.
Frank M. Corlett, Mgr.
Raymond L. White, Asst. Mgr.

Our report, while rather interesting from a traffic standpoint, is by no means complete. A complete report cannot be made

up unless we have the material from which to make it, and this material can only be furnished by the station owners in the field. If you station owners do not report the amount of traffic handled to your City Manager, Asst. Dist. Supt., etc., and they in turn make their reports to Division Headquarters, we of course can not make up a report that is true to the conditions throughout the division.

Co-operating with the Dallas Police Department, 5ZC and 5ZG, are sending Police Broadcasts, information furnished by the Police on crimes, stolen automobiles, etc. These broadcasts are being copied and delivered to other police departments by some 20 to 30 out of town stations. We want more out of town stations to copy these broadcasts and be sure and let us know that you are copying them so that due credit may be given your station. Broadcasts are sent as received from the Police but are repeated on a regular schedule by 5ZC at 7 and 10 P.M. 375 meters.

District Supt. Dill of Oklahoma sends us his first monthly report and for a starter it is indeed good; weather conditions in Oklahoma for the past three weeks have not been good, but traffic is going through splendidly just the same. From Oklahoma City, traffic passes east through 5JD and 5YH, and north it seems to go well through most any station. Oklahoma stations are handicapped in handling state traffic due to signals swinging very badly, but tests are being made continuously. 5JS and 5HK have been doing some fine DX work.

Asst. Dist. Supt. Selby, of Muskogee, reports conditions in his territory are encouraging, 5BR will soon be on the job again with a greatly improved station. 5LO of Miami, is doing good work, being reported QSA by 9ZC at Baudette, Minn.

A.D.S. Schonwald of Blackwell sends in his resignation, account other duties permitting no extra time for League work.

All station owners who have not done so, kindly get in communication with Mr. Dill, Mr. Selby or Mr. Poor and get lined up with the A.R.R.L. and let's get things moving fast and in a more satisfactory manner.

Dist. Supt. Falconi, of Roswell, reports that traffic is going through on all routes without any difficulty, and total number messages handled by 5ZA this month 215. Also correct last month's report to read 494 messages handled by 5ZA instead 247 as previously reported, as relayed messages only counted as one instead of two.

Dist. Supt. Tilley of the Southern Texas District reports encouraging for the Austin Texas Territory. Several new stations have made their appearance on Trunk Line F, completing the route to San Antonio with a branch. The Austin City stations are busy doing much daylight work and keeping the air busy almost continuously, stations 5JA, 5EJ, 5BO and 5ZU doing the greater amount of relay work. Traffic with Houston direct is still impossible due to bad QSS, and our only come-back is dear old 5XB for a relay both ways. Houston Territory handled a total of 537 messages.

5ZR, 5KQ, 5IO and 5GS, all of San Antonio, afforded a reliable outlet to San Tone, through New Braunfels, and it is believed this line can work all right the year around. San Antonio stations will QRX the first five minutes of the hour and half hour to co-operate with 5UJ and will be open for traffic work after 9 p.m.

A.D.S. Martin of Amarillo sends in a list of quite a number of amateurs that he is trying to get in shape to do effective work as soon as possible, and states that stations consistent from his station are: 5BI, 9AEZ, 6IG, 9LR and 9EL.

Dist. Supt. Heafer is back from his honeymoon.

A.D.S. Henry Harris of The Waco Texas Territory reports stations have been located at Temple and Hamilton, and look very encouraging, especially the former, as he will be of great help to us on Trunk Line "F". Three new stations have opened in Waco, namely: 5GG, 5CC and 5FB.

Guy Neel, 5LR, Dublin, Tex., reports traffic going through in great style.

Reports from Asst. Dist. Supts. Pierce and Dorsa are missing.

Total messages 1216. Busiest station 5JA, 150 msgs.

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

It is seldom that the District of Northern Indiana leads this report, not because of ability there but largely because of an unfortunate paucity of stations. This month, however, we are giving this District first mention because of the splendid spirit shown by its D.S. Mr. H. H. Moore of Elkhart, Ind. Mr. Moore has been extremely ill for the past month and in fact has been so sick that he has been unable to write letters personally. Nevertheless he has kept his organization going, carrying on his correspondence through others and has submitted an excellent report covering the activities of his District during February. Mr. Hutchinson, A.D.S. Northern Indiania, has been co-operating with Mr. Moore very closely and reports for March should be sent to him. Several of the stations in Northern Indiana which have been out of commission for the past month are again operating, among which is 9ME. Other stations which have been

(Concluded on page 47)

Determination of Resistance, Inductance and Capacity by the Wheatstone Bridge Method

By Julius G. Aceves

Research Assistant to Dr. M. I. Pupin, Columbia University

Presented before the Radio Club of America, October 22, 1920.

IN order to understand the behaviour of circuits, such as used in wireless telegraphy, the first step is to ascertain the constants of the various pieces of apparatus of which the circuit is made up, and their combinations, so that the laws of action and reaction may be properly applied.

In alternating current circuits there are two reactions against the applied E.M.F.; the dissipative, and the conservative reaction. In the first case, energy is transferred in or out of the circuit, and in the second case, energy is merely stored in the electro-static or electro-magnetic fields. The first kind is the result of a RESISTANCE and the second one of a REACTANCE. It is our aim to show how these can be measured in a very accurate and convenient manner.

At the bginning of the Twentieth Century, Dr. M. I. Pupin of Columbia University suggested and used the Wheatstone Bridge with alternating current to determine resistance and reactance and we use it now at this research laboratory as the standard method for measurements with currents of from 20 to 200,000 cycles.

This method of measurement requires three principal devices:

I. A Wheatstone Bridge.

II. A Source of Alternating Current.

III. A Detector that indicates when the bridge is balanced.

I. The Bridge.

The theory of the bridge tells us that in order to have the difference of potential across the detector D (Fig. 1) at all times equal to zero, the resistances and reactances must satisfy the condition

$$\frac{R_a}{R_b}=\frac{R_s}{R_x}, \text{ and } \frac{R_a}{R_b}=\frac{X_s}{X_x}$$

where $X=2\pi f$ or $\frac{1}{2\pi fC}$, produced either by inductance or capacitance. The subscripts denote the bridge arm to which they belong, s meaning standard and x the unknown.

There are various methods of balancing a bridge, but we shall only show the most important ones.

I. Balancing an unknown impedance against an adjustable standard resistance and reactance.

II. Balancing against a fixed standard reactance and adjustable resistance, varying the ratio arms of the bridge.

III. Balancing a reactance by a standard one of opposite sign by a resonance bridge.

IV. Substituting in the bridge already balanced the unknown by adjustable standards.

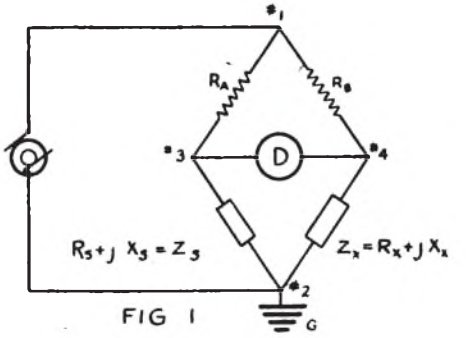


FIG 1

Examples of carrying out each respective method shown above follow:

I. This is a very simple method and accurate when the powor factor of the unknown Z is about 70%, that is, X= R.

Example: To measure a 2 milihenry coil at 25,000 cycles, having about 300 ohms resistance. A variometer is connected with a resistance in arm S as per Fig. 2.

II. When an adjustable standard coil or condenser is not available, then use a fixed one and adjust the ratio $\frac{R_a}{R_b}$ and the resistance R_s.

Example: To measure the effective capacity and resistance of a cable, having a 0.1 mfd. condenser, connect as per Fig. 3 and vary alternatively the ratio $\frac{R_a}{R_b}$ and the value of R_s.

III. If a coil or condenser has a very low power factor, say of 2%, then very serious errors are usually made when using methods I and II without a great many precautions. Then a non-reactive bridge will give excellent results.

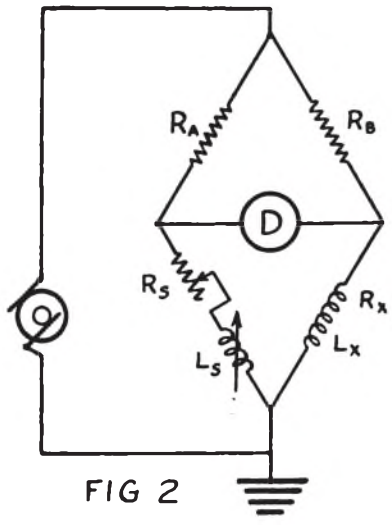


FIG 2

Example: To determine the inductance and resistance of a "duo-lateral" coil. Connect as per Fig. 4, using a standard mica or air condenser. Then

$$L_x = \frac{1}{(2\pi f)^2 C}, \text{ and } R_x = R_a \frac{R_b}{R_a}$$

If f is not known, a standard L_o is substituted for the unknown and the bridge rebalanced with a capacity of C'_s, when

$$L_x = L_o \frac{C'_s}{C_s}$$

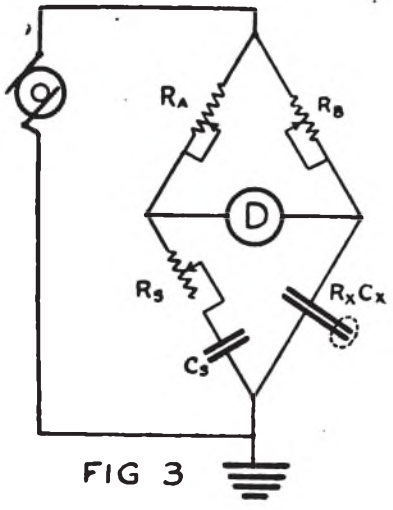


FIG 3

IV. For very small capacities a substitution or differential method is very accurate. (Fig. 5.)

Example: To determine the capacity between grid and filament of a vacuum tube.

Connect as per Fig. 5, balancing the bridge against a ballast condenser C_o which may be known or not. Then close switch (K) and without disturbing anything else, rebalance by means of C_o. The difference is the unknown C.

The principal sources of error are:

A. Electrostatic and magnetic induction upon the detector from any part of the circuits.

B. Stray capacities and conductances across the various standards, and the unknown.

C. Mutual induction and capacity between these pieces of apparatus.

D. Self-induction of long leads and of some resistances of very small value, say one ohm or less, when using low impedances.

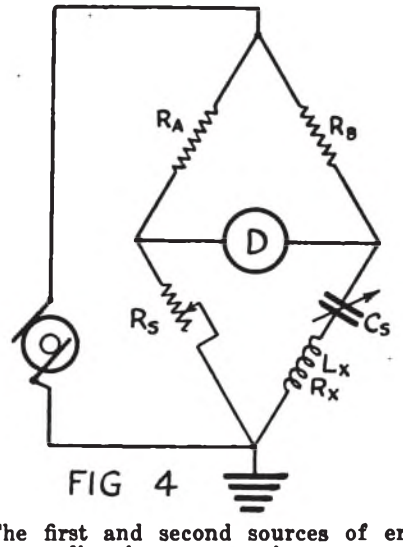


FIG 4

The first and second sources of error are usually the most serious ones. In order to eliminate the first cause, i.e. induction upon the detector, it must be thoroughly screened; but the details will be given when we will show the design of this apparatus.

The stray capacities are unavoidable; they may be made very small and also their effects can be compensated by the following method.

After the best arm ratio $\frac{R_a}{R_b}$ has been selected, the unknown and the standard should be disconnected from corners 3 and 4 (Fig. 1) and a small variable air condenser placed between ground 2, and either

corner 3 or 4 as the case may require, and adjusted until the detector is silent. Then the arm ratio should not be disturbed materially, otherwise a new setting of the condenser will be necessary. The other sources of error may be avoided by skillful selection of the apparatus and of their relative positions, as well as by electrostatic screens suitably located.

II. The Source

The source of A.C. usually is an oscillating audion. It must be such that

(a) the frequency is constant.
(b) the wave shape is sinusoidal.
(c) the voltage is constant.

The oscillating circuit should have a wide range in frequencies and be as free as possible from complicated adjustments. Fig. 6 illustrates a circuit in which these conditions are practically fulfilled.

Two audions are used, and the feed back is obtained by means of a small condenser k, (Fig. 6), made of about 3" of twisted

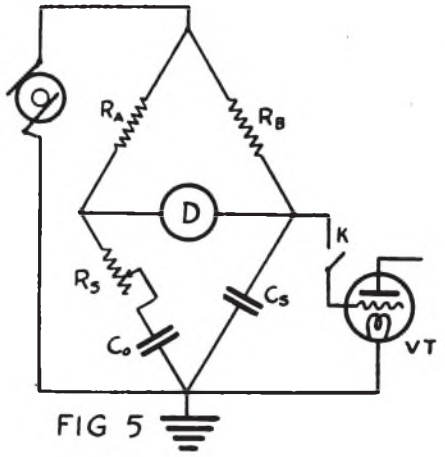


FIG 5

insulated wire. This is fixed for any frequency from about 200 to 200,000 cycles. To vary the frequency all that is necessary is to vary the product LC of the oscillating circuit by adjusting C for various values of L.

A hot wire or a thermo-galvanometer G will measure the A.C. only, as it is in series with a condenser, and may be calibrated in volts. Across its terminals the bridge may be fed directly or thru a potentiometer to reduce the voltage.

In order to secure constant frequency without having to regulate closely the filament current and plate voltage, certain relative values of L and C for a given frequency should be used. By experience we found that it for a given product LC we select C=2L, L being in henries and C in microfarads, the frequency will remain constant within 1% for a 100% change in plate voltage or about 25% in filament current. The assumption involved is that the coil should have a reactance at least 20 times its resistance.

III. The Detector

The detector consists of a receiving set specially designed so that it is:

(a) Responsive to nothing else but a difference of potential between corners 3 and 4 of the bridge.
(b) Selective.
(c) Sensitive.

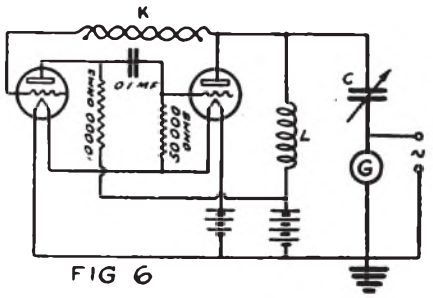


FIG 6

The first condition is of the utmost importance, otherwise misleading balances would result, introducing errors at times of many hundred per cent.

If the detector is selective, it is not necessary to use a pure sine wave for the test, as the detector would be unaffected by the harmonics.

Fig. 7 shows a detector for radio frequencies employing no amplifiers.

Here is a small inductance coil L_1 with a corresponding condenser C_1 (Fig. 7), joined to Corners 3 and 4 of the bridge, (Fig. 1), and becomes the primary of a regular autodyne receiving set. The only difference from an ordinary set is that it must be all enclosed in a metallic box of rather thick walls so that no electrostatic field may disturb it. A peculiar screen, S, is used between the primary coil L_1 and

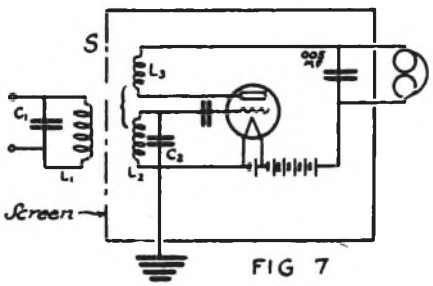
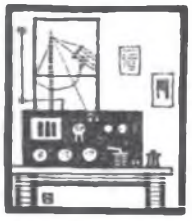


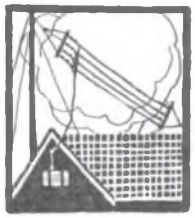
FIG 7

the secondary coil L_2 connected to the grid, to prevent electrostatic action and to permit the magnetic field to act upon the detector. This screen may be constructed by pasting tinfoil on a thin board and cutting slits to prevent eddy currents. The tinfoil and the metallic box should be

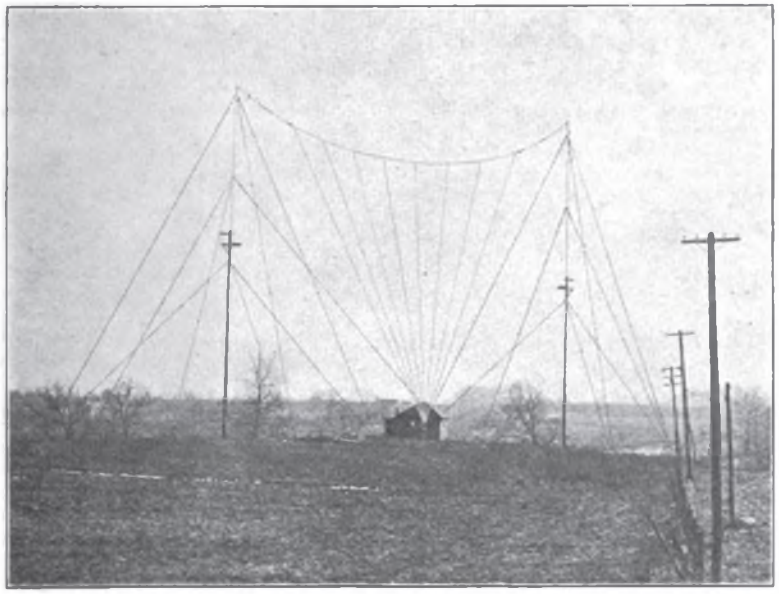
(Concluded on page 48)



Amateur Radio Stations



8ZR, MANSFIELD, OHIO



The Radio Club of Mansfield was organized in June, 1919, C. S. Fernyak being elected secretary-treasurer and C. C. Endly president. The members decided to pool their apparatus and contribute $250 each towards the erection of a real station. 8ZR of today, formerly 8HH, is the final result and is a good example of what a club station can be.

8ZR is located in a large open field on the outskirts of Mansfield, which is the highest city in the state of Ohio. The aerial is a vertical fan of eight wires, 110 ft. high, with the station building midway between the two masts. An excellent job seems to have been done of all the outside work. The eight aerial wires are gathered at a large insulator fastened to the top of a stout post in front of the station, with the lightning switch inside a weatherproof box on the side of the post, and with the lead-in running from the box thru the station wall. The ground system is of "Round's round ground" type, consisting of copper plates buried endwise in a circular trench six feet deep and one hundred thirty feet in circumference. (Get that, you chaps: .. ..——.. 130 ft. circumference!) The station is located in the center of this system, and leads of 2-inch copper ribbon supported on *insulators* on short posts run radially to the buried plates. This is our conception of an ideal ground system.

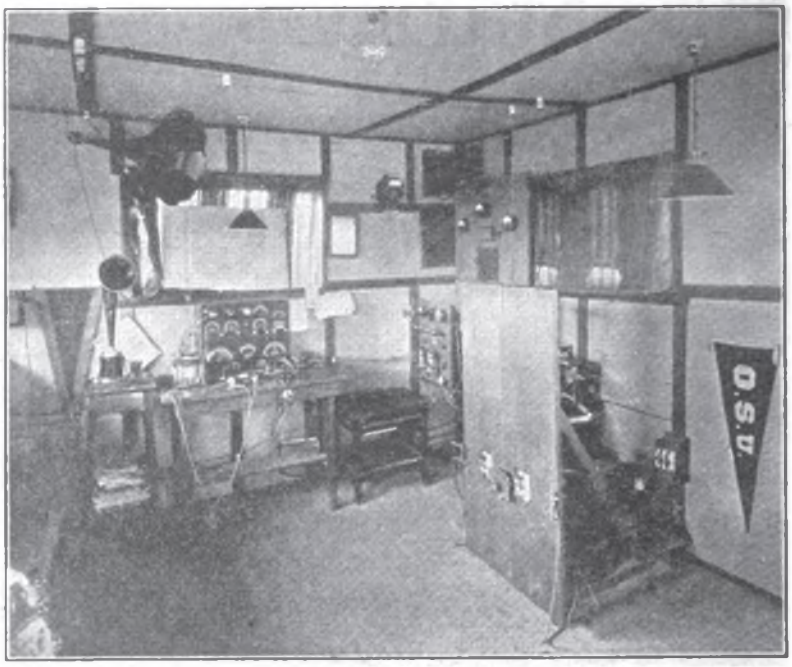
8ZR has experimented the past season with several spark transmitters. The first consisted of the transformer and gap from a Clapp-Eastham Hytone set, with Dubilier .01 mfd. condenser and Thor O.T., which put in the antenna 10 H.W.A. amperes on 200 m. and 14 amps. on 375 m. on about 2 k.w. input. Later with an Amrad quenched gap and the same other equipment 15 to 17 amps. were obtained on 375 m. Since the first of the year the equipment has comprised an American Radio

Sales & Service Co.'s gap and oscillation transformer, Thordarson old-style 1 k.w. transformer, and Dubilier .01 condenser. The input as shown by a Roller-Smith watt-meter is exactly 1 k.w. and the antenna current 11 to 12 hot- wire amperes on 375 meters. All of 8ZR's extreme long-distance work has been done on this last set.

The deForest Type O Radiophone has a voice range of a hundred miles with 0.8 amps. in the antenna, and its CW has been reported from Lawrence, Kan., and Ellendale, N. D.

The receiving equipment shown in the photograph is a Chicago Radio Laboratory's Z-Nith Regenerator and Amplifigon but has since been replaced by similar apparatus manufactured by the American Radio Sales & Service Co.

With the last-described transmitter 8ZR has been putting traffic thru consistently in jumps of up to a thousand miles and has been heard a number of times on the Pacific Coast. On Jan. 19th 6EJ at Walnut Grove, Cal., heard 8ZR twice, six inches from phones and on Feb. 24th 6AK, also of Walnut Grove, heard him all evening long a foot from phones on one step, while on Feb. 14th 7ZJ at Vancouver, Wash., reported him QSA. Which is reaching out, art.



6IG, DOUGLAS, ARIZ.

6IG is one of those few good stations in the sparsely-radioed Southwest where relay fame is naturally thrust upon a good station because the traffic has to go thru and there are only a few to do the work.

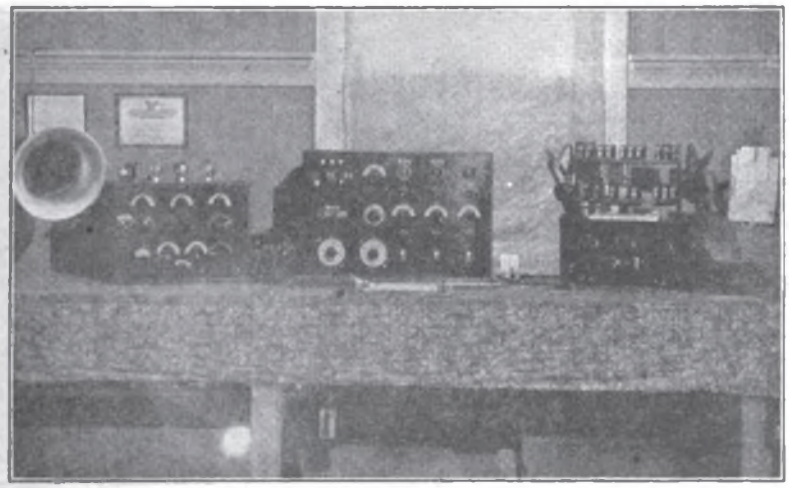
The aerial is a 4-wire T type with a flat-top 70 ft. long, suspended between 70 ft. poles while the ground consists of 1000 ft. of half-inch copper strip buried under the aerial and a connection to buried hot-water boilers.

The transmitter is in duplicate and is located in the cabinet under the table, easily accessible, but unfortunately not showing in the photograph in any detail. There are two transformers, an Acme and a Thor, both 1 k.w., operated by the same key, with a three-point lever switch on each to select either set or to vary power. No other switching is necessary. The two condensers are of .008 mfd. each, home-made of No. 213 Bakelite in oil, three sheets of 1/32" insulate being used between a pair of .005" copper plates, with ⅛" separators between plates to allow oil circulation. The oscillation transformer has a secondary common to both circuits but with individual primaries, each consisting of a single turn of heavy ribbon mounted on top of its condenser, with one end connected to the center point between the two condensers and the other end con-

necting (thru the rotary gap) to the outside terminal of the proper condenser. Only one rotary is used, a Hyrad, a gap across two teeth being used on either side for the respective primary circuits. The gap is enclosed, with glass windows, and runs 3600 r.p.m. At the gap speed used the antenna current with the Acme is 5 amperes, and with the Thor 4.5 amperes, input 1020 watts, current readings made on a Jewell thermo-couple ammeter.

A rotating aerial switch starts the gap motor, "puts juice on the key", turns out all amplifiers, selects long or short wave receiving set or radiophone, and in its off position grounds the aerial, all without complication in wiring or lengthening connections.

The receiving set in the photo is made of deForest equipment, with four steps of well-behaved shielded audio amplification, with separate A and B batteries for detector and amplifiers. A new short-wave set has been made up of Radio Shop parts built into a duplicate of a Grebe CR-6, with plug and jack to use the same tube equipment as the long-wave set.



There are two operators at 6IG; Buxton, sine "BN"; and Gooding, "CL". Solid message copy of 6IG's signals has been made by 8IB, Columbus, Ohio, and ships at sea have been worked. The relay work is mainly with 5ZA, 9LR, 9OE, and 9AEG to the east, and 6DP, FD, 6ZN, 6EA, etc., west. Ten hundred and fifty four messages were handled between October and February, which speaks for the volume of traffic passing thru the Southwest.

3AOV, STONEGA, VA.

Mr. S. J. Gundry, Manager of Stores of the Stonega Coke & Coal Co., located in Stonega, Va., is here shown seated at his radio set. We will let him tell his own story:

"About a year ago I learned that I could get time signals by wireless and immediately got busy, purchased a deForest RS-200 Time Receiver, and after a good many ups and downs heard NAA's time signals in May, 1920. As I have been a 'time fanatic' for 25 years you will be unable to appreciate the joy I expected when the signals were first heard. No one (unless a real bug) can know the convenience of going to your home at several stated intervals each day and getting the correct time, not having to wait on the telegraph system, fearing the wires are down, no connections made at relay points, operators using the wire, etc. It surely is a pleasure to one who desires absolutely correct time.

"In this connection it may be of interest to the amateurs to say a few words concerning time: A watch ticks or beats 5 times a second or 432000 times each day and to keep correct time (by which I mean within two seconds) a watch should be wound regularly; wind it say at nine p.m. or at any other hour. Morning is the better time, if you can. When you have selected your hour for winding, wind it each day or night at this hour or as near it as possible. Keep your watch '12 up' at all times. Do not lay it down at any time, and always fasten it to a chain arranging so that the watch must stand '12 up' in your pocket. At night time leave it in the pocket; do not lay it on its back, under your pillow or on the dresser.

"My watch is *never* in any other position than '12 up', night or day. My best record

to date is 2 seconds gain in 88 days or 10 beats more than actual correct time of 38,016,000 beats. Let's hear from some other time fanatic. I really believe I have a watch second to none in the world.

"After learning the alphabet in May 1920, and getting so much enjoyment, I secured a Penn C Regenerative set, which is giving excellent satisfaction. In fact KDKA concerts and NSF come in so loud, I am having wireless parties every night; of course you must take care of the ladies.

"Having just received my call, 3AOV, am fearful will have to stand off the parties somewhat and get into the real game. I have two antennas, one 75 feet long, 45 feet high, T shape of 4 wires; the other 450 feet long, single wire, 90 feet high. Also have 1KW Acme, Benwood gap, Thordarson oil immersed condenser and pancake oscillation transformer, wavemeter, ammeter, rectifier, voltmeter, Brandes and Baldwin mica phones.

"Have several danger signs, one of which reads 1,000,000,000 Micro-Henries equals 1 Henry—Danger—Keep Away. Lady inquired who is "Henry"?

"Expect to make a few improvements to increase radiation and then for out in the big lot."

2SZ, TROY, N. Y.

2SZ is the station of the Troy Y.M.C.A. Radio Club, affiliated with the A.R.R.L., and illustrated in the following photographs.

The antenna is a 4-wire T, average height 115 ft., 97 ft. long, stretched between two masts two hundred feet apart. The two tin roofs marked X in the photo are made to serve duty as grounds, together with the water supply, drainage system, and steam piping of the building. The station being on the third floor, a short ground lead to earth was impossible.

The transmitter has a 1 KW Thordarson and a 1 KW Blitzen transformer, either of which may be used, a glass plate in oil condenser, 8-point HyRad gap, 2 inch copper oscillation transformer, and Clapp-Eastham antenna switch. Many DX men are under the impression that 2SZ's "juice" is 25 cycles, but it is 40 cycles. Their peculiar warble, however, seems to cut thru average QRM in very good shape. With six inch coupling the antenna current is 4.5 amperes on a thermo-ammeter, with a decrement of .09 on a Kolster decremeter.

The receiving apparatus is home-made and consists of a short wave regenerator, audiotron detector, and Baldwin phones. No amplifier is used at present.

2SZ is operated every Tuesday, Wednesday, Thursday and Friday

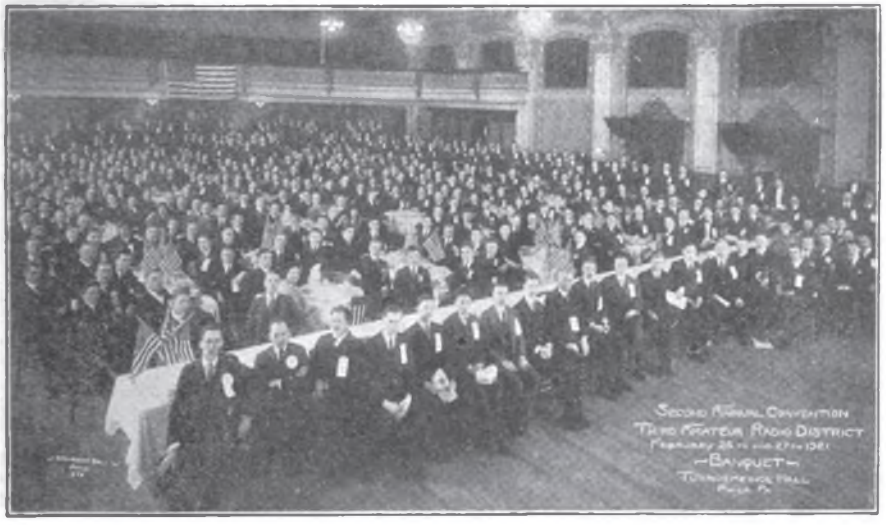
(Concluded on page 47.)

WE have the honor of announcing the affiliation of the following additional societies with the A.R.R.L. as of February 19, 1921:

Colorado Springs High School Amateur Wireless Assn., Colorado Springs, Colo.
St. Paul YMCA Radio Club
St. Paul, Minn.
The QSA Radio Club
So. Richmond, Va.
Tri-County Radio Club
Richmond, Va.
Montreal Radio Association
Montreal, Que., Canada
West Allis Radio Club
West Allis, Wisconsin
Fort Wayne Radio Assn.
Fort Wayne, Indiana
Radio Assn. of the University of Vermont
Burlington, Vermont
Union Central Radio Association
Cincinnati, Ohio
The Morris County Radio Club
Morristown, New Jersey
The Hudson Amateur Radio Club
New York City
Northwestern Radio Club
Detroit, Michigan
Wayland Academy Wireless Club
Beaver Dam, Wisconsin
United Electric & Wireless Assn.
Hagerstown, Md.
Radio Club of Jamaica
Jamaica, New York
Stuyvesant Radio Club
New York City, N. Y.

The Philadelphia Convention.

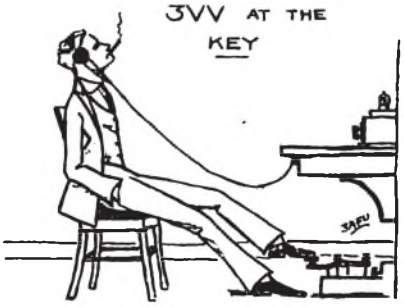
The second annual convention of the Third District, which was held in Philadelphia on the 26th of February, was a great success in bringing all parts of the District together, big delegations being present from Baltimore, Washington, Norfolk, etc., with inspiring enthusiasm. Over four hundred were present at the banquet in the evening, in the immense Turngemeinde Hall, where with the best of good times many fellows who had been working each other thru the air in an impersonal way made friendships which cannot help but result in knitting the whole district together in a spirit of co-operation as could be accomplished in no other manner.



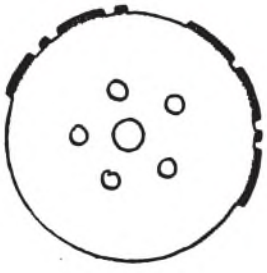
Convening at 10 a.m., an address of welcome was delivered by Dr. Gordon M. Christine, M.D., President of the Convention, to whose untiring efforts much of the success of the convention is creditable. Mr.

K. B. Warner, Editor of QST, responded on behalf of the visitors, and the meeting was then turned over to the delivery of technical papers in a series. which continued without interruption until 6 p.m., many of the gang entirely forgetting lunch in the pursuit of knowledge from the splendid array of talks presented under the chairmanship of Mr. S. Kruse. Some of these papers we hope to secure for presentation in QST.

One of the prime purposes of the convention this year was the institution of some scheme to improve Third District operating conditions. A paper by Mr. R. H. G. Mathews on "The Chicago Plan", late in the afternoon, opened the dis-

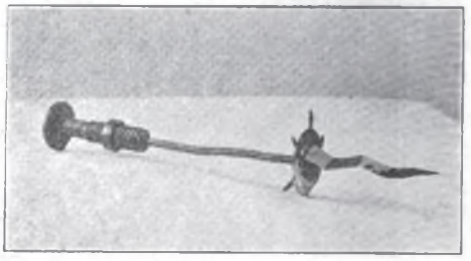


cussion on this question, and the convention went into the matter in open session and with plenty of spirit. After discussion of some of the major aspects of the problem, a representative committee of about twenty-five prominent men from various sections was appointed to formulate a detailed plan and present it to the Convention. This committee had a hard task but the co-operation was good to see and while naturally ideas differed regarding details, nevertheless the large majority were of the opinion that the motto of "live and let live" was a good one in radio as well as in other walks of life, and a plan was adopted by which it is hoped that unnecessary interference may largely be eliminated, and admitting of all classes of stations working in a harmonious manner



KRUSE AT 9:55 P.M. PREPARING FOR 10:00 P.M. QSS TEST

under proper and sensible rules. The plan calls for the creation of The Third District Amateur Radio Council, with officers and a board of governors, and with all the amateurs of the district as members. A district board of amateur inspectors, each in charge of a geographical section, is to be formed, and each is to organize his section by calling together the various interests therein and causing them to elect representatives to form sectional boards which will be empowered to handle local matters. For instance, each club will have two representatives on the board handling affairs in its section, and those representatives can be instructed to look after that club's interests, etc. This organization will be the machinery by which district-wide co-operative measures can be put into effect, and will make possible individual help for those who need it. The plan is not one of punishment or "fines", but of helpfulness.



At the banquet this scheme was adopted by a vote of those present, and the preliminary organization work is already under way. The banquet was an enjoyable affair interspersed with songs, movies, music, and lantern slides, some of which latter, product of The Washington Radio Club, we reproduce on these pages. During the proceedings The Washington Radio Club presented Traffic Manager Schnell with a genuine Rettysnitch, already minus two teeth in a preliminary test of its QRM-minimizing ability, and as our photograph shows, surely a fitting helpmate for the Sacred Wouff-Hong. While the Wouff-Hong acts by leverage, the application of the Rettysnitch is rotary. The Traffic Manager is keeping it unlimbered for any

emergency.

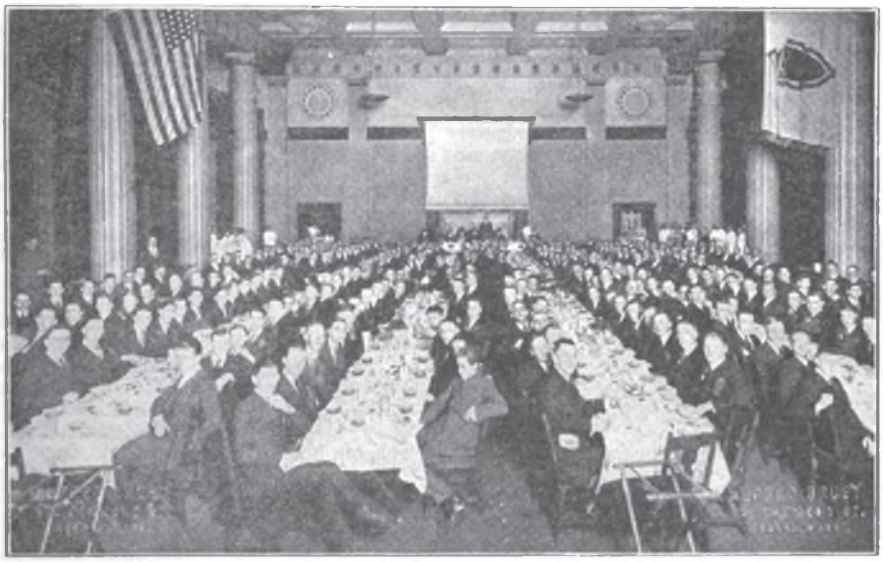
The Convention selected Washington, D. C., as the place for the 1922 Third District Convention, and elected Mr. S. Kruse, of Washington, as President of the organization. From the enthusiasm shown by the Washington and other southern contingents, it is quite evident that the next convention will be a good one also.

Boston Radio Dinner.

A good three hundred New England brass-pounders got together in beautiful Walker Memorial Hall at the Massachusetts Institute of Technology, Cambridge, on the occasion of the annual banquet of the Boston district affiliated clubs of the A.R.R.L. on March 5th, the M.I.T. Radio Society doing the honors. Representatives were there from most of the New England clubs and some of the nearer ones turned out en masse.

After an enjoyable dinner talks were given by Radio Inspector C. C. Kolster, who promised his hearty assistance in any co-operative measures which may be adopted; former inspector H. C. Gawler, who read a paper on power tube operation illustrated with numerous slides; Mr. Hiram Percy Maxim, our president, who incidentally being a Tech graduate of '86 was given a rousing reception by the M.I.T. contingent; Mr. F. S. Dellenbaugh, Jr., instructor in E.E. at Tech; Dr. A. E. Kennelly, known and beloved by all; Dr. V. Bush; and K. B. Warner, our secretary-editor. Mr. Dellenbaugh exhibited thru the courtesy of the Western Electric Co. a Bray movie of the action of electron tube circuits, the electrons whizzing thru the circuits in what we *think* was a most realistic fashion; at any rate it was intensely interesting and carefully absorbed by all. Following the diner an expedition was made to the Tech station, 1XM, where a big variety of equipment was on exhibit and in operation, including a 500-cycle set, a 3-phase quenched gap set, a 5-watt phone, and a 500-watt C.W. set in construction. The Boston Traveler had out a souvenir edition for the banquet, most of its first page being devoted to the affair, and a copy was at each guest's place. (Incidentally, the Traveler publishes three times a week a column entitled "Citizen Wireless", written especially for radio men and edited by G. R. Entwistle, our Division Manager.)

Copies of the photograph of the banquet, 6½ x 10½", can be obtained for $1.00 each from Alfred Brust, 171 Tremont St., Boston.



Houston Radio Club.

The Houston Radio Club of Feb. 12th and 13th held its first annual Banquet and Hamfest with most of the leading south Texas DX men in attendance, Division Manager Corlett thru absolute necessity being absent to the regret of all.

Decorations of a most unique sort were everywhere in evidence, there was a spread of "radio eats" to tempt the most fastidious, and some very interesting contests were held and the winners awarded valuable prizes. The second day of the convention was spent in visiting the various Houston stations.

Mr. F. C. Estey of the Essex County Radio Assn. paid the Houston club a visit recently, and delivered a lecture on club organization which was very helpful. Mr. Estey was voted an honorary member of the club.

We used to have a spare Editorial Goat but it has been annexed by the practice of some folks in talking about how many amperes they radiate. For goodness' sake, fellows, get right on this thing. It's true that in a given aerial and for a given decrement, spark frequency and wave length, the more the antenna current the more the radiation to be expected, but you don't radiate amperes. You radiate energy —which is measured in watts. So say that your antenna current is so many amperes, not that you "radiate" that many amperes.

Fellow dropped in the other day and said he had heard 6BO very QSA. We always told Bill Woods of BCO (now 9ZB) that he had a rotten fist.

"My brother gave me a slip of paper for Christmas on which he wrote 'A Year's subscription to QST. Well, January came around and no magazine, so I asked him where he sent the subscription and he told me he loaned me the two dollars last November!! What the hexx do you know about that?"—U. G. P.

8ZW gets 550 D.C. for his C.W. set off the trolley wire for four bits a month. Doesn't even need filtering. Pretty soft.

Wanted: Quiet room in the country by patient who wishes to cure himself of severe case of KEY-itis. Address—3AHK.

The "Rock Crusher" at 9ZN is still fiercer at close range. Ask Hassel to show you the ear he put against the antenna lead.

In the press and in various radio publications announcement has been made that the call letters "KDKF" have been adopted as a secondary "SOS", signifying that individual life was in danger and medical advice needed. This statement is incorrect. The call letters belong to the Seaman's Church Institute, New York City, on a limited commercial license which is used only between 2 and 10 p.m. for emergency medical service in the case of vessels in the vicinity of New York. There is no authority for using these letters in the general way suggested in the press.

The Radio Corporation of America recommends A.C. in preference to D.C. for heating the filaments of their power tubes, A.C. giving a better distribution of electron emission and potential gradient. When stepped down from a higher voltage, the adjusting rheostat should be in the primary circuit so that the terminals of the secondary may be connected directly to the filament; then with the return from grid and plate circuits connected to the central point of the secondary winding, the circuits will be symmetrical. The filament current should be adjusted to within 3% of the normal value; less than this makes it impossible to get the desired output, while exceeding normal by 3% will reduce the life of the tube by as much as 50%. This is in the case of new tubes. As tubes approach the end of their life the filaments are becoming smaller in cross-section because of the emission, and it is therefore really desirable that the *voltage* across filaments be kept constant rather than the *current* thru them, for as they decrease in diameter it is hardly reasonable to suppose that they can continue to carry the same current.

3UJ (Baltimore) claims to have logged 6DA. Will the young gentleman in Baltimore using that call please step forward? —"The Radio Condenser."

What we want to know is where "The Radio Condenser" got that illustration for their advertisement of the Philadelphia Convention. Kippy, eh wot, ol' deah?

Noticed the silence of 2TF? Mr. Franklin has left amateur radio and is now an operator at the Belmar station of the Radio Corporation. Recollecting that mean swing, we think possibly the ops on the other side are fortunate in having Franklin receiving instead of transmitting.

Got an aerial fastened to a tree? Run the rope thru a pulley fastened in the tree, with a heavy weight on the end of the rope, and it will take care of itself when the tree sways in a wind storm.

Lines to Miss M. A. G.

Oh Lady Bug! Dear Lady Bug!
If it could only be
That all the girls were just like you,
So quiet, friendly, frank and true
And yet could laugh the way you do—
They'd make a hit with me.

But when I mention Radio—
That fascinating game—
To any other lady-fair,
She'll wiggle, giggle, pout or stare
Or turn her back and fix her hair;
The poor benighted dame.

Now with you, friend, its different;
You're 'there' in every way.
When e'er talk this wireless stuff
You hold you own without a bluff
And never seem to hear enough.
That's what I call 'OK'.

And when you start to slinging code
That's when I like to be
Asittin' with my bulbs alight,
The pencil flying, phones clampt tight—
Say! I could listen half the night
When you are at your key.

Now, as I mentioned just above,
If all the girls could be
As nice as you, and use their heads
For other things than millin'ry spreads
And paint displays in creams and reds,
They'd sure appeal to me.

Johnny Clayton of 5ZL has been down with appendicitis but is now rapidly recovering and soon will be working the Canadian stations as well as ever. Here're our best wishes, Jawn.

The Magnavox Telemegafone has been redesigned for the amateur field and is now offered under the name of the Radio Magnavox at half the old price. It is built on the same electro-dynamic principle as the type R-1, the difference being in the winding and construction of the field. It operates on field currents of from 0.5 to 1.75 amperes instead of the much heavier current required by the earlier type, which means that complete saturation is no longer necessary and amateurs may run the new Magnavox on 2, 4 or 6 volts as they desire. With such a good loud-speaker at a reasonable price, we believe they will be very popular.

A competitive examination will be held beginning April 25th for the filling of 2585 vacancies in the grade of second Lieutenant in the Army, of which vacanices 114 are for Signal Corps appointments. Practically the equal of a B.S. degree in electrical engineering is required. Application blanks and further information can be obtained by request from the Commanding Officer of the nearest military post or station.

2CT, in trying to find the trouble with his round system, discovered that six feet of an exhaust pipe to which he was connected was made of rubber hose! Wasamatterwasamatter?

Chicago's twenty-two high schools are being equipped with radio. The Chicago Radio Laboratory has the contract for several of the installations.

Mr. Philip R. Coursey, Ass't Editor, "The Radio Review", 12-13 Henrietta St., London, inquires whether members of our League have heard signals from the Air Ministry's station in London, call letters GFA, and requests that anyone interested listen for these signals. Meteorological and other bulletins are broadcasted on 1400 meters, C.W., at 9:05 p.m., 3:05 a.m., 4:15 a.m., 9:05 a.m., 2:05 p.m., and 3:00 p.m. daily, Eastern Standard Time, and also at 4:35 a.m. and every hour thereafter until 1:35 p.m., E.S.T., on 1680 meters. Please report reception.

Has any QST reader constructed a satisfactory audibility meter? If so, the Editor would be very glad to have a description of its construction, as several A.R.R.L. members have recently inquired about the matter.

The Army Air Service, realizing the importance of radio, has established a school for training personnel to install and operate equipment on airplanes at the various flying fields. Their latest bulletin indicates that they are looking for help, and experienced amateurs may qualify for attendance at this school upon application to any army recruiting officer or to the office of the Chief of Air Service, Washington.

"Salvaged" Air Service headsets built in a helmet come in pretty handy when an amateur operator is troubled by what is known as "domestic QRM".

There are two methods of securing a sufficiently negative bias on a detector grid to make the tube operate right: either the use of a battery or drop across the filament rheostat to directly polarize the grid, or the use of a grid condenser and leak which accumulates electrons collected by the grid and permits their leakage at a definite rate and so establishes a definite bias. While either method may be used satisfactorily on undamped signals, we wish to point out that for the reception of spark signals the advantage is altogether with the condenser-and-leak method. Where the bias is obtained by an impressed

potential, the tube detects because of the bend in the characteristic curve, while with the condenser the action occurs thru an accumulating charge from the rectified oscillations of the incoming wave train and will take place at any place in the curve and has a much greater effect on the plate current than simple operation at a bend in the curve.

In certain gaseous tubes no leak across the condenser is required. This is because in such tubes the charge leaks off thru the electrode supports within the tube or is given up by ionization.

Gems from examination papers of a radio instructor in an army school during the war:

"Audion: A glass bulb filled with vacuum".

"Logarithmic decrement is the appearing logarithm" ... etc., for "Naperian". "Decrement is caused by corona", which may be truer than he knew.

"The telephone is composed of a hard rubber coating. Inside this coating is a diaphragm made of some special kind of rubber, which is acted on by a permanent horse magnet".

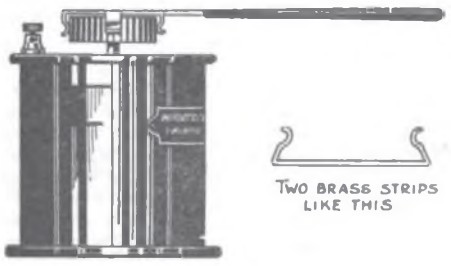
"The specific gravity can be found by the use of a galvanometer".

E.M.F.: "Electrive Motor Force".

References to "hot wave meter", "hot air ammeter", "cat-tail detector", "Lydite" as a rectifying mineral, etc.

At the St. Louis Convention Mr. M. B. West started us all thinking with a number of startling ideas on spark transmission. There are many things that we don't fully understand in our operation, and our conventions are excellent places to discuss these things. In September we are going to have a big national convention in Chicago. Can't we get up a list of our problems in time to arrange for talks on these subjects by qualified men? We can, if you fellows will submit the questions to QST.

9AMU sends us this idea for a long removable handle for a condenser. Two



strips of spring brass are bent to grip the knob, and a handle may be made of thin bakelite or wood.

WOULDN'T IT BE WONDERFUL—

If it didn't take people so long to learn not to call everybody they hear?

If your best girl was an operator and nobody but you could understand her?

If the other guy seemed to need his sleep worse than you did, and would go to bed instead of sitting you out?

If we could go to a meeting of the I.R.E. and get some actual constructional details instead of being drowned in a sea of higher math?

If those .05 decrement, 600 meter transmitters were not heard on 200?

If all income spent on radio apparatus was exempt from income tax?

If these DX birds who call fifteen times would sign off before they fade?

If 3YG wouldn't break up Arlington's weather report with his QST?

If the Fifth District would have a convention?

If 9UQ would give music lessons with that rotary?

If all relay messages were handled as quickly as the Transcons!

If some of our fone stations would play their music to *themselves* for a change? (Amen!)

If 2DR would stop calling nines long enuff to see what's happening on the air?

If all newspaper reporters took interest in amateur wireless and reported results with the same accuracy that S. W. Smith of the Hartford Courant does?

If 5ZP could explain how he gets six thermo-couple amperes on ½ k.w.?

If 6CH and 6OC would stop arguing about which one causes the most QRM in Los Angeles?

If 1JQ and 1UAV were pinched for carrying concealed bricks?

If Grebe would give a regenerative receiver for fifty soap wrappers? (But what bug finds time to wash?)

If 3IY would go to work?

If a pair of Murdock phones could be put on with one hand?

If oatmeal was put up in Bakelite boxes?

If a hairdresser could give a radio set a permanent wave (sharp one, we mean)?

If Bakelite didn't smell like a hospital?

If amateur stations in general and 3DH, 3AHK and 8ARW in particular would take a nap during church services from KDKA and give the parson a chance to get *his* traffic thru?

If compensated CW artists would tune to maximum with closed key, so their backwash wouldn't be so many times more QSA than their signal?

If 1HAA could hear all the stations he broadcasts traffic to?

If Brother A. L. Groves could have a transmitter?

If we all had time-pieces as accurate as 3AOV?

2SZ, TROY, N. Y.

(Concluded from page 40)

night, the Chief Operator being E. M. Williams, and the others L. S. Inskip, J. A. Lynd, and D. H. Harris, all students at Rensselaer Polytechnic Institute.

In fifty nights of operation, with a single tube, over 300 DX stations were copied, 9LR being the farthest, and 100 DX stations were worked, 9JN, Ames, Iowa, being the most distant.

OUR GOAT.

(Concluded from page 26.)

knew for a fact that there were hundreds of you chaps on and just itching to work. But you did not, and we put the biggest thing across that has ever been attempted in amateur radio. It was just thrilling, and entirely aside from the superb engineering feat represented it was a demonstration of ORGANIZATION and that good old A.R.R.L. SPIRIT of co-operation. It was perfectly splendid, and when anybody says he never heard of the A.R.R.L. it gets our goat.

THE OPERATING DEPARTMENT.

(Concluded from page 33.)

handling the bulk of message traffic in this District are 9HR, 9FS, 9ALY.

Mr. R. D. McCommon, D.S. of Eastern Ohio, has been endeavoring to line up C.W. stations for C.W. relay routes to various parts of his district. Several stations in this territory are equipped with excellent tube transmitters. Among these are 8FD, 8JU and 8ZG.

Mr. McCommon is laying plans for summer daylight routes and at present is in need of a good station to relay between 8FD and 8ZE. Stations so located as to be suitable for this purpose are requested to communicate with Mr. McCommon.

Cleveland, Ohio, has been working very hard to perfect an organization and has succeeded in wonderful style. During the first fading tests a report was received from the Bureau of Standards to the effect that absolutely no curves of any value were received from Cleveland because of the local interference situation there. Since that time the situation has steadily improved by the efforts of Mr. A. J. Spiller, Mr. F. M. J. Murphy, Mr. J. W. Speer, Mr. R. N. Stoddard and other prominent Cleveland amateurs. A plan of traffic handling somewhat similar to that followed in Chicago has been drawn up and put into effect with a strong radio club to back it and the results have been excellent. In adition to improving local conditions the Cleveland radio men have been conducting a campaign in the interests of public opinion. Several interesting demonstrations have been given, the most unusual one being a radiophone concert with an aerial formed of the audience holding hands. This stunt was pulled off by C. J. Carter, 8AGZ, Mr. Speer, Mr. Spiller and Mr. Stoddard and attracted much attention. Message reports from Cleveland show a big increase in the amount of long distance traffic handled which is unquestionably due to the improvement of local conditions.

The District of Kentucky is showing more pep every day as is evidenced by the number of messages now going through this District regularly. We can remember the time when Kentucky was considered the dead spot of the Central Division but this is certainly not the case now. Mr. J. A. Kolb, the D.S. reports the following: Newport, Ky., C. M. Hengelbrok, 9IO, will have a C.W. set in operation in the near future. 9AVF has been working DX but his business handicaps him. 9APZ is reconstructing his transmitter and will be heard soon. Covington, Ky., A.D.S. Brown, 9UH, never sleeps and has done heaps of relaying. C. M. Kleaman, 9VZ, is in the ether again and has done some real DX. 9AIR has had trouble with the power company but has had a special line installed. 9APS has excellent equipment.

Louisville, Ky., 9OX, has been working consistently and had done some real DX but is out for the present with Dubiller

trouble. 9GX also is troubled with condensers. 9LK is increasing his power.

Mr. K. A. Duerk of Toledo District of Ohio reports Eastern Ohio traffic has been going via 8ZR from his station, while Detroit traffic has been getting off in fair shape, it being possible to QSR through 8LV at Ann Arbor. Some Toledo traffic has gone in via 8AHI at Toledo, but as he is on only irregularly, the USM route is still in use. All traffic in other directions goes off without any delay.

Mr. and Mrs. Chas. Candler, Superintendents of the Miami Valley District of Ohio, report that traffic both within the district and with distant stations has been moving with even greater activity than heretofore. 8ZL is in direct daylight communication with all points within the District as well as with all points of the Toledo district and connects easily in daylight with all surrounding Districts.

8FT is not allowed to transmit before 10:30 p.m. nor after 5:30 a.m. 8TN was out of commission for a large part of the month because of condenser trouble. He is now ready again to go ahead next month full blast. 8AKV is very much handicapped with QRM from Cincinnati, but does fine work. 8AEY, Merril T. McColm, 448 Silver St., Lebanon, Ohio, has been appointed official relay station for Lebanon, Ohio.

Mr. C. E. Darr, District Superintendent of Michigan reports no material change in traffic routing or handling in his state, traffic being disposed of in the same chanels as usual. Several of our relay stations in Toledo, on whom we depend greatly, have not been in operation lately on account of disabled apparatus. 8ZZ has not been in operation for six weeks on account of heavy induction. We have a new special station in Lansing, 8YG, Michigan Agricultural College.

Mr. Schlaak, 8OJ, A.D.S. of Michigan reports traffic moving with a businesslike regularity the last month although we are still in need of stations in the north and northwest part of the district, in the vicinity of Grand Rapids and Bay City. And what has happened to our friends in Toledo?

Mr. Burhop, 9ZL, reports traffic moving as usual over the North Shore routes.

Taken as a whole the general condition in the Central Division has been improving steadily and especially is this true with the advancement of C.W. transmission into more general use. More consistent communication may be carried on through certain kinds of interference by this means and accordingly extensive C.W. routes are being planned to work in harmony with the regular spark routes throughout the Division. The first of these routes is in nightly operation from 11:30 P.M. to 1:00 A.M. central time and runs from 9XI to 9XM to 9ZN to 8ZG from which station Pittsburgh and New York C.W. connections are made. An attempt is being made to connect this route with stations farther west and since 7XD at Billings, Mont., is installing a tube transmitter it is believed that an effective and consistent C.W. transcontinental route will soon be in operation which in combination with the existing spark relay routes should give wonderful communication.

Total messages 3270. Busiest station 8IK = 302 msgs.

DETERMINATION OF RESISTANCE

(Concluded from page 36)

grounded to the negative filament terminal of the audion and to Corner 2 of the bridge.

For audio frequencies the same detector circuit will do but the audion must be non-oscillating, only regenerative, by loosening the plate-to-grid coupling. When the impedances to be measured do not exceed about 1000 ohms, an ordinary pair of wireless phones attached to the high-tension winding of a modulating transformer, with the low tension winding across corners 3 and 4 will make a very sensitive detector, for audible frequencies and free from interference.

For best results, in the detector the primary circuit L_1 C_1 should have for a given frequency a small L and high C, and the secondary, L_2C_2, a high L and low C in order to increase the ratio of transformation from secondary to primary. The low L and high C in the primary will also secure maximum sensitiveness from the bridge itself, which takes place when the impedance of the detector is equal to that of the arms. Usually for a good coil with a resonating condenser across it, the effective impedance is very much larger than the arms of the bridge. The bridge may be used to determine a given frequency with great accuracy. A standard condenser and inductance in a resonating bridge like in Fig. 3 when balanced will give the frequency

$$F = \frac{1}{2\pi\sqrt{LC}}.$$

The detector may thus be calibrated for frequency and become an accurate wave-meter.

Thru error the cuts in the advertisement on page 100 of this issue, were transposed.

Calls Heard

HEARD DURING FEBRUARY
Unless Otherwise Specified

In addition to the following instructions please read references to this section on pages 30 and 58 in February QST.

(1) Typewrite or neatly print the calls, "double-spaced," on a separate sheet of paper, running them across the sheet, not down a column, and writing on but one side of the paper.

(2) Arrange alphabetically thru each district, from 1 to 9, with no break between districts, using commas to separate items and putting parentheses around calls of stations also worked—all as per the lists below.

(3) The period covered by the report shall be from the first of one month to the first of the following month. All lists must be received by us by the 10th of the second month, for publication in the next following QST.

If you will co-operate with us in this, no calls published will be over two months old, and their value will be greatly increased in that we can keep tab on how improvements in our transmitters are working out, etc. It will be our aim to publish representative lists, equally distributed over the country; and in general to conduct this department so as to be of the highest possible service.

Heard at Sea.

S.S. "City of St. Joseph", 900 m. S.E. Cape Henry Va., 1HAA, 2EL, 8XE. 280 m. S.E.: 1CZ, 2BM, 2FG, 2QR, 2UK, 2DR, 3CC, 3AL, 5XA, 8XE, 8BC, 8IK, 8KL, 8RP, 8ZD. 70 m. S.E.: 1YB, 1HAA, 3DH, 3DN, 3GO, 3IX, 3JN, 3RK, 8XR, 8ZD, 8ZL, 8BP, 9ZL.

NRJ at Portland, Me., Feb. 22: 2DN, 2JJ, 2OA, 2RK, NSF, 3ACM, 3DH, 3HG, 3NB, 8HG, 9ZL.

KEJX between N. Y. and Baltimore, galena: 1RAY, 1HAA, 2FG, 2OU, 3EN, 4BY, 8DR, 8DZ, 8TT, 8QJ, 8AGK, 8JL, 8AMM, 8ARW, 8CAA, 8KP, 9LQ, 9HN, 9NJ, 9XW, 9AJN.

U. S. Marines Stn., Manati, Ouente, Cuba, January: 2RK (loudest), NSF, 5XB, 5ZC, 8ZL, 8ZR, 9ZJ (most consistent.)

KOBT enroute N. O. to Havana: 2JU, 3BZ, 3DH, 3EN, 3FG, 3GO, 3VV, 3XF, 4AG, 4AI, 4BK, 4BY, 5BI, 5ER, 5HV, 5HL, 5IS, 5JE, 5KP, 5JD, 5PM, 5ZA, 5ZC, 5ZP, 5ZS, 5ZU, 8AV, 8IK, 8NZ, 8SP, 8ZL, 8AAZ, 8AEX, 8ANJ, 9EL, 9EQ, 9HI, 9JN, 9JQ, 9LF, 9LQ, 9PS, 9XM, 9ZB, 9AEG.

1RAY UNIVERSITY OF VERMONT, BURLINGTON, VT.

1AAG, 1AE, 1AO, 1AS, (1AW), 1BAB, 1BAC, 1BB, (1BBL), 1BGR, 1BM, 1BY, 1CC, 1CK, 1CY, (1CZ), (1RAC), 1DH, 1DT, 1DY, 1DZ, (1EAT), 1EAV, (1EK), 1ER, 1FBV, 1FK, 1FU, 1FV, (1GBC), 1GBT, 1GY, (1HAA), 1IA, (1JA), (1LAX), (1LBR), (1MAD), (1MBS), 1NAQ, 1OE, 1OY, (1PAO), 1PY, (1RAS), 1SA, 1TA, (1TS), 1TX, 1UA, 1UD, 1VAA, 1XB cw., (1XT), 2AA, (2ACD), (2ADE), 2AEL, (2AJW), 2ALD, 2ALK, 2AR, 2AWL, 2BG, (2BGR), 2BK, 2BM, 2CC, 2CT, 2DA, (2DI), 2DR, 2EH, (2EL), 2IL, 2JJ, (2JU), (2KM), 2ML, 2NW, 2OA, (2OM), 2RK, 2SH, 2TE, 2TJ, (2TK), 2UC, 2UK, (2VA), 2XJ, 2XQ fone, 2YM, 2ZM, 3AAG, 3ACE, 3ACT, 3AER, 3AH, (3AIC), 3AK, 3AL, (3BG), (3BP) Canadian, 3CC, 3CE, 3DA, 3DD, 3DDS, (3DH), 3EE, 3EH, (3EN), 3EY, 3FB, (3GO), 3HB, (3HJ), 3HX, 3IL, 3IX, (3KM), 3LI, 3LR, 3MB, 3MZ, (3NB), 3OE, 3OM, (3OU), (3PS), (3PU), (3QW), 3RW, (3TJ), 3UC, 3UU, 3XF, 3ZE, (4A), 4BQ, (4EY), 4FD, 4YB, 5DA, 8AD, (8AFB), 8AFG, 8AGD, 8AGK, 8AGO, 8AHR, 8AIO, 8AJ, 8AJO, 8AJI, 8AL, 8ALE, 8AMF, 8AMJ, 8AMQ, 8AMZ, 8AWX, 8BO, 8CF, 8CG, 8DC, 8DH, 8DP, (8DR), 8DV, (8DZ), 8ED, 8EV, (8FAA), 8FE, 8FI, 8FW, 8GB, (8GI), 8GO, 8GY, (8HG), 8HJ, 8HN, 8HP, 8HQ, 8HY, 8IG, 8IL, 8IZ, (8JE), 8JQ, 8KE, 8KK, (8KP), 8KZ, 8LH, 8MAO, 8ML, 8NZ, 8OY, (8OZ), 8PQ, 8PU, 8PW, (8QJ), (8QM), 8RE, 8RP, 8RQ, 8RW, (8SP), 8TT, 8OU, 8WP, 8WY, 8XA, (8XE), (8XG), 8XK, 8XU, 8ZA, 8ZD, 8ZE, 8ZJ, 8ZL, 8ZQ, (8ZR), (8ZT), 8ZW, 8ZY, 9AEK, 9AFA, 9AFK, 9AIX, 9AWX, 9BL, 9DP, 9ET, 9FN, 9FS, (9GP), 9JN, 9KL, 9LA, 9LK, (9LQ), 9MC, 9PC, 9PO, 9SQ, 9WC, 9WO, 9WU, 9XM, 9YA, 9YB, 9YW, 9ZD, 9ZJ, 9ZL, 9ZN, 9ZQ.

1UD, DUXBURY, MASS.

1AB, (1AE), 1AW, 1AS, 1BAX, 1BB, (1BH), 1BV, (1BW), (1CBD), 1CF, (1CK), 1CP, (1CZ), 1DBM, (1DBU), 1DH, (1DR), 1FZ, (1DY), (1EAV), (1EBW), (1EP), (1ES), 1EV, 1FBT, (1FBV), 1FC, 1FF, (1FU), (1FV), 1FW, (1GBG), (1GBL), (1GBT), 1GM, 1GZ, (1HAA), 1HAI, (1HAK), (1HAL), 1HF, 1HN, 1IA, 1IE, (1ID), (1IS), (1JBT), 1JG, 1KAG, 1KM, 1LAX, (1LBR), 1MAD, (1MAU), 1MBE, 1MF, 1NAQ, 1OA, 1OE, 1PAO, (1PAT), (1PAW), 1PBE, (1PU), 1QR, (1RAY), (1RV), 1SAS, 1SAF, 1SD, 1SS, (1TS), 1UC, 1UE, (1UL), 1UM, (1UN), (1VAA), 1VY, 1WJ, 1WQ, 1WR, 1XB, 1XE, 1XF, 1XM, (1XT), (1XX), (1YB), 1YC, 1YS, 2AAC, 2AAE, 2ACM, 2AE, (2AER), 2AGC, 2AHK, 2ALK, (2AM), 2AR, 2AX, 2AXB, 2BB, 2BGR, 2BGN, 2BK, 2CC, 2CT, 2DA, 2DI, 2DL, (2DN), 2EL, 2DR, 2FD, 2FG, 2FZ, (2HJ), 2HK, 2IG, 2JJ, (2JU), 2JW, 2KY, 2LO, 2NC, 2ND, 2NN, 2OA, 2OAR, 2OO, 2PL, 2RB, (2RK), 2SZ, (2TF), 2TC, (2TJ), 2TK, 2TS, (2UA), 2UV, 2VA, (2WZ), 2XJ, 2XX, 2YM, 2ZL, 2ZM, 2ZV, 3AAG, 2ABI, 3ACM, 3ACS, (3AHK), 3AIK, (3ALN), 3BP, 3BG, 3CC, 3CS, 3DR, 3DH, 3DS, 3EH, 3EI, 3EN, (3GO), 3HG, (3HJ), 3HX, 3IW, 3IY, 3KV, 3NC, 3OB, 3PN, (3PU), (3QF), 3SB, 3UC, 3VV, 3XC, 3YM, 3YV, 3ZE, 3ZM, 4AG, 4BY, 4FF, 4XC, 8AB, (8AD), 8ADQ, 8AGK, 8AIO, 8AJW, (8AMZ), 8APB, 8AR, 8ARK, (8AMM), (8BC), 8BK, 8BO, 8BW, 8CW, 8DK, 8DR, 8EV, 8FC, 8GH, 8GI, 8GX, 8HG, 8ID, 8IZ, 8JS, 8JQ, 8KK, 8KM, 8KP, 8KU, 8KZ, 8LF, 8LQ, 8MF, 8MG, 8MH, 8ML, 8OI, 8OY, 8OZ, 8PI, 8PN, 8PQ, 8QM, (8RQ), 8RU, 8SH, 8UU, 8VA, 8VU, (8WV), 8WY, 8XC, 8XE, 8XH, 8XX, 8ZA, 8ZE, 8ZL, 8ZJ, 8ZM, 8ZR, 8ZX, 8ZY, 9AAW, 9ET, 9FA, 9HM, 9PC, 9QL, 9WE, 9VK, 9ZJ, 9ZL, 9ZN, 9ZW.

NAF1 RADIO COMPASS STATION, PRICE'S NECK, NEWPORT, R. I., March.

1II cw, 1YK cw, 1XF cw & fone, 2JU spk, 2RM cw, 2ZL cw, 3AR cw, 3HB spk, 3MR cw, 3XI cw, 3ZA spk, 7ZZ cw, 8GB spk, 8ZG cw, 8ZW spk, 9AB spk, 9JD spk & fone, 9LJ cw, 9OX spk, 9WS spk, 9XI cw, 9ZJ spk, 9ZN spk.

1TS, BRISTOL, CONN.—One Tube.

1AE spk & cw, 1AO, 1AR cw, 1AS, (1AW), 1BAB, (1BBL), 1BBO cw, 1BH, 1BM, (1BV) cw, 1CAY,

1CBJ, 1CF C.W., 1CK spk & C.W., (1CM), 1CP, 1CY, 1CZ, 1DA C.W., 1DAC, 1DAP, 1DAQ, (1DR), (1DY), 1EAV, (1EBW), 1EP, (1ES), 1FAQ, 1FBF, (1FBK), 1FL, (1FQ) C.W., 1FU, (1FV), 1GAN, 1AS, 1GBC, 1GBL, 1GBT, (1GM), (1GY), 1GZ, (1HAA), 1HAF, 1HAK, 1HO, (1IA), 1IAO, 1ID, 1JAR, (1JBF) spk., C.W. & fone, 1JBT, 1JN, 1JQ, (1KAZ) spk. & C.W., (1LAX), (1LBR), 1LJ, 1MAD, 1MBS, 1MP, 1MX, (1NAQ), 1NAW, 1NO C.W. & fone, 1OAD, (1OBC), (1OBE), (1CE), (1PAO), 1PAW, 1QAJ C.W. & fone, 1QBF, 1QR C.W., 1QT, 1RAS, 1RAX, (1RAY), (1RU) C.W. & fone, 1RV, 1RX, 1RZ spk. & C.W., 1SAZ, (1UD) spk. & C.W., (1UJ), 1UN spk. & C.W., (1UQ), 1VAA, 1WAB, 1WP, 1WR, 1XD fone, 1XE, 1XM, (1XN), (1XT), (1XV) C.W. & fone, (1XX spk. & C.W., (1YB), 2AAG, 2ACD, 2AEF, 2AER, 2AJF C.W., 2AJN, 2AJU C.W., 2AJW, 2ALK, 2AMY, 2ANN C.W., 2ANZ, 2ARA spk. & C.W., 2ARD C.W., 2ARY, 2AW, 2AXB C.W., 2BAD, 2BB, 2BGH, 2BGN, 8BGR, 2BIP, (2BK), (2BM), 2BY C.W., 2CC, 2CS spk. & C.W., 2CT spk. & C.W., (2DA), 2DI, 2DN, 2DR, 2EL, 2FD C.W., 2FG, 2HI C.W., 2IN, 2JJ, 2JU, 2KR, 2KW, (2LO), 2MJ, 2NB, (2NN), (2OA), 2OM, 2OO, 2PL, (2QR), 2RB, 2RK, 2RM, 2RQ, 2SZ, 2TB, 2TF, 2TJ, 2TK, 2TS, (2UA), 2UE, 2UH, 2XK C.W., & fone, (2XQ) spk., C.W. & fone, 2XX C.W. & fone, 2ZC, 2ZD C.W., 2ZL C.W., 2ZM spk., & C.W., (3AA), 3AAE C.W., 3AAG, (3ABI) C.W., 3ABV, 3ACE, 3ACM, 3ACS C.W., 3AIC, 3AHK, 3AK, (3ALN), 3BG, 3BZ, 3CC, 3CE, 3CF, (3DH), 3EE, 3EH, 3EN, 3FB, 3FM, 3FR, (3GO), 3GX, 3HJ, 3HX, 3IX, 3IY, (3KM), 3LR, 3NB, (3OB), 3OU, 3PS, (3PU), (3QF), 3RU, 3RW, 3TJ, 3UF, (3VV), (3XF), 3YG, 3YH, 3YV, 3ZA, (3ZE), 4AG, 4CK, 4EY, 4FD, 4XB C.W., 4XC, 4YA, 5HA, 5XA, 5YH, (8AB), 8ABG), 8ACF, 8AD, 8ADE, 8ADQ, 8AEE, 8AFB, 8AFO, 8AFS, 8AGB, 8AGK, 8AGO, 8AIB, (8AIO), 8AJ, 8AJT, 8AJW, 8AKA, 8AKS, 8AKV, 8AL, 8ALY C.W., 8AMF, 8AMJ, 8AMM, 8AMQ, (8AMZ), 8ANT, 8AOF, 8AOU, 8APB, 8ARK, 8ARW, 8ATN, 8AVD, 8AWX, 8AXC C.W., 8AXK, 8AY, 8AYA, (8BC), 8BO, 8BP, 8CD, (8CG), 8CI, 8DP, 8DR, 8DT, (8DV), 8DY, 8DZ, 8FAA, 8FD, 8FE, 8FI, 8FK, 8FW, 8GI, 8GW, 8HA, (8HF), 8HG, 8HI, 8HP, 8HY, 8IB C.W., (8ID), 8IK spk. & C.W., 8IL, 8IN, 8IV spk. & C. W., 8JE, 8JJ, 8JM C.W., 8JQ, 8JU spk. & C.W., 8KE, 8KK, 8KM, 8KP, (8KZ), 8LE, 8LF, 8LI, 8LQ, 8LV, 8LX, (8MF), (8ML), 8MT, 8MZ, 8NV, 8NZ, 8OC, 8OI, (8OJ), 8ON, 8OZ, 8PE, 8PJ C. W., 8PN, 8QJ, 8QM, 8QQ, 8RH, (8RQ), 8RU, 8RW, 8SH, (8SP), 8TB, 8TK, 8TN, 8TT, 8UK, 8UO, 8UY, 8VJ, (8VQ), 8VS C.W., (8VU), (8VW), 8WO, (8WY), 8XA, (8XE), 8XH, 8XI, 8ZK C.W. & fone, 8XS, 8YG C.W. & fone, 8YV, 8YF, 8ZA, (8ZD), (8ZE), 8ZG C.W., 8ZL spk. & fone, 8ZR, 8ZV C.W., 8ZW, 8ZY, 8ZZ C.W., 9AAC, 9AAW, 9AEA, 9AFK, 9AFO, 9AGY, 9AIX, 9AON, 9AOJ, 9APK, 9AWZ, 9BP, 9CP, 9DBT, 9DV, 9EQ, 9GN, 9GP, 9HI, 9HJ, 9HM, 9HN, 9HP, 9HR, 9HY, 9JN, 9KA, 9KL, 9KN, 9KV, 9LA, 9LQ, 9LR, 9MC, 9MT, 9PG, 9PV, 9QO, 9SQ, 9UH, 9UU, 9WE, 9WK, 9XI C.W., 9XM spk., C.W. & fone, 9YB, 9YC, 9YI, 9ZA, 9ZB, 9ZJ, 9ZL, 9ZN spk. & C.W., Canadian (2AK), (2CI), 8AO (3BO), 3EI, (NSF) C.W. & fone.

1NY, BELMONT, MASS.

1AB, 1AE, 1AS, 1AW, 1BBBD, 1CK, 1CY, 1CZ, 1DR, 1DY, 1EP, 1EBW, 1EV, 1GAW, 1GBT, 1IE, 1IC, 1JBT, 1PD, 1PAW, 1QT, 1RAY, 2BK, 2EL, 2JJ, 2JU, 2OM, 2OO, 2RK, 2SZ, 2TF, 2XQ, 2XX, 2ZL, 3AL, 3ACM, 3AHK, 3CC, 3DH, 3EN, 3GO, 3HG, 3HX, 3NB, 3VV, 8AD, 8AFB, 8AGK, 8AI, 8AWX, 8DR, 8DV, 8EC, 8FK, 8GI, 8HG, 8ID, 8JJ, 8KK, 8KZ, 8MZ, 8NZ, 8WY, 8XE, 8XU, 8ZE, NSF.

2AIH, BRONXVILLE, N. Y.

1AW, 1DR, 1FVS, 1HAA, 1HBA, 1RK, 1RAS, 1RAY, 1RR, 1TS, 1VAA, 1XF, 1YB, 2AEF, 2AJE, 2AJP, 2AJT, 2AKO, 2ALW, 2AM, 2AMI, 2ANZ, 2APF, 2AQI, 2AST, 2AVR, 2AZ, 2BAI, 2BB, 2BEY, 2BF, 2BFL, 2BGD, 2BIS, 2BK, 2BM, 2CC, 2CT, 2CY, 2DK, 2DN, 2FG, 2HJ, 2HZ fone, 2HQ, 2JJ, 2JU, 2KN, 2LZ, 2NT, 2NV, 2OA, 2OM, 2OW, 2PE, 2QK, 2QY, 2RB, 2RK, 2TB, 2TK, 2UA, 2VA, 2VH, 2XC fone, 2XG fone, 2XK fone, 2XQ, 2ZM, 3AHD, 3AII, 3BP, 3BZ, 3DH, 3EN, 3GG, 3GX, 3HG, 3HJ, 3NB, 3PU, 3ZE, 4MI, 4XC, 8AB, 8ACF, 8AE, 8AGH, 8AIO, 8AJW, 8AJT, 8AKJ, 8AKV, 8AMM, 8AMZ, 8AU, 8BC, 8BO, 8CD, 8CG, 8CH, 8DC, 8DR, 8FA, 8FC, 8FN, 8FT, 8GI, 8GO, 8HA, 8HP, 8ID, 8IK, 8JE, 8JJ, 8JL, 8JQ, 8JU, 8KB, 8KM, 8LF, 8LQ, 8LV, 8ME, 8NT, 8NZ, 8QJ, 8RQ, 8RU, 8RZ, 8SH, 8SP, 8TK, 8TN, 8TT, 8TY, 8VQ, 8WO, 8WY, 8XE, 8XK, 8XU, 8ZA, 8ZD, 8ZE, 8ZL, 8ZY, 9AAC, 9AIK, 9AKH, 9AON, 9CP, 9EB, 9EY, 9HN, 9HT, 9JN, 9LA, 9LQ, 9OE, 9PW, 9UU, 9ZL, 9ZN, NSF.

2TT, NEW YORK CITY.

1AE, CW., 1AW 1BBL, 1BM, 1CK, 1CP, 1CZ, 1DY, 1EBW, 1FV, 1HAA, 1MAD, 1OE, 1TS, 1RAY, 1UD, 1VAA, 1XX, 1YB, 3ABI I.C.W., 3ACM, 3ACS, 3AHK, 3AIC, 3AK, 3ALN, 3BG, 3BZ, 3CC, 3DH, 3EN, 3FR, 3GO, 3GX, 3HG, 3HJ, 3HX, 3IY, 3LY, 3NB, 3OB, 3PU, 3VV, 3YV, 4XC, 5YE, 8AD, 8ADE, 8AFO, 8AGK, 8AGO, 8AIO, 8AJW, 8AKA, 8AKV, 8AL, 8ATN, 8BC, 8BO, 8OF, 8DR, 8DV, 8EB, 8FE, 8FK, 8FT, 8GW, 8HA, 8HF, 8HH, 8HG, 8HO, 8ID, 8IK, 8IV, 8JE, 8JF, 8KK, 8KP, 8KZ, 8LQ, 8MF, 8MZ, 8OI, 8RU, 8SP, 8UK, 8UY, 8VJ, 8VQ, 8WY, 8ZE, 8XK, 8XU, 8ZA, 8ZD, 8ZE, 8ZGQ C.W., 8ZL, 8ZR, 8ZW, 8ZY, 9AAW, 9EQ, 9JN, 9KN, 9MH, 8SQ, 9UH, 9WE, 9XM spk. & C.W., 9XI C.W., 9YB, 9ZL, 9ZN, NSF, Can. 3BP.

2PL, MAPLEWOOD, N. J.

1BAB, 1BBL, 1CY, 1CZ, 1DL, 1DY, (1EAV), 1GY, 1HAA, 1Q. (1RAY), (1VAA), (1XT), 2ZL, 3AB, 3ACE, (3EN), 3FG, 3GO, 3GX, 3HB, (3HG), 3KM, 3NB, 3SW, 3UC, (3VV), 4BY, 4DM, 4EY, 8AAZ, (8AMZ), 8AI, ((8AIO), (8BO), 8BP, 8CD, 8CM, 8DI, 8DJ, 8ED, 8ER, 8EV, (8FE), 8FK, (8FT), (8GI), (8GW), (8GX), 8HG, 8HP, 8IZ, 8TS, (8KK), (8KM), (8KP), 8LW, (8MH), (8ML), 8NI, 8QJ, (8RQ), 8RW, 8SH, (8SP), 8TN, 8TT, (8WY), 8ZL, 8ZD, 8ZL, 9ANZ, 9AP, (9BP), (9EL), 9GP, 9LQ, (9PV), 9ZL.

2AUG, RIDGEWOOD, N. J., Indoor Aerial.

1AW, 1AE, 1DR, 1DY, 1EP, 1GM, 1GY, 1GZ, 1HW, 1LA, 1OE, 1UD, 1UT, 1EBW, 1GBL, 1HAA, 1RAY, 1VAK, 1XD, 1XX, 3BP Canadian, 3DH, 3DS, 3EI, 3GO, 3HG, 3KM, 3NB, 3UC, 3VH, 3VV, 3ABC, 3AHK, 3ALN, 4EY, 4XC, 5YH, 5XA, 8AD, 8AL, 8BC, 8BP, 8FC, 8FK, 8FQ, 8GI, 8HY, 8HJ, 8HP, 8HQ, 8HY, 8ID, 8IK, 8IU, 8JJ, 8JL, 8JQ, 8KE, 8KK, 8KM, 8KN, 8KP, 8KU, 8LF, 8LM, 8LQ, 8LV, 8MT, 8OJ, 8PL, 8PN, 8RU, 8SH, 8JJ, 8TK, 8TN, 8UY, 8VJ, 8WY, 8XE, 8XU, 8ZA, 8ZD, 8ZE, 8ZL, 8AAX, 8ACF, 8ADE, 8AGK, 8AJB, 8AJW, 8AKV, 8AMK, 8AMM, 8AMW, 8AOF, C.W., 8AXC C.W., 8AYY, 8FAA, 9CP, 9DV, 9EQ, 9FG, 9GP, 9HM, 9HN, 9HP, 9HR, 9JK, 9JN, 9JQ, 9KN, 9KO, 9LA, 9LQ, 9LR, 9LW, 9MH, 9NV, 9TK, 9UU, 9ZB, 9ZJ, 9ZL, 9ZN, 9ZQ, 9ZV, 9AAW, 9AEG, 9AIX, 9AOA, 9DBQ, 9NHN, NSF, WL 2 C.W.

3FB, ATLANTIC CITY, N. J.

1AE, 1AS, 1AW, 1BBL, 1CK, 1DY, 1GBC, 1HAA, 1JG, 1JBT, 1MAD, (1OE), 1OJ, 1RAY, 1XT, (1YB), 2AER, (2AJW), 2ALK, 2BM, 2BK, (2BGR), 2CC, 2CT, 2DA, 2DI, 2DN, 2DR, (2EL), 2FG, 2JJ, (2JK), (2JU), 2KR, 2OA, (2OE), 2OM, 2RK, (2SU), 2SZ, 2ZL, 3AAN, 3ALN, 3AOE, (3AS), (3BA), 3BG, 3BP, 3BZ, 3CC, (3DH), 3EN, 3GO, 3HG, 3HJ, 3IX, 3JC, 3KM, 3NB, 3OU, (3OQ), (3PU), (3SC), (8TH), 3UF, NSF, VMI, 4EY, 8AAW, 8ACF, 8AGK, 8AGB, 8AKA, 8AIO, 8AMQ, 8ANW, 8APB, 8AOU, 8AWK, 8AWX, 8BC, 8CH, 8DV, 8EF, 8FC, 8FK, 8FAA, 8GI, 8GW, 8HA, 8HP, 8IK, 8JU, 8JQ, 8KK, 8LX, (8QJ), 8RW, (8SP), 8TT, 8VQ, (8WY), 8XK, 8XE, 8XU, 8ZE, 8ZL, 8ZR, 9CP, 9ACL, 9AGY, 9DV, (9FQ), 9GP, 9JT, (9KL), 9UU, 9QP, 9ZN.

3CA, ROANOKE, VA.

1HAA, 1LBR, 1RAY, 1RZ, 2ALK, 2BM, 2DA, 2OA, 2OO, 2TQ, 2VA, 2ZC, 2ZM C.W. & spk., 2XQ, 3AAE C.W., 3ACE, 3ACS, 3AHK, 3AOV, 3BG, 3CC, 3DH, 3EH, 3FR, 3GO, 3GX, 3NB, 3PU, 3QW, 3TN, 3ZO C.W., 4BK, 4DJ, 4EK, 4XC, 4YB, 5YH, 8ACF, 8AEY, 8AKD, 8ALG, 8AP, 8ARW, 8AY, 8AYA, 8BP, 8CU, 8FC, 8HA C.W., 8HF, 8IK,

8IM, 8IZ, 8JQ, 8KE, 8KP, 8LM, 8LN, 8NM, 8NQ C.W., 8NZ, 8OJ, 8OM, 8SP, 8TN, 8TT, 8VY, 8VZ, 8WV, 8WY, 8XA, 8XE, 8XY, 8YK, 8YV, 8ZA, 8ZE, 8ZG, 8ZH, 8ZL, 8ZR, 8ZT, 8ZV C.W., 8ZX, 9ABL, 9CB, 9EA, 9FS, 9GN, 9GX, 9HN, 9LQ, 9MC, 9OE, 9SQ, 9XE, 9YC, 9ZB, 9ZL, 9ZM, 9ZQ, 9ZY.

3RF, HADDON HEIGHTS, N. J.

1EAV, 1HAA, 1RAY, 1XD fone, 2BM, 2DA, 2EL, 2JJ, 2OO, 2PL, 2RZ, 2SH, 2SZ, 2XJ fone, 2XQ, 2XX fone, 2ZL C.W., 2ZM C.W., 3AK, 3AR C.W., 2AAA, 3ABG, 3ACS, 3AHK, 3BG, 3BK, 3BP, 3BZ dalite, 3CC, 3DH, 3EH, 3EN, 3FC, 3FR, 3GO, 3HG, 3HJ, 3LG, 3LP, 3NC, 3ND, 3OA, 3OB, 3PB, 3PU, 3RK, 3UC, 3YM, 3ZC, 3ZV, 4AA, 4AN, 4AU, 4BB, 4BK, 4BY, 4XC, 4YB, 5EK, 5DA, 5XA, 5YH, 8AB, 8AD, 8AY, 8AAT, 8AAU, 8ABK, 8ACF, 8ACL, 8ADE, 8AEY, 8AGD, 8AGK, 8AGO, 8AIO, 8AKH, 8ALG, 8ALO, 8AMZ, 8ANB, 8ANY, 8ARW, 8AUS, 8BP, 8CA, 8CH, 8CM, 8DC, 8DJ, 8EE, 8FC, 8FD, 8FI, 8FS, 8GB, 8GH, 8GI, 8HA, 8HG, 8HM, 8HW, 8IK, 8IM, 8JE, 8JI, 8JJ, 8JQ, 8KE, 8KP, 8LK, 8LQ, 8LU, 8LV, 8MF, 8ML, 8NM, 8OJ, 8PI, 8PN, 8PW, 8QJ, 8RA, 8RQ, 8RU, 8RW, 8SH, 8SP, 8TG, 8TN, 8TT, 8UH, 8UY, 8VQ, 8WY, 8XE, 8XH, 8XK spk. & C.W., 8YV, 8ZA, 8ZD, 8ZL, 8ZI 8ZQ, 8ZR, 8ZS, 8ZW, 8ZX, 8ZY, 9AU, 9AY, 9AAF, 9ABL, 9AEG, 9AKM, 9ALK, 9ALS, 9ANN, 9AON, 9ASJ, 9AWX, 9CP, 9DK, 9EQ, 9ET, 9FA, 9FG, 9FK, 9FQ, 9FS, 9GN, 9GP, 9HG, 9HR, 9JN, 9LN, 9LQ, 9LS, 9MC, 9RZ, 9UH, 9VC, 9VS, 9XM, 9XW, 9YA, 9ZL, 9ZN, 9ZQ, 9ZR.

3IL, WASHINGTON, D. C.

1AN, 1AT, 1AW, 1BBL, 1CP, 1DR, 1DY, 1HAA, 1JBT, 1MAD, 1OE, 1RAY, 1TS, 1YB, 2BB, 2BG, 2BM, 2CT, 2DA, 2DU, 2DR, 2EL, 2FG, 2JJ, 2JU, 2OA, 2GR, 2RK, 2WE, 2WK, 3AHK, 3BZ, 3CC, 3EN, 3GO, 3HG, 3HJ, 3NB, 3PS, 3UC, 4XC, 4YB, 5XA, 5ZL, 8BC, 8EC, 8GI, 8SH, 8SP, 8SX, 8TS, 8PE, 9MC, 9UH, 9ZN.

3EN, NORFOLK, VA.

1AE C.W., 1AS, 1AW, 1BAB, 1CK, 1CY, 1FV, 1GBT, 1HAA, 1JAP, 1MAD, (1RZ), (1RAY), 1XT, 1YB, 1YBT, (2AID), 2AR, 2BK, 2BM, (2CT), (2DA), (2DN), (2DR), (2EL), 2FG, 2JJ, 2JL, (2JU), 2JZ, (2NX), (2OA), 2RB, (2RK), 2RL, 2SH, 2SZ, 2TF, 2TS, (2UA), 2UK, 2VA, 2ZL C.W., (2ZM), (3AAE C.W.), (3ABC), 3AC C.W., 3ACS, (3AHK), 3AIC, (3AR), (3BG), 3BP, 3CC, 3DH, 3GX, 3HB, 3HG, (3HJ), 3HX, 3IB, 3JC, 3NB, 3PU, 3QW, 3TJ, 3ZF, (3YV), (NSF C.W. & fone), (4AG), (4AU), (4BY), (4CK), (4FD), 4RK, (4UF), 4XC, 4YB, 5DA, 5ER, 5OE, 5XA, (5ZP), 8AAIE, 8ACF, 8ACH, (8ADE), 8AEE, 8AEY, 8AFO, 8AG, 8AGK, 8AGO 8[illegible], 8AJW, 8AK, 8AKV, 8AL, (8ANK), 8ARW, 8AY, 8AXC C.W., 8BP, 8DR, 8DV, 8DY, 8DZ, 8EV, 8FAA, 8FT, 8GB, 8GI, 8GW, 8HA, 8HG, 8HP, (8ID), 8IK, 8IW, (8IV), 8JE, 8JJ, 8KK, 8KL, 8KM, 8KP, 8KZ, (8LH), 8LQ, (8LU), (8LV), 8MF, (8ML), 8MZ, (8NZ), (8OJ), 8QJ, (8RQ), (8SP), (8TN), (8TT), 8UT, 8UY, 8VJ, (8VQ), 8VU, (8WY), (8XE), (8XH), 8XS, 8XU, 8ZA, (8ZE), (8ZD), 8ZG C.W., (8ZL), (8ZR), (8ZT), (8ZV C.W. & fone), (8ZW spk. & C.W.), (8ZY), 8YG C.W., 8YK, 9AAC, (9AAV), 9AAW, 9AWF, 9BB, 9CA, 9DBT, 9EQ, 9ET, 9GP, 9HJ, 9HN, (9JT), 9JV, 9KL, 9KO, (9KV), 9LO, 9LQ, 9LR, (9MC), 9MO, 9OR, 9OX, 9SQ, 9SU, (9UH), 9UJ, 9VC, 9WE, 9WW, 9XM, 9XW, 9YA, 9YB, 9ZL, 9ZN, 9ZV.

4EG, WOODRUFF, S. C., Jan. 22-Feb. 22.

1AK, 1AW, 1EK, 2EL, 2EP, 2ER, 2SJ, 3BZ, 3DE, 3EN, 3GO, 3GZ, 3KM, 3ND, 3RK, 4AD, 4AG, 4AM, 4AN, 4AO, 4AT, 4AU, 4AX, 4BK, 4BA, 4BY, 4CU, 4DJ, 4DU, 4EF, 4EK, 4EY, 4FD, 4XC, 5DA, 5EN, 5ER, 5GX, 5JA, 5JD, 5LA, 5ZD, 8ACF, 8AE, 8AG, 8DE, 8DP, 8DR, 8DZ, 8EL, 8FG, 8HE, 8JD, 8OP, 8RG, 8SP, 9UY, 8XE, 8XK, ICW, 8YF, 9ZZ, 9AS, 9ADR, 9AMK, 9ASF, 9GL, 9JE, 9JY, 9KR, 9LM, 9NR, 9OE, 9QC, 9UF, NSF.

4BI, MAIMI, FLA.

1CZ, 1DY, 1OX, 1WR, 2DA, 2EL, 2JJ, 2JU, 2RK, 2ZL, 3AA, 3AAG, 3AC, 3AG, 3EN, 3GO, 3ND, 3PM, 3PU, 4AC, (4AM), (4BH), (4ES), (4FD), 4BY, 5OA, 5XA, 55XB, 5ZD, 5ZO, 8ZE, 8XE, 9XE, NSF, XK1, KF1.

5XA, AUBURN, ALA., Jan. 18-Feb. 19.

1AW, 1XP, 2CC, 2DN, 2EL, 2GO, 2HX, (2RK), 2ZL, (3AH), 3AO, (3BZ), (3EN), (3GO), (3VV), 3XR, 4AG, 4AN, 4AU, 4BK, (4BY), 4FD, (4YA), (4YB), (5BC), 5BK, 5BO, 5BR, 5CG, 5CK, (5DA), 5DI, 5DW, (5EJ), 5ER, 5FA, 5FD, (5HL), (5HV), 5IK, 5IS, (5JD), 5KP, (5LA), (5LR), 5LS, 5LY, (5MF), (5YE), (5YH), 5ZA, 5ZD, 5YI, (5ZK), (5ZP), 5ZX, 8AAL, (8ANO), 8AX, 8DC, 8DR, 8DZ, (8EB), 8FT, 8GW, 8HM, 8KP, 8RE, 8RQ, 8QJ, 8SP, 8UI, (8UY), 8ZJ, (8ZL), 8ZR, 8XE, 9ABH, 9ABL, 8ACL, (9AEG), 9AGG, (9AON), 9ARQ, 9AWR, 9AWX, 9BE, (9CE), 9EE, (9EL), 9ET, 9EHL, 9HI, 8JC, 9JE, (9FU), 9KL, 9KN, 9KO, 9LF, (9LA), (9LQ), (9LR), 9LZ, 9MEQ, (9MC), 9MH, (9OX), 9QJ, (9UH), 9UK, (9UU), (9UF), (9VC), 9VZ, 9WC, 9WE, 9WW, (9ZB), 9ZJ, 9ZL, (9ZT), NSF.

5ZN, EAGLE PASS, TEXAS, Oct. 26-Mar. 4.

(5AO), 5BB, 5BC, 5BG, (5BI), 5BM, 5BO, 5CG, 5DO, 5DW, 5EA, 5ED, 5EF, 5EO, 5ES, 5EW, 5FA, 5FL, (5HL), 5HV, (5IS), (5JA), 5JD, 5JE, 5JG, 5JI, 5JS, 5JX, 5LR, 5LO, 5LZ, 5PN, 5WA, 5XB, 5YE, 5YH, (5ZA), (5ZC), 5ZD, (5ZF), 5ZG, 5ZH, 5ZK, 5ZL, 5ZO, 5ZP, (5ZS), (5ZT), 5ZU, 5ZV, 5ZX, 5ZZ, 6CO, (6GE), 6IG, 6MA, 6ZA, 7XZ, 8ZL, 9AAC, 9ABF, 9ACN, 9AE, 9AEG, 9AEQ, 9AFX, 9AHS, 9AIZ, 9AMB, 9APC, 9AJ, (9AUO), 9BJ, 9BW, 9DE, 9DU, 9EL, 9FF, 9HI, 9HO, 9JN, 9KV, 9LE, 9LC 9LL, (9LR), 9MC, (9OE), 9OF, 9PS, 9SZ, 9WN, 9XI C.W., 9XW, 9YA, 9ZB, 9ZN, 9ZO, 9ZQ, NSF.

6ZH, Richfield, Utah.—Jan. 1-Feb. 26.

(5ZA), 5XB, 5XD, 5IF, 5BI, 5ZJ, 5ZL, 5ZP, 5JT, 5ZT, (6JT), 6ZA, (6ZM), 6EC, 6EB, (6EJ), 6ZN, (6IG), (6RE), 6JD, 6JI, 6PO, 6GI, (6MK), 6BA, (6AE), 6WV mod., (6GE), (6BQ), 6EA, 6JR, (6SK), 6KP, 6VL, (6BJ), (6EN), 6EB, 6UO, 6PR, 6KA, 6DP, 6OT, (6AK), (6VS), 6IF, 6BP, 6FH, 6IL, 6ZR, 6QR, 6AH, 6MH, 6GY, 6AJX, 6XZ, 6ZO, 6PQ, 7EX, 7YA, (7ZJ), 7CC, 7LN, 7XD, 7JX, 7ZG, 9ASF, 9EE, 9OE, 9YY, 9JN, 9ABX, 9AEG, (9WU), (9LR), 9SC, 9AIG, (9YW), 9AEY, 9YI, 9LW, 9AFX, 9AEQ.

6TG, OJAI, CALIF.

5ZA, 6AAM, 6ACI, 6ACM, 6ACR, 6ADL, 6AFN, 6AH, 6AIL, 6AJ, 6AJH, 6AK, 6AM, 6BJ, 6CV, 6DK, 6EA, 6EB, 6EC, 6EN, 6ER, 6FI, 6GI, 6GT, 6HC, 6HH, 6IG, 6IT, 6IU, 6IV, 6JI, 6JJ, 6JN, 6JR, 6KM, 6KP, 6KX, 6KZ, 6LB, 6LM, 6MC, 6MK, 6MZ, 6OC, 6OW, 6OY, 6PJ, 6PQ, 6RN, 6SK, 6TC, 6TE, 6TF, 6TV, 6VL, (6VZ), 6WN, 6XZ, 6ZA, 6ZH, 6ZN, 6ZR, 7IN.

6AE, STANFORD UNIVERSITY, CALIF.

(5XD), (5ZA), 6ABP, (6ADL), 6ADX, 6AJH, (6DA), (6EA), 6EB, (6ED), 6EK, (6EN), (6ER), 6GH, 6GP, 6GW, 6HH, 6HY, 6ID, 6IF, 6IS, 6IU, 6IV, 6IZ, (6JD), 6KA, (6KP), 6MX, 6NY, (6OL), 6PQ, (6PR), 6RE, 6RN, 6UF, 6VL, 6WN, 6WZ, 6XZ, 6ZB, 6ZH, (6ZM), (6ZN), 7AD, (7BC), 7BH, (7BJ), (7BK), 7BP, 7BQ, 7BR, 7CE, (7CC), 7CW, 7DH, 7EX, 7GI, 7GQ, (7IN), 7JR, 7KB, 7KK, 7KU, 7LU, 7OJ, (7YA), 7YS, 7ZA, 7ZB, 7ZH, 7ZI, (7ZJ), 7ZK, 8GW, 9AVS, 9YW.

6KL, OAKLAND, CAL.

5ZA, (6AT), (6EB), 6ED, (6EN), (6ER), 6DP, (6DK), (6GF), 6HH, (6HY), 6IG, (6JD), 6JI, (6JM, (6KA), (6KP), 6OT, (6PR), 6PQ, 6RN, 6SK, 6ZA, (7BK), (7BO), 7BP, 7ED, (7CC), 7FK, (7DA), (7O), 7YA, (7ZI), (7ZJ), 9LR.

6CU, LOS ANGELES, CALIF.—Janary.

5XD, 5ZA, 6AAK, 6AAT, 6AAW, 6ACD, 6ADA, 6AE, 6AFU, 6AFY, 6AH, 6AID, 6AK, 6AN, 6BJ, 6BQ, 6CO, 6CV, 6DK, 6DP, 6EJ, 6EX, 6FH, 6FI, 6GF, 6IB, 6IG, 6IY C.W., 6JI, 6JJ, 6JN, 6JR, 6JT, 6KM, 6OH, 6OT, 6OW, 6PG, 6PR, 6QD, 6QR, 6QY, 6TC, 6WN, 6XZ, 6ZA, 6ZB, 6ZB, 6ZE, 6ZK, 6ZM, 7DA, 7GB, 7IM, 7YA, 7YA, 7ZA, 7ZB, 7ZJ.

ASA S. KELLER, CASHMERE, WASH.
Jan. 8-Feb. 18.

6AA, 6AC, 6AD, 6AE, 6AF, 6AG, 6AH, 6AK, 6AN, 6AS, 6AW, 6BJ, 6CV, 6DJ, 6DP, 6EJ, 6EN, 6FC, 6FH, 6FI, 6FL, 6GF, 6GK, 6GY, 6HH, 6IC, 6JA, 6JZ, 6KL, 6LH, 6LI, 6LJ, 6LK, 6LL, 6LN, 6LR, 6OC, 6OH, 6G, 6PQ, 6PR, 6RK, 6RR, 6ZA, 6ZR, 6AAR, 6ACD, 6ACQ, 6AIW, 7AD, 7BC, 7BH, 7BJ, 7BK, 7BP, 7BQ, 7CC, 7CH, 7CK, 7CO, 7CW, 7DA, 7DC, 7DI, 7DJ, 7DO, 7DP, 7DQ, 7DS, 7ED, 7EK, 7EP, 7FB, 7FL, 7GJ, 7GK, 7GQ, 7GY, 7IC, 7IN, 7JR, 7JX, 7JZ, 7LR, 7MD, 7OH, 7QQ, 7RR, 7WC, 7YA, 7ZB, 7ZI, 7ZJ, 7ZK, CL1, CL2.

7AD, SEATTLE, WASH.,—Jan. 1.-Feb. 15.

5YH, 5ZA, 5ZH, 6AAJ, 6AAK, 6AAT, 6ABP, 6ACA, 6ACM, 6AE, 6AEW, 6AFN, 6AGF, 6AH, 6AIL, 6AK, 6AN, 6BB, 6BJ, 6BQ, 6CC, 6CO, 6CV, 6DH, 6DK, 6DP, 6DY, 6EA, 6EJ, 6EN, 6ER, 6EX, 6FE, 6FH, 6FI, 6FJ, 6GI, 6GR, 6GY, 6HC, 6HH, 6HP, 6HY, 6IF, 6IU, 6IY, 6JD, 6J1, 6JJ, 6JQ, 6KM, 6KP, 6OC, 6OH, 6OT, 6OW, 6PK, 6PM, 6PO 6PQ, 6PR, 6QM, 6QR, 6QY, 6RE, 6SK, 6TC, 6UM, 6VS, 6WZ, 6ZA, 6ZE, 6ZH, 6ZK, 6ZM, 6ZN, 6ZO, 6ZR, 7BH, 7BP, 7BQ, 7BR, 7CC, 7CW, 7DA, 7DH, 7DM, 7ED, 7EX, 7FB, 7FI, 7FL, 7FQ, 7GQ, 7HH, 7HS, 7IN, 7JP, 7JR, 7JX, 7YA, 7YG, 7YS, 7ZG, 7ZI, 7ZJ, 7ZK.

7KX, CASPER, Wyo.,—Jan. 20-Feb. 28.

5BM, 5BR, 5DD, 5HL, 5HV, 5IF, 5JH, 5JS, 5LD, 5LS, 5MF, 5ZA, 5ZC, 6FI, 6FL, 6IG, 6JT, 6TB, 6QR, 6ZA, 6ZM, 6ZH, 6ZR, 7CC, 7EX, 7FL, 7HS, 7MO, 7ZG, 8KI C.W., 9AP, 9BW, 9BY, 9DC, 9DB, 9DO, 9DV, 9ET, 9EQ, 9EY, 9FL, 9FU, 9GS, 9GN, 9HI, 9HM, 9IF, 9JL, 9JN, 9LA, 9LB, 9LC, 9LR, 9LW, 9MC, 9MB, 9NQ, 9OE, 9OB, 9OO C.W., 9PL, 9PN, 9PS, 9RU, 9SZ, 9TI, 9QO, 9UT, 9UU, 9UQ, 9VC, 9WI, 9WU, 9XI C.W., 9XL, 9XT, 9XW, 9YA, 9YI, 9YO, 9YW, 9ZB, 9ZC, 9ZJ, 9ZL, 9ZN, 9ZQ, 9ZZ, 9AAW, 9ABX, 9ACF, 9AEG, 9AEJ, 9AEQ, 9AEY, 9AFX, 9AFO, 9AGN, 9AHS, 9AID, 9AIF, 9AIG, 9AIZ, 9AJI, 9AJS, 9AKC, 9ALO, 9AMH, 9AMX, 9AND, 9AOJ, 9AON, 9AOO, 9ARJ, 9ARQ, 9ARX, 9ATO, 9AUU, 9AVC, 9AWB, 9AWG, 9AWK, 9AXR, 9AXV, 9AXU, 9AYW, 9DCG, 9DBT.

7ZG, BEARCREEK, MONTANA—Jan. and Feb.

1IRJ, 2RK, 3DM, 5BI, 5IF, 5EF, 5XB, 5XD, 5YE, (5ZA), 5ZJ, 6AE, 6AF, 6AH, 6AK, 6ACD, 6AFD, 9AGF, 6AEZ, 6AIW, 6AMF, 6BJ, (6BQ), 6CD, 6CO, 6DP, 6EA, 6ED, 6EJ, 6FE, 6FI, 6IG, 6KE, 6MK, 6JD, (6JT), (6PE), 6QR, 6RE, 6VS, (6WV C.W.,) (6ZA), (6ZH), 6ZJ, 6ZK, (6ZM), 6ZN, 6ZO, 6ZR, 7AD, 7AF, 7BC, 7BM, 7BL, 7BP, (7BQ), (7CC), 7CW, (7DH), 7DS, (7EX), 7ED, 7FI, 7FL, 7GA, (7GK), 7GO, (7HS), 7IN, 7IY, 7JD, 7JR, 7JX, 7KL, (7LU), 7ME, 7MP, 7XB, (7YA), 7YG, 7YS, 7ZB, (7ZH), (7ZI C.W.,) (7ZJ), 7ZK, 8ZC, 8ZR, 9AAC, 9AAW, 9ABT, (9ABX), 9ACB, 9ACF, 9ACN, 9AEG, (9AEQ), (9AEY), 9AFO, 9AFX, (9AGN), 9AGR, 9AHF, 9AIO, 9AIF, 9AIG, 9AJS, 9AKX, 9ALU, 9ALO, 9AMB, 9AMH, 9AMT, 9AMU, 9ANN, 9AON, 9ARJ, 9ARQ, 9ASF, 9ASJ, 9ATD, 9ATO, 9BJ, 9BW, 9DBT, 9DC, 9DCG, 9DM, 9DO, 9DU, 9DY, 9EE, (9EL), 9EQ, 9ET, 9FZ, 9GN, 9HC, (9HI), 9HM, 9HT, 9IF, 9JA, 9JB, (9JN), 9JI, 9KN, 9LA, 9LN, (9LR), 9LW, 9NQ, (9OE), (9OT), 9PI, 9PL, 9QO, 9RG, 9RV, 9SC, 9SZ, (9TI), 9UT, 9UQ, 9WI, (9WU spk. & C.W.,) 9XI, 9XT, (9XM spk. & C.W.), 9YA, (9YG), 9YI, 9YM, 9YO, 9YP, (9YW), 9YY, 9ZB, (9ZC), 9ZJ, 9ZL, (9ZN), 9ZQ, 9ZT C.W., 9ZU, 9ZY

8APS, HOLLAND, MICH.

1RK, 1XD, 1XF, 5MF, 8AG, 8AR, 8AY, (8CP), 8DG, 8HG, 8HL, 8IE, 8JE, 8JR, (8JZ), 8KZ, 8LR, 8LU, 8ML, 8NZ, 8OL, 8QJ, 8RE, 8RW, 8SP, 8WO, 8WY, 8WZ, 9AC, 9AW, 9AY, 9BY, 9DD, 9DN, 9DV, 9EO, 9EQ, 9FN, 9GP, 9IC, 9GD, 9JE, 9JL, 9JN, 9KJ, 9LA, 9LN, 9LQ, 9LR, 9LW, 9MC, 9MN, 9NQ, 9OO, 9PN, 9QO, 9SP, 9ST, 9TB, 9TW, 9UK, 9UT, 9VC, 9ZD, 9ZH, 9ZL, 9ZQ, 9ACL, 9ACN, 9AON.

8HJ, ELMIRA, N. Y.

1CY, 1MX, 1UN, 1EAT, 1EAV, 1GAW, 1LAX, (1VAA), 1JBG, 1XJ, (1YB), (2DA), 2HJ, (2JU), 2MJ, 2UA, 2UC, 2SH,, 2TF, 2VA, 2ABM, 2AST, 2AWL, 2ZC, (3BP), (3HG), 3NB, 3OU, 3SM very QSA, 3XF, (8AJ), 8AY, 8BC, 8BO, 8CF, 8CG, (8FN), (8FT), (8ID), 8JQ, 8KM, (8MH), (8RQ), (8SH), 8UY, 8VU, (8WV), (8ABG), (8ADH), 8AFO, 8AJT, 8AMM, (8AMZ), 8AOT, 8AVC, (8AVD), (8XE), (8XU), 8ZL, 8ZP, 9UU, 9AAF, 9AAW, 9AKH, 9AWZ, 9AYE, 9ZN, 9ZQ, (NSF).

8JQ, WASHINGTON, PA.

1AE, 1AS, 1AW, 1BM, 1CM, (1CY), 1CZ, 1JQ, 1WR), 1XB, 1XD, (1XT), 1XX, 1YB, 1ARJ, 1BBL, 1GAI, 1HAA, 1RAD, (1RAY), 2BK, (2DA), (2DI), 2DR, (2EL), (2FG), 2GR, 2HK, 2JJ, 2JU, 2OA, 2OO, 2RK, 2RL, 2SR, 2SZ, (2TF), 2UK, 2VA, 2XJ, 2XX, 2ZC, 2ZL, 2ZM, 2ACT, (2ALK), 2ALY, 2ARA, 2BGR, 3BP, 3BZ, (3CC), (3DH), (3EH), 3EN, 3FG, 3GO, (3HJ), 3HG, (3NB), 3PS, (3PU), (3QW), 3VV, (3XF), 3YG, 3IW, 3WK, 3ACS, (3AHK.), (4AG), 4CK, 4EY, 4XB, 4XC, 4YA, (4YB), 5DA, 5XA, 8AD, 8AN, (8BC), 8FC, 8GI, (8HY), 8JJ, 8JS, 8KP, (8OW), 8PU, 8QQ, 8QJ, 8RG, 8RI, (8TN), 8WO, 8WY, 8XE, 8ZL, 8ZR, 8AGB, (8AGK), 8AJB, 8AMQ, 8AMZ, 8APB, 9DB, 9EQ, (9FS), 9FZ, 9GN, 9GP, 9GX, 9HI, 9HJ, 9HN, (9HR), 9JN, 9JQ, 9JV, (9LQ), 9LR, (9MC), 9NQ, 9SJ, 9SQ, 9UF, 9UK, 9VC, 9WC, 9WE, 9YB, 9YI, 9ZB, 9ZJ, 9ZL, 9ZQ, (9ACJ), (9AON), 9ASL, 9AIX, NSF.

8ZA, NEW PHILADELPHIA, OHIO.

1AE, (1AW), 1BBL, 1CK, (1CY), 1EAM, 1GBC, 1GBT, 1HAA, 1IRZ, 1JBT, 1OE, (1RAY), (1RZ), 1RA, 1TS, 1VA, 2ALK, (2AR), (2FG), 2JU, 2BB, 2BG, 2BGR, 2CS, 2DA, 2EL, 2KY, 2RK, (2SZ), 2ZC, 2ZL, (2ZM), (3ABC), (3AHK), 3ARN, 3ACF, 3BP, 8BH, (3BZ), 3DH, (3EH), 3EI, 3FG, (3GO), 3GW, (3HG), 3HX, 3LI, 3PS, 3PU, 3QW, 3SM, 8YG, (3YV), 4AG, 4BO, 4BY, 4DM, 4EY, 4XB, (4XC), 4YA, 4YB, 4ZA, 5DA, 5DK, 5YE, 5YH, 5XA, 5ZP, (8AK), (8ACF), (8AKJ), (8AGB), 8AGZ, (8AMQ), 8ANJ, 8ALM, 8BC, 8BO, 8BP, 8DR, (8DJ), (8EV), 8GB, 8GI, (8GW), 8HG, (8HP), 8HS, (8IK), 8JQ, (8JJ), 8KK, 8KP, 8LF, 8MZ, 8NZ, 8PN, 8PU, 8QQ, (8RQ), (8SH), 8WP, 8XA, (8XE), 8XH, 8XU, 8YV, 8ZB, (8ZD), 8ZE, 8ZF, (8ZL), (8ZR), (8ZV), 8ZW, (8ZX), (8ZY), (9AAF), 9ABL, 9AEG, 9AGV, 9AGW, 9AHO, 9AON, 9AWZ, 9BP, 9BW, 9BY, (9CP), (9DV), (9DBT), (9DFK), 9EL, (9EQ), 9ET, (9FG), (9FN), (9FS), (9GC), (9HM), (9HN), (9HR), (9JT),, 9HT, 9KL, 9KN, 9KR, 9KV, 9LA, 9LC, 9JN, 9LR, (9MC), 9MS, 9NQ, 9OE, 9PV, 9RY, 9UK, (9UU), 9XI, (9XW), 9XM, 9YB, 9ZB, (9ZL), (9ZN), (9ZQ).

8ZY, DEFIANCE, OHIO.

1AW, 1OE, 1RQ, 1TS, 1HAA, 1RAY, (2BK), (2DA), 2DR, 2EL, 2JU, 2OM, 2OA, (2RK), 2RL, 2TF, (2UE), 2SZ, 2TS, (2ALK), (2ZM), 2ZL, C.W.; 2XQ fone 60 ft., 3BP, (8BZ), 3CC, (3DH), (3EN), (3GO), (3HJ), 3HX, 3OA, 3PU, 3QF, 3QW, (8NB), 3KKF, 3AAE C.W., 3ACS, (3AHK), (3ALN), 4XC, 4YA, 4YB, 5BM, 5DA, (5EW), 5JD, 5JE, 5MF, 5XA, (5YH), (5ZX,, 6ER, 7CC, 8AY, 8ADE, 8ADQ, (8ALG), (8ARS), 8AFS, 8AFQ, 8AAU, 8AEB, (8ACF) 8AGK, 8AGO, 8AL, 8AD, 8AG, 8BC, 8CH, 8DR, 8EC, 8EV, 8FI, 8FT, 8FC, 8GW, (8HA), 8HG, 8HP, 8ID, (8IK), 8IV, 8JE, (8JJ), 8KM, 8KK, 8LH, (8LV), (8LQ), 8MZ, 8NZ, 8JU, 8QJ, 8RQ, 8SP, 8PU, 8TT, 8UR, 8VQ, 8WY, (8XE), 8XH, 8XI, (8XK), (8XU), (8ZA), (8ZD), 8ZE, 8ZG, (8ZR), 8ZT, 8ZH, 8ZW, (9AAW), 9AAF, 9AAC, (9AON), (9AWV), 9AGY, 9AEQ, 9AXU, 9AJI, 9AKC, (9AEG), 9AWX, (9ACN), 9ACL, 9AK, 9AWZ, 9ABL, 9ATN, 9ARG, 9AEY, 9AGY, 9AUO, (9DBT), 9DBQ, 9DFB, 9DFK, 9DFC, 9DCG, 9EAQ, (9BP), 9BW, 9BY C.W., 9CQ, 9CA, 9CS, 9CP, 9DC, (9DV), (9EE), (9EL), 9EQ, 9ET, (9FS), 9FG, 9FN, 9FU, 9GP, 9GY, 9GN, 9HN, (9HI), (9HR), (9HM), 9IF, 9JA, (9JN), 9JT, 9JL, 9KB, 9JQ, 9KO, 9KN, 9KL, (9KQ), 9KZ, (9LA), (9LR), 9LW, 9MC, 9MH, 9HS, (9NQ), (9OE), 9OX, 9OR, 9ON, 9QR, 9QO, 9SQ, (9TI), 9TV, 9UU, 9UT, 9VC, 9WT, 9WZ, (9WU), 9XM, (9XI), 9XW, 9YA, (9YM), 9YR, 9YO, 9YV, 9YZ, (9YW), (9YI), (9ZB), (9ZN), (9ZL), (9ZC), (9ZJ), (9ZQ).

8ACM, (NOW 8AYM), JAMESTOWN, N. Y.
1BBL, 1CK, 1EAV, 1GBC. 1HAA. 1MAD, 1RAY. 1RZ, 1TS, 1XF, 1XT, 1XX. 2AER. 2AID, 2ALK. 2AWL C.W. & fone. 2BG. 2BGR, 2BK, 2BM. 2DA, 2DY, 2EL, 2FG, 2JU. 2ND, 2NN, 2OA. 2OB. 2QR fone. 2SS, (2SZ), 2VA. 2XQ, 2ZM. 2AR, 3AAG. 3ACS, 3AEP. 3BG, 3BZ, 3BP, Can., 3CG, 3DH. 3EH, Can., 3HG, 3HJ, 3HX. 3IW, 3NB, 3PS, 3PU. 3TK, 3VV, 4AG. 5DA, 5YH, 8AD, 8ABG, 8AEE. 8AGK, 8AIS, 8AJL, 8AJT, 8AMB, 8AMM, 8AMQ. 8AMZ, 8ALG, 8AOT, 8AQL, 8ARF. (8ARK), 8BP. 8CG, 8CP, 8CX, 8EF, 8FE, 8GA, 8GH, 8GI, 8HA. 8HJ, 8IF. 8IK, 8JJ, 8JQ, 8KK, 8KP, 8LB. 8LV. 8LX, 8MP. 8MZ, 8NN, 8NZ, 8OI, 8OJ. 8PN. (8PU), 8QJ. 8RW, 8SH. 8SP, 8TC. 8TN, 8TT. (8WY), 8WO. 8WV, 8XA. 8XE, 8XU. 8ZD. 8ZF. 8ZL. 8ZN, 8ZR. 8CH, 9AAF. 9AAG. 9AAG. 9AAW. 9ABL, 9ACN. 9AEG, 9AKM. 9BP, 9CP. 9DH. 9EQ. 9FG, 9FN, 9FS. 9GN, 9GO. 9HR. 9JA. 9JK. 9JN. 9KK. 9KL, 9LM. 9LR, 9LQ. 9MC. 9OR. 9OJ. 9RT. 9UU, 9ZB. 9ZN, 9ALS. 9DV. BCO. NSF. WL2. XB1, XF1.

9AAW, CHICAGO, ILL.
1AW. 1GM, 1OE, 1HAA, 1JBT. 2AL. 2BK. 2DR. 2EL, 2JJ. 2NE. (2RK), 2SZ. (2TF). 2UE. 2VA. 2XX fone. 2ZM. 2ALK, (3BP Canadian). (3CC). (3DH). 3EN. (3GO), (3HJ). (3NB). 3OB. 3PU. 3SG. 3YA. 3ZM, (3AHK). 3AIK. (4AG). 4XC. 5JE. 5XB. 5YE. (5YH), 5ZA. 8AB. 8AY. (8BC), 8BO. 8BP. 8BU. 8DR. 8DV. 8FI. (8FK), 8FT. 8GI. 8GX. 8HG. (8IK). 8IV. (8JE). 8JJ. 8JP. 8JQ. 8KK. (8KM). 8KP. 8LQ. 8MF. 8OJ. 8PN. 8QJ. 8RE. (8RQ), (8TN). 8TK. 8UF. (8VJ), (8WY). (8XE), 8XK. 8XU. 8ZA. (8ZD). (8ZE). (8ZL). 8ZR. 8ZW. (8ZY). 8ADE. (8AFS). 8AGK. 8AGO. 8AIB. 8AIO. (8ALG). 8ARW. (9DU). 9EE. 9EI. (9EQ), 9FS. 9GN. (9GP), 9HM. (9JN. (9JQ.) 9KE. 9LA. 9LQ. (9LR). 9MC. 9MS. 9NQ. 9OE. 9UH. 9UK. (9VZ). 9WE. 9WT. 9XB. 9XI. 9XM. 9XW. 9YM. 9YY. 9ZB. 9ZJ. (9ZL). 9AAC. 9AAF. 9AEG. 9AJN. 9AON. 9AWZ. 9DDA. NSF. WL2. XB1. XF1. XK1.

9OE. WICHITA, KANS.
2RK, 4BQ. 4XC. 5AF. 5AJ. 5BM. 5BO 5BR. 5CG. 5CI. 5DO, (5EA). (5EJ). (5ER). (5EW). (5FL), (5HV). (5IF). 5IS. (5JD). (5JE). 5JR. (5LR). 5LS. 5MF. (5ML). 5XB. (5YH). (5ZA). (5ZC). 5ZD. 5ZJ. (5ZS). (5ZT). (5ZU). (5ZV). (6ZW). 5ZX. 6GE. (6IG). 6KP. (6WV). 7DH. (7EX). 7LU. 7ZG. 8AE. 8BP. 8CF. 8DC. 8DZ. 8FK. (8FT). 8HG. 8IG. 8IK. 8JJ. (8KP). (8MI.). 8NI. (8QJ). (8TN). (8UY). 8VJ. 8XS. (8ZL). 8ZR. 8ZV. 8ZW. 8ZX. (8ZY). 8AFS. 8AIB. 8AKV. 8AKS. (9BQ). 9BY. 9CA. 9DC. 9DD. 9DQ. 9DU. (9DV). (9EE). (9ET). (9EW). 9FF. 9FJ. (9FS). 9FU. 9FT. 9GC. (9GN). (9GP). 9HM. (9HN). (9HT). 9HY. 9IE. (9IF). 9IY. (9JA). (9JN). (9JQ). 9JT. 9KL. 9KN. 9KO. (9LC). 9LF. (9LQ). (9LW). 9LZ. (9MC). 9MH. 9MS. 9NQ. 9OA. 9OB. 9OO. 9OX. (9PV). 9QJ. 9SP. 9SQ. (9TF). 9TH. (9TI). 9TW. (9UF). (9UH). (9UT). (9VC). (9WI). (9WU). (9XI). (9XM). 9XW. (9YA). (9YG). 9YI. (9YW). (9ZB). (9ZC). 9ZJ. (9ZL). 9ZN. (9ZQ). 9ZZ. 9AAR. 9AAC. 9AAG. 9AAW. 9ABX. 9ACG. (9ACL). (9ACN). (9AEQ). 9AFO. (9AFX). (9AGY). (9AIF). 9AJI. (9AJS). (9AKC). 9AKR. (9ALK). 9ALS. 9ALLY. (9AMB). 9AMI. (9AMK). 9AMS. 9AOJ. (9AON). 9AOU. (9AOX). (9ARG). 9ASF. 9ASL. 9ATO. 9ATN. (9AVC). (9AWG). (9AWX). 9AYE. 9AYW. (9AXU). (9DBT). 9DCG. (9DCO). 9DFD.

9UT, SIOUX FALLS, S. D.
5BM. (5BO), (5EJ). 5ER. (5EW). (5HL). 5HV. 5IF. (5IF). (5IS). 5JD. 5JM. 5LA. 5LR. 5LO. 5LS. 5MF. 5XB C.W.. 5YH. 5YS. 5ZA 5ZG. 5ZS. 5ZU. 6IG. (7LU). 8ADY. 8AG. 8ALS. 8AXC C.W.. 8AY. 8DZ. 8FT. 8GH. 8HZ. 8JJ 8KI C.W.. 8KP. 8LR. 8LQ. 8ML. 8OZ. 8PC. (8QJ). 8RO. 8TK. 8VJ. 8XK C.W.. 8XR. 8YG C.W.. 8ZA. 8ZJ. 8ZL. 8ZQ. 8ZR. 8ZW. 9AAF. 9AAG. 9AAR. 9AAW. 9ABX. 9ACD. 9ACL. (9ACN). 9AEG. 9AEQ. (9AEY). 9AFK. (9AFO). (9AFQ). 9AFX. 9AGN. 9AGY. 9AHF. 9AHS. 9AHZ. 9AIL. 9AIZ. 9AJI. 9AJN. 9AJS. (9AKC). 9ALY. (9AMB). 9AMH. 9AMT. 9AMX. 9AOJ. (9AON). 9AP. 9ARJ. 9ASL. (9ATL). (9ATO). (9AUO). 9AUX. 9AW. (9AWG). 9AWX. 9AWZ. 9AXJ. 9AXU. 9AXU. (9AYE). (9AYW). 9BB. 9BM. 9BP. 9BT. 9BW. 9BY. 9CA. (9CP). 9CS. 9CW. (9DAT). 9DB. (9DBT). 9DE. 9DFK. (9DFT). 9DV. 9EE. 9EL. 9EQ. (9ET). 9FG. 9FI. 9FN. 9FS. 9FZ. 9GC. 9GN. 9GP. 9GQ. 9GS. (9HI). 9HJ. 9HL. 9HT. 9HY. (9IF). 9JA. 9JK. 9JL. 9JN. 9JQ. 9JT. (9JV). 9KA. 9KG. 9KK. 9KL. 9KN. 9KO. 9KP. 9KV. 9LA. 9LB. 9LF. 9LN. 9LQ. (9LR). (PLW). 9LY C.W.. 9LZ. 9MC. 9MH. (9MS). (9NQ). (9OE). 9OR. (9PI). 9PN. (9PS). 9PV. (9QO. 9RG. 9RY. 9SQ. (9SZ). (9TI). 9TO. 9TW. 9UF. (9UG). 9UK. 9UP. (9UU). 9VR. (9WI). 9WT. 9WU. 9XI. 9XM. 9YA. 9YI. 9YM C.W.. 9YY. (9ZB). 9ZC. 9ZG. 9ZJ. (9ZL). 9ZN. 9ZQ. 9ZV. 9ZY. NSF C.W. & fone.

9DV, NEENAH, WISCONSIN.
1AW. 2DR. 2EL. (2RK). 2SZ. 2XQ. 3DH. 3EN. 3HG. 3HJ. 3NC. 3AHK. 4XC. 5BM. 5BR. 5BZ. 5HL. 5HV. 5LA. 5MF. 5JE. 5YE. 5YH. 5ZA. 5ZC. 5ZD. 8AB. 8AD. 8AL. 8AR. 8BO. 8BP. 8CF. 8DC. 8OP. 8DR. 8DV. 8EB. 8EK. 8FI. 8FT. 8GB. (8GI). 8GO. 8GW. 8HG. (8HJ). 8HP. 8ID. 8IL. 8IK. 8JE. 8KK. 8KM. (8KP). 8KZ. 8LD. 8LF. (8LQ). 8LR. 8MF. 8ML. 8OC. 8OI. 8OZ. 8QJ. 8RU. 8SK. 8TN. 8TT. 8VJ. 8VQ. 8WY. 8ADY. 8AFS. 8AKJ. 8AKV. 8AMJ. 8ALG. 8AWK. 8FAA. 8XA. (8XE). 8XS. (8ZA). 8ZD. (8ZL). 8ZR. 8ZW. 8ZY. 9AT. 9AU. 9BK. 9BP. 9BT. 9BW. 9DB. 9EE. (9EL). 9EO. 9FL. 9FS. 9FT. 9FU. 9GN. 9GO. 9GQ. 9HI. 9HM. 9HN. 9HT. 9IF. 9JA. (9JN). (9JQ). 9KL. (9KO). 9KR. 9KS. 9KW. (9LA). 9LB. 9LC. 9LF. 9LQ. (9LR). 9LW. 9MC. 9NQ. (9OE). 9OG. 9OJ. 9PC. 9PN. 9PS. 9PV. 9QO. 9QY. 9RG. 9RP. 9RY. 9SO. 9SP. 9SQ. 9SZ. (9TI). 9UG. (9UK). 9UT. 9VA. (9VC). 9WE. (9WI). 9WO. 9WT. (9WU). 9WW. 9AAC. 9ABT. 9ABX 9ACD. 9ACL. (9AEG). 9AEQ. 9AEY. 9AFK. 9AFO. 9AGN. 9AHS. 9AHZ. 9AIN. 9AJN. 9AJS. 9AKM. 8AMH. 9AOG. 9AOJ. (9AON). 9ARJ. 9ARK. 9ASF. 9ASJ. 9ATO. 9AXU. 9XI. 9XW. 9YA. 9YB. 9YG. 9YI. 9YM. 9YO. 9YW. 9YY. (9ZB). (9ZC). (9ZQ). 9ZZ. NSF.

9XI. MINNEAPOLIS. MINN.
WA1, XF1 C.W., 2OA, 2PL. 2RK. 2XX C.W.. 2ZD C.W.. 2ZI, 2ZL C.W.. 3BP, 3CW. (3DH). 3MI. 3XF. 4AG. 4BI. 4CS. 4XC. 5BY. 5EJ. 5HV. 5JD. 5MF. (6WV C.W.). 7EX. 7YA. 7ZG. 8AB. 8AD. 8AL. 8BP. 8CW. 8DZ. 8FT. (8IB C.W.). 8ID. (8IK C.W.). 8IV. 8JJ. 8KP. (8MF). 8MH. 8NZ. 8PI. 8PM. (8TN). (8TY). 8UK. 8UY. 8VJ. 8VS. (8XA). 8XK C.W.. 8XP. 8XS. (8YG C.W. & fone). 8YR. 8YS. 8ZA. 8ZC. 8ZL spk. & fone. 8ZR. 8ZW. 8ZY. 8ZZ. (8ADY C.W.). 9AG. 9AJ. 9AY. 9AZ. 9BP. 9BR. 9BV. 9BW. (9BY C.W.). 9CA. 9CP. 9DB. 9DC. 9DJ. 9DV. (9EE). 9EK. (9EL). 9EQ 9ET. 9EW. 9FG. 9FS. 9FZ. 9GC. 9GN. 9GP. 9GV. 9HG. 9HI. 9HQ. 9HT. 9IY. 9JK. 9JN. 9JQ. 9KE. 9KI. 9KN. 9KR. 9KU. 9KV. 9LA. 9LB. 9LG. 9LL. 9LR. 9LU. 9LW. 9MC. (9MH). 9MS. 9NC. 9NO. 9OE. 9OK. 9PN. 9PS. 9PV. 9QO. 9QR. 9RG. 9RQ. 9SQ. 9SZ. 9UJ. 9UK. 9UT. 9UU. 9WH. 9WI. 9WT. (9WU). (9XM spk., C.W. & fone). 9XT. (9YA). 9YF. 9LG. 9YH. (9YI). (9YM spk. & C.W.). 9YN. 9YO. (9YW spk. & C.W.). 9YX. 9YY. 9YZ 9ZA. 9ZB. (9ZC). 9ZJ. (9ZL). (9ZN spk. & C.W.). 9ZR. 9AAV. 9AAW. 9ABX. 9ACJ. 9AEQ 9AEY. 9AFK. 9AFX. 9AGN. 9AHS. 9AIN. 9AIR C.W.. 9AJS. (9AON). 9ASF. 9AWX. 9AXU. 9AYE. (9DBT). 9DSE.

9DCG, PAPILLION, NEBRASKA.
1AW. 4AL. 4MI. 5QA. 5YO. 5YV. 5ZA. 5ZO. 7LU. (9AAX). 9ABX. (9ACS). 9AEG. (9AEQ). (9AFX). (9AHW). (9AIS). (9AJC). (AJS). (9ALK). (9ALO). 9AMA. (9AMB). (9APA). 9AQ. (9AQC). (9AQS). (ASO). (9ASW). (9ATC). (9AWK). 9AXU. (9AYS). 9BR. 9BQ. 9DBS. 9EL. 9EQ. 9ET. (9EW). (9GN). (9HT). 9LA. 9LQ. 9LR. 9LW. 9MC. 9MS. 9OE. 9QI.. (9SC) 9SN. (9UQ). 9UU. (9VE). 9VR. 9XI. 9XM. (9XT). 9YD. 9YI. 9YN. (9YO). (9YP. both C.W. and spk.). (9YY). 9YT. 9ZN. 9ZC.

February Station Reports

THIS is the new department of our QST announced on page 18 of the January issue. If you don't remember the article, read it again so you will appreciate the value of this section. We hope that it will be a guide to us as to just where we can work and how well, thereby enlarging upon the knowledge gained thru "Calls Heard" alone. This department should be an accurate table of who is loudest and who most consistent in every section of the country. The reports at present are confined to members of the Operating Department personnel.

The scheme is for each reporting station to list the best, second and third best stations from each district, both as regards consistency (steadiness, reliability) and as regards relative strength of signals. In the groups of three calls hereinafter, the first one is the best, the second next best, and the last one third best. Where no stations are listed from certain districts, none were heard.

1TS, Bristol, Conn.

1HAA—1YB—1RAY
2RK—2OM—2JU
3ABI (c.w.)—3DH—3VV
4XB (c.w.)—4YA—4EY
8XE—8ZV (c.w.)—8ZL
9ZL—9AAW—9ZJ
Can. 3BP—2AK—2CI

3NB, Vineland, N. J.

Steadiest	Loudest
1RAY—1OE	1HAA—1AW
2TF—2SZ—2VA	2SZ—2TF—2RK
3GO—VMI—3FG	VMI—3YV—3GO
4XC	4XC—4AG
8ZL—8ZY—8ZR	8ZW—8XE—8ZY
9ZN—9AAW—9ZL	9ZL—9AAW—9ZN

General Reception Report for District of Columbia. Compiled from Washington Radio Club stations by F. X. Baer, District Supt., 3XF.

Steadiest		Loudest
1AW—1HAA—1BBL		1HAA—1AW—1BBL
1XT—1XX	(C.W.)	1XT
2RK—2EL—2DA		2RK—2BK—2JU
2ZL	(C.W.)	2ZL
3GO—3DH—3NB		3DH—3GO—3EN
4XC—4YB—4AL		4XC—4YB—4AL
5DA—5YH—5XA		5DA—5ER—5YH
8ZR—8ZL—8RQ		8ZW—8SP—8ZR
9ZJ—9ZN—9LQ		9ZJ—9ZN—9UH

3CA, Roanoke, Va.

1RAY—1HAA—1LBR
2DA—2ZM—2BK
3DH—3AHK—3PU
4BK—4XC—4EK
5YH
8ARW—8BP—8ACF
9LQ—9MC—9FS

4XC, Atlanta, Ga.

Steadiest	Loudest
None	1AW—1HR—1JAB
2RK—2JU—2EL	2RK—2DA—2ZM
3GO—3DH—3HJ	3AHK—3GO—3BZ
4BY—4AN—4AG	4BY—4YB—4FD
5YE—5YH—5DA	5YE—5YH—5DA
None	8SP—8ZY—8ZW
8ZY—8ZW—8ID	9ZJ—9YI—9LR

4YA, Atanta, Ga.

Steadiest	Loudest
None	1AW
2RK—2EL—2JU	2RK—2EL—2DA
3GO—3VV—3EN	3VV—3GO—3HJ
None	4AG—4FD—4BK
5YH—5ER	5XA—5YH—5ZP
8ID—8KP—8ZE	8ID—8ZW—8SP
9LR—9ZJ—9MC	9ZJ—9LR—9FU

5ZP, New Orleans

Steadiest	Loudest
2RK	2RK
3EN—3Z—3GO	3EN—3DH—3BZ
4AG—4XC—4BY	4XC—4AG—4EK
5XA—5YH—5ZX	5YH—5ZX—5YE
8ZY—8ZL—8IK	8ZY—8IK—8ZL
9AEG—9EL—9LR	9XW—9AEG—9JN

5XA, Auburn, Ala.

Steadiest	Loudest
1AW—1XP	1AW—1XP
2RK—2ZL—2EL	2RK—2DN—2GO
3VV—3O—3EN	3GO—3EN—3XR
4BY—4AG—4AN	4BY—4YA—4AG
5ZP—5YH—5HL	5YH—5ZP—5MF
8ZL—8SP—8KP	8ZL—8KP—8RE
9MC—9LR—9VC	9LR—9FU—9KV

5ZU, Austin, Tex.

Steadiest	Loudest
5XB—5LR—5YK	5XB—5LR
6IG	6IG
9LR—9ZT—9AEG	9LR—9ZJ—9AEG

9DU, Dubuque, Iowa.

Steadiest	Loudest
1XD—1XF	1XD—1XF
2RK—2ZL—2BK	2RK—2BK—2SZ
3DH—3EN—3AHD	3DH—3EN—3AHZ
3BY Canadian	3BY Canadian
4XB—4YB—4AG	4YB—4XB—4XC
5YH—5ZA—5YE	5YH—5ZL—5ZA
6ER	6ER
7EX (not very reliable)	7EX
8ZW—8ZR—8YG	8ZL—8ZR—8XK
9XM—9OE—9ZL	9OE—9JN—9LR

9ZL, Manitowoc, Wisc.

Steadiest	Loudest
None	1NAQ—1TS
2SZ—2RK—2TF	2RK—2SZ—2XQ
3DH—3GO—3NB	3DH—3NB—3CC
4XC	4XC—4AG
5YH	5YH—5YE—5ZA
8ZI—8ZR—8ZY	8ZW—8ZR—8XK
9HM—9ZC—9DBT	9YI—9JN—9ZJ

9ZC, Baudette, Minn.

Steadiest	Loudest
5YB—5ZA—5ZZ	5HS
7EX—7ZG	7EX—7ZG
8ZR—8ZY—8XK	8ZR—8ZY—8BP
9YI—9YW—9AGN	9YI—9JN—9XI

9HT, Omaha, Neb.

Steadiest	Loudest
2RK—2SZ	2RK
5ZA—5YH—5HL	5YH—5ZA—5EJ
6OT—6JD—6IG	6JD—6IG—6OT
7EX—7CC	7EX—7CC
8IK—8AKV—8ZL	8IK—8OJ—8ZL
9AKV—9AON—9UU	9LR—9AON—9ARG

9YB, Purdue University, Lafayette, Ind.

Most Consistent	Loudest
None	1AW—1XF
None	2RK—2ZM
3DH—3EN—3GO	3DH—3EN—3YV
4XC—4AU	4XC—4AU
5DA—5YH—5YE	5DA—5YE—5YH
8ZR—8ZA—8XE	8ZR—8ZL—8ZA

(Concluded on Page 60.)

Radio Communications by the Amateurs

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

DISCUSSION OF M. B. WEST'S "WHYS AND WHEREFORES."

304 Columbus Ave.,
New York City.

Editor, QST—

I have read Mr. West's interesting article in the February QST concerning some important factors relative to spark transmitters. Since Mr. West invites discussion on this article, I take the liberty of pointing out some possible answers.

Probably one of the most important factors concerning the balance of spark transmitter oscillating circuits is the wattless component. But before taking up this discussion it may be well to review the behavior of a parallel resonance circuit. Fig. 1 represents an inductance and capacity connected in parallel and supplied by an alternating current source. The reactance due to inductance is equal to $2\pi fL$ while reactance due to capacity is equal to

$$\frac{1}{2\pi fC}$$

For the purpose of illustration let us neglect the resistance or other losses which would be in phase with the impressed E M F. It will be seen that if $2\pi fL$ minus

$$\frac{1}{2\pi fC}$$

equals zero there will be no phase displacement between the impressed voltage and current. In such an arrangement it may be shown that the local current value between the inductance and the capacity may be greater than the current value supplied by the external source. However, these currents are 90 degrees out of the phase with the impressed E M F and do no good insofar as the transmission of energy is concerned.

Fig. 2 represents a vector diagram showing a condition of the currents when the inductive reactance is equal to the capacity reactance.

Fig. 3 represents a vector diagram showing a condition of the currents when the capacity reactance is greater than the inductance reactance. It will be seen that the diagonal vector is the resultant component of the three quantities, inductance, capacity and resistance.

By inspection it may be seen that for most economical operation, that is to obtain the condition of least phase distortion, the vectors should result in—the one due to capacity being cancelled by the one due to inductance. When such a condition is brought about the impressed voltage and current may be multiplied directly at any instant to obtain the true energy in the circuit.

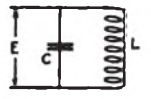
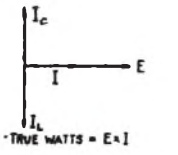


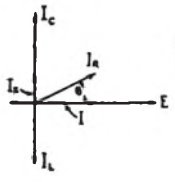
FIG. 1

FIG. 2



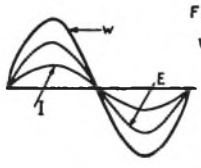
I_c = LEADING CURRENT DUE TO CAPACITY
I_L = LAGGING CURRENT DUE TO INDUCTANCE
I = RESULTANT IN-PHASE CURRENT DUE TO IMPRESSED EMF.
E = IMPRESSED EMF

FIG 3



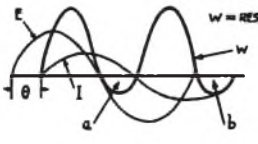
I_c = LEADING CURRENT DUE TO CAPACITY
I_L = LAGGING CURRENT DUE TO INDUCTANCE
I_R = LEADING EXCESS - DIF. BTW. I_c AND I_L
I = COMPONENT OF IN-PHASE CURRENT DUE TO RESISTANCE, LOSSES, ETC.
I_R = RESULTANT CURRENT
TRUE WATTS = $E \times I_R \cos\theta$

FIG. 4



W = RESULTANT TRUE POWER

FIG 5



W = RESULTANT TRUE POWER

From the above it follows that an oscillating circuit should be so proportioned that the capacity reactance is neutralized by the inductive reactance, so that the impressed voltage and current may behave as though they were flowing in a circuit of pure resistance.

Fig. 4 represents a set of power curves showing voltage and current in phase. Note the absence of negative power loops.

Fig. 5 represents the same set of curves showing an excessive inductance reactance causing the current to be distorted to a lagging position with respect to the impressed E M F. It will be seen that the small loops *a* and *b* of the heavy curve are the product of a negative current and positive voltage or vice versa giving a negative power component. This negative power component is known as the wattless component. It does no work in the circuit except to heat it and is returned to the supply source.

The important thing then is to proportion oscillating circuits so as to have

$$2\pi f L = \frac{1}{2\pi f C}, \text{ so that}$$

$$I = \frac{E}{\sqrt{R^2+\left(2\pi f L-\frac{1}{2\pi f C}\right)^2}}, \text{ or}$$

$$I = \frac{E}{R}, \text{and } W = E I.$$

thereby eliminating these negative power or wattless component loops and secondly, so that the resulting in-phase voltage and current may do their best work and attain their highest values together. The resistance in the circuit including that of the spark gap should be reduced to a minimum.

I assume that the readers are familiar with the derivation of the formulae concerned in this discussion and also with the fundamental principles of alternating currents; therefore, I will not take the space to derive them. However, should there be any readers desiring the derivation of the formulae together with a physical explanation of the fundamental theory of alternating currents, I would be pleased to submit them for publication in a later issue. I also would be pleased to outline a possible method for improvement.

Respectfully,
Frederick Winkler, Jr.

Pacific Radio Supplies Company,
San Francisco.

Editor, QST—

Mr. McNamee and I have been very much concerned over the article by Mr. West, appearing on Page 21 of the Feb. issue of QST, because it is absolutely incorrect in many instances.

1. Mr. West in his opening paragraphs is trying to cloud, in an air of mystery, matters which should not be abstruse to radio people.

2. So far as the optimum wave length of a transmitter is concerned, which he mentions in the first paragraph, it should be remembered that the radiated energy is equal to the radiation resistance times the square of the antenna current. The radiation resistance of an antenna is, as has been shown many times in the papers of Austin and others, a hyperbola. The ground, or Joulean, resistance is a straight line function, so that the optimum wave length of a transmitter for maximum radiated energy is that wave length which will give the maximum antenna current consistent with the maximum radiation resistance. This point is more fully covered in my book, "Elements of Radiotelegraphy".

3. On page 22, Mr. West makes the following statement: "If we should connect a condenser and coil together in the same circuit and properly proportion the capacity of the condenser to the inductance of the coil we could exactly balance one against the other so that the tendency of the current to lead in the case of the condenser alone would be neutralized by the tendency to lag in case of the coil alone, and the result would be that we would transmit our power thru such a circuit with losses occasioned only by the resistance of the conductors and dielectric", and goes on to say that while "we have both inductance and capacity, it is seldom likely that they are so balanced as to produce ideal conditions. In fact, it seems that no attempt at all is made to balance them." I doubt if in all my radio reading I have ever seen a statement so contrary to fact as this. So far as *free oscillations are concerned, such as those obtained in a gap circuit, or in an antenna circuit shocked by impulse excitation, the very frequency of the circuit is that which automatically—we might say—balances or neutralizes the inductive and capacitive reactances. In the case of *forced oscillations, such as those impinged upon a receiving antenna circuit and which have the frequency of the exciting e.m.f., in the very act of tuning this circuit to resonance with the incoming frequency, we are doing exactly what Mr. West dictates—that is to say, we are balancing the inductive and capacitive reactances of the circuit. The only way in which we can have a low power factor in a radio frequency circuit is by detuning it from the impressed radio frequency, and in such a case, the current will fall off from its resonance value, rather than rise to the "amazing values" mentioned by Mr. West.

4. The definition of resonance, as used in radio parlance, is exactly the same as that used in alternating current practice, and if Mr. West does not know that in tuning a circuit to resonance, he is neutralizing the inductive and capacitive react-

ances so as to produce unity power factor with the Joulean resistance of the circuit as the only impeding factor, it is about time that he learn this fundamental fact.

5. Figures 3 and 4 cannot be intelligently discussed because they are absolutely meaningless. The power factor of any circuit is the power factor of the whole circuit, and as I have previously noted, the power factor is unity in all radio circuits containing *free oscillations, and in all *forced oscillation circuits where the circuit has been tuned to resonance with the impressed frequency.

Very truly yours,
Ellery W. Stone,
General Manager.

*See definition of "free" and "forced" oscillations in the Report of the Standardization Committee of I.R.E.

It must be remembered that Mr. West's article was very frankly speculative, and as he himself said possibly faulty in spots technically, but was advanced for the purpose of stimulating thought on a subject that is by no means clear. We feel that it merits discussion only in the same spirit.

Mr. West's comments follow:

---

141 E. Fourth St.,
Waukegan, Ills.

Editor, QST—

Referring to attached, I have numbered the paragraphs in Mr. Stone's letter and will refer to them by those numbers.

Par. 1. This is obviously untrue. No such attempt was made or is effected. The statements therein are true. Radiation resistance may explain it BUT the Navy has not yet devised means to utilize in practise the knowledge concerning radiation resistance, its effect on signal strength and range, and its relation to total resistance, and until the Navy attempts to utilize this knowledge in practical work it is hardly to be expected that amateurs will be able to do so. The RESULTS can be attained, however, by experiment as has been pointed out.

Par. 2. The "optimum wave length" of a transmitter is the best wave of *the antenna* and may perhaps be explained in the manner mentioned but (until some *practical* method of determining the various resistances mentioned is devised) can better be determined by the amateur by experiment than by calculation from formulae, the values of the factors of which can only be approximated.

Par. 3. If resonance indicates merely that the capacitive and inductive reactances are neutralized, how can we have resonance at the same wave length with such widely varying degrees of these two factors, UNLESS as is stated in my article, page 22, in reference to Fig. 3, there be some *point* between L and C at which power factor is unity? This point may be inside of either L or C depending on their relative values but it seems to me absurd to state that any values of L and C which may be combined to produce a given wave length will produce unity power factor. Quoting from Wm. C. White, page 274, Radio News for Nov. 1920, "In order to get full output from a tube it is necessary to have only resistance effective in the circuit. Any excess values of inductive or capacity reactance means a heavier current for the same energy delivered (the so-called wattless component) and this component gives an added loss in passing thru the necessary impedence of the filament-to-plate path in the tube". It seems to me that the General Electric people are the only ones that are putting to practical use their knowledge of power factor and its relation to efficiency in radio circuits. It is the basis of several late patents and is the explanation of the effectiveness of the multiple tuned antenna. Let Mr. Stone explain: The closed circuit of a certain actual amateur transmitter has a voltage of 30,000 (estimated by distance jumped at gap) and an actual current in excess of 100 amperes (limit of ammeter). How does he account for the power in that circuit which, with an input to the transformer of 768 watts, will greatly exceed 300,000 watts if his power factor is unity? How, if the power factor is unity, can he account for the fact that the voltage of an amateur antenna often reaches a value that will jump ten inches (let's be ultra-conservative and call it 50,000 volts) with current measured by thermo-ammeter of 5.4 amperes, an apparent watt value of 270,000 with the same input of 768 watts?

Par. 4. May be. BUT WHY is there always a critical value of inductance and capacity for a given wave length that ALWAYS gives best results (both receiving and transmitting) if capacitive and inductive reactances are balanced at the wave length to which it is resonant? Why won't a short wave receiver work with a condenser across the secondary as well as it does when the capacity of the tube and windings are the only capacities present? In any case the fact remains that there is a relation of the values of capacity and inductance for every circuit, whatever may be its purpose, which gives best results for that purpose.

Par. 5. Can't agree. If Figs. 1 and 2 are correct (and I am informed they represent very accurately conditions often encountered in power distribution) I cannot see why Fig. 3 is not a sensible conclusion and from a purely logical standpoint Fig. 4 follows. Of course Fig. 4 seems hardly applicable to a spark transmitter but think a bit about some of the tube transmitter

"hook-ups" and see if it may not perhaps be in common use altho somewhat modified. Any circuit in which L is divided between a coupling coil and a loading coil represents to some extent the condition shown in Fig. 4 and it is well known that for long waves VERY MUCH BETTER results are attained by that arrangement.

In conclusion. Mr. Stone seems to take extreme satisfaction in criticizing what I say rather than the ideas that I am trying to convey. Scientific knowledge is useless to the mass of humanity unless it is put in the form of simple directions of how to do things and so results in widespread good rather than the advantage to the few who can understand complex scientific terms. All these seemingly complicated treatises can be reduced to simple terms if the one who writes them will only see the other fellow's viewpoint and really try to do so.

Very truly yours,
M. B. West, 9DEA.

(In a freely oscillating circuit the current and voltage differ by ninety degrees. But it certainly seems true that there is but one combination of inductance and capacity to give the required wave length in the closed circuit of an amateur transmitter which will give the highest *resultant* power factor also.—Editor.)

A NEW SOUTHERN STATION

Editor, QST—
Dear Friend Warner:

This is to inform you of the fact that one of the star relay stations of the South is to be erected at Thibodaux, La., a city fifteen miles from our city, within the near future.

This station has been obtained for the Lafourche High School through the efforts of Messrs. John B. Taylor, Dr. Smith, Supt. Lafargue of the Lafourche Schools, Mr. Miller, Supt., Mr. Payne of the Lafourche Lumber Co., and Mr. Broussard, all prominent business men of the city of Thibodaux. This station has had not a cent spared to make it one of the best radio stations in the United States, the funds for the erection of same being raised by popular subscription, and generous donations from the committee in charge.

The site selected has not any metal work for a great distance, and will afford the American Radio Relay League one of the best stations of the South. The equipment will consist of 1 KW Acme transformer, Dubilier Condensers, Benwood enclosed gap, and T. & H. Radio Oscillation transformer for the transmitting unit. The receiver will be composed of specially built regenerative receptor, two stage amplifier, two pair of Baldwin phones, in connection with a Magnavox loud speaker, and special battery of storage and B battery cells to carry on the best long distance work that could be desired. This set will be conducted in connection with the physics class of the school, which will prove to be a tremendous benefit to the school, as well as the city of Thibodaux in general. We hope that all who hear this station will forward their station card, and will be greatly appreciated.

This is to wish all the boys around the home office the best of luck, and hoping that you all will report us, whenever you hear us. We are installing the set for the school, and have every faith that it will be an exceptionally fine one.

Sincerely,
F. L. Pullen, 5JE.

HI!

Baltimore,
March 7, 1921.

Dear Eddy—

After you have been to a convention and met all the important folks and come back and look thru your back QSTs and find you have pictures of almost all of them—AINT IT A GRAN' AND GLORIOUS FEELIN'?.

As one OW to another, I wanna tell the girl who fell in love with C. A. Service's picture that she just oughta meet him. That picture doesn't half do him credit.

Y.L.

FORMULA CORRECTION

Toronto, Ont.,

Editor, QST—

Re. "Measurement of High Resistance", p. 27, Dec. QST.

R_x does not equal

$$R_v\left(\frac{E_b}{E_v}-1\right),$$

which was probably a misprint, but equals

$$R_v\left(\frac{E_b}{E_v}-1\right).$$

My method of obtaining a formula would be:

$$\frac{R_x}{R_v}=\frac{E_x}{E_v}=\frac{E_b=E_v}{E_v}$$

where E_b is the open circuit voltage of battery as above.

73,
"Canuck Student".

A CAUSE OF QSS?

117 South Blakely Street,
Dunmore, Pa.

Editor, QST:

I have never seen or heard the following given as a possible reason for sigs fading, and I wonder.

This dope came to me while trying out CW stuff, using rectified AC. While using

this for CW I noted, more than once, a drop in both the radiation, (on a very sensitive milli-ammeter) and also on the plate or space-current ammeter, when leaving the set running as straight CW. At first this had me guessing. But after rewinding and rewiring the entire set and many other changes, I finally checked up on it and found that this occurred mostly during the early part of the evening. Then in order to convince myself that this might be the theory, I had the Light Company install a recording voltmeter. After having this meter connected on for almost a week, I found that the voltage varied anywhere from 110, which is supposed to be normal, to as low as 85 volts and as high as 132½ volts. The curve was very irregular and at times made jumps from about 90 volts to 115 and then again it would run 110 for hours and then finally take a jump higher and sometimes lower and on a very long curve. Then is when I happened to think of how sigs faded. Remembering that they almost always run about five to fifteen minutes and then faded, I again checked up on the curve and found that it might be possible. You no doubt see my idea already; I will try and give it as clearly as possible:

Take in the case of a ½ KVA transformer, which is supposed to draw approximately 4½ amps at 110 volts or around 450 watts. But according to the curve above mentioned, suppose that the service dropped to, say, 100 or 90 volts, wouldn't it mean that there would only be less watts drawn by the transformer, according to the above voltage? Naturally less watts working upon the antenna would not have the same effect at the receiving end as when 450 watts had been put through, consequently there would be a drop in signal strength.

Furthermore, tuning in a station whose signals are QSA, requires a different setting than signals that are QRZ. Am I right, or is it my set? Then, coming back to this drop in service line voltage, wouldn't the signals become weaker when the line voltage drops, and if signals were coming QSA and you were tuned for them and then the service drops, causing the signals to become weaker, wouldn't it require the different tuning to keep him audible? Then if you did not change the setting, the signals would again come in QSA when the service came to normal again.

Now Eddy, I may have wasted some stationery and worn out a ribbon on this mill and have lost about a half hour's sleep, but just the same, I had to get it out of my system and you were the first one in mind, so don't think hard of me, OM.

Very truly yours,
Roy C. Ehrhardt,
Radio 8ZQ.

THE "BD" MYSTERY

Marion, Mass., 1HAA

Editor, QST:

Every so often something will happen that reminds me of the old days before there were and QR or QS signals, and when licenses were absolutely unknown.

'Way back in these days the Massie Wireless Co. had a ten kilowatt spark set in upper New York City on Jerome Ave. As rotary gaps were unknown, they had a straight spark gap and had her wide open. Without exaggeration, when they had the door opened we could hear the darn thing up in Mt. Vernon, some miles distant. He almost broke a leg trying to reach to the Massie station at Wilson's Point, Conn.—old "WN". The Long Island Sound boats were equipped with this same system.

How I laugh when I think of their detectors! They consisted of two horizontal carbon rods upon which they placed an oxided needle. Old Hiram Hilkens, who was operator on one of the tubs, was sure a scream with one of these detectors. Hiram wore glasses about a half inch thick, anyway, and every time the old tub gave a lurch the needle rolled off the carbons. After a vain search of the wireless cabin, Hiram would fish another needle out of his vest pocket and be all set again. It was a great life.

After a year or so of operation the Massie Co. went on the rocks, as did many other wireless concerns in those days. This meant the closing of old ten K.W. "BD" station on Jerome Ave. Now somebody, I'm not saying who, thought up the idea of making a visit to old "BD" and just "removing" the 10 K.W. to another location. So one dark and stormy night a truck backed up to the door and away went the transformer, key, condensers, helix and spark gap. This was great dope, and as nobody seemed to care a hoot, they thought they'd go back and get the tuner and stove, so hitched up the old mare and made a return visit. Ha! Strange to say, someone else had had the same idea a little ahead of time, for the whole works, shed and all, were gone. The only thing that was there was the mast—the aerial wires, even, had vanished with the shed.

I think I know where that shed is today, but whatever happened to the rest of the outfit the old timers only know. There were sure some mighty powerful sparks around our neighborhood those days. The old 5 K.W. I had—a Clapp-Eastham Type E—used to pull 53 amperes, 110 volts, on the primary. Our home-made rotaries a few years later were made of big wooden discs an inch thick and were 24 to 36 inches in diameter. The one I had was hitched to a 250 volt D.C. motor, and I just hurried it along a bit by putting 550 volts on it, which somehow or other

mysteriously leaked off a trolley wire into my radio shack.

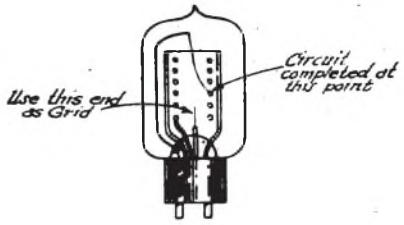
Sincerely,
Irving Vermilya.

"REPAIRING" TUBES

1617 19 St. N.W.,
Washington, D. C.

Dear Eddie—

Little things like burning out tubes dont worry me any more, for lo and behold, I have found a way to utilize dead tubes. I was examining a dead Moorhead the other day and noticed that one end of the fila-



ment had bent over and touched the grid, making a complete circuit thru the grid and filament terminals I immediately changed the connections of my socket, using the dead end of the filament as a grid and to my surprise, it worked nearly as well as a new tube. I have since "repaired" another tube in the same manner by carefully tapping on the glass until the filament touched the grid.

WL, OM, NM, nw, CUL,
A. R. McGonegal, 3AFW.

THE ROUTE TO ALASKA

Box 206,
Ketchikan, Alaska.

Editor, QST—

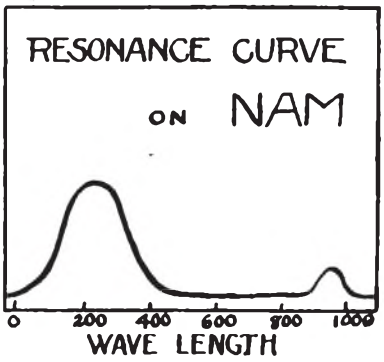
As yet no radio amateur has communicated with amateurs in the states via the ether. As practically all of the Alaska towns have Government stations, the power allowed amateurs is only one-half kilowatt. With this power there is very little possibility of anyone here being heard as far south as Seattle, except possibly on rare occassions. One of the electricians stationed at the local Naval Radio Station reported to me that 7CU of Vancouver, Wash., came in clear using an aerial of about 350 meters natural wavelength, and only a one step amplifiier. He said there were many others heard, but "too many cooks spoil the soup" so he couldn't get their calls.

However, it is possible that a half K.W. could be heard in British Columbia, at least as far as Prince Rupert which is about 20 miles from Ketchikan. In this manner messages could be relayed, during the winter at least. But the principal difficulty encountered is this: Are there any amateurs in Prince Rupert or vicinity who have, are allowed or else have the means to get a half K.W. installed? For this reason I am writing to you, to find out whether you know of any Radio Amateurs, hams or otherwise, in the above mentioned vicinity.

If you do know of any would you please let me know, as I am anxious to help in opening a relay route from Alaska, either this spring or next fall.

Yours respectfully,
Roy Anderson of Station 7IT.

(Will anyone with knowledge of amateur station possibilities in the vicinity of Prince Rupert, B. C., communicate with us or Mr. Anderson?—Editor.)



FEBRUARY STATION REPORTS

(Concluded from page 54.)

9ZJ—9ZL—9LQ 9ZJ—9ZL—9LQ

Remarks

First District. No consistent stations; 1AW heard occasionally and some others less frequently.

Second. 2RK very loudly at times, other stations irregular and usually lost in QRM.

Third. 3EN seems to have come back to life as we are hearing him more often again. 3HJ seems to have dropped off the map. None of the others come in very well. 3GO heard pretty well on a few nights recently.

Fourth. 4YB not working much this month. 4IC best we have heard. Heard a number of other 4's but none very loud.

Fifth. Much the same as last month but with 5ER dropping out and 5YE coming in more often.

Sixth and Seventh Districts. No stations logged from these districts athough we almost thought we heard a 6 one night.

Eighth. Where is 8ZL? We have them logged on only one occasion when they came in strongly. 8ZR seems to be in the lead now. There is a flock of good special stations in the Eighth District, among them 8XA. 8XE, 8XK, 8ZA, 8ZD, 8ZH, 8ZL, 8ZO, 8ZR, 8ZW and 8ZY. Some of the other eighth district stations seem to think that the wave length law does not mean anything. We have heard regular amateurs on wave lengths up to 400, we know, because we have measured them.

Ninth. Same stations as last month are doing the work. Our neighbor, 9KR at Lebanon, seems to be quite active and is reaching out somewhat. Some of the ninth district boys are stretching the wave length law also.

QST'S DIRECTORY OF CALLS

ADOPTING the Department of Commerce's list of amateur stations as it's standard, QST will publish each month the calls of new stations in each district commencing where the government book stops. To make this possible, amateurs are requested to report new or changed call letters to this office.

FIRST DISTRICT

A. R. Findlay,	391 Windsor Ave., Hartford, Conn.	1GBP
E. E. Parmenter,	3 Sheldon Pl., Waterville, Me.	1GBQ
R. E. Hull,	169 Lothrop St., Beverly, Mass.	1GBR
H. G. Ringwood,	29 Arnold St., Boston, Mass.	1GBS
S. S. Heap,	132 Atlantic St., Atlantic, Mass.	1GBT
Boardman H. Chase,	39 Chester Ave., Winthrop, Mass.	1GBU
James P. Saunders,	15 Cherry St., Salem, Mass.	1GBV
Frederick E. Hue,	183 Winthrop St., Winthrop, Mass.	1GBW
Warren F. Priest,	Foster St., Littleton, Mass.	1GBX
Wm. T. Chase,	16 Evans St., Dorchester, Mass.	1GBY
Arthur L. Spring,	25 Loring St., Newton Center, Mass.	1GBZ
Warren A. Ford,	855 Massachusetts Ave., North Adams, Mass.	1HBA
Gordan Wells,	139 East Cottage St., Dorchester, Mass.	1HBB
Richard F. Shea,	668a Dudley St., Roxbury, Mass.	1HBC
Clarence H. Morse,	33 Union St., Mansfield, Mass.	1HBD
Albert A. Sears,	14 Erin St., Whitman, Mass.	1HBE
Arthur L. Fern,	12 Essex St., Hartford, Conn.	1HBF
Robert E. Gray,	234 Thomas St., Groton, Conn.	1HBG
Laurence B. Cheney,	R. F. D. No. 1, Southbridge, Mass.	1HBH
Robert V. Howard,	Loomis Inst., Windsor, Conn.	1HBI

SECOND DISTRICT

J. P. Jessup,	93 California St., Ridgewood, N. J.	2AUG
Clifford Holman,	Highland Park, New Brunswick, N. J.	2AZY
G. Curtis Engel,	181 Upper Blvd., Ridgewood, N. J.	2BBB
A. L. Wilcox,	424 Tremont Ave., Westfield, N. J.	2BEL
Thos. Robinson,	226 Lincoln Ave., New Brunswick, N. J.	2BER
H. C. Hogencamp,	623 E. 22d St., Paterson, N. J.	2BID
Paul Rank,	319 Union St., Union Hill, Weehawken, N. J.	2BJB

THIRD DISTRICT

Roy W. Geiger,	Oringsburg, R. R. 1, Penna. (Reassigned)	3UA
R. H. Velutine, 3d,	1931 N. 23d St., Philadelphia	3AAE
Jas. Curry,	Box 293, Hilton Village, Va.	3AAG
Geo. Butler,	647 N. 12th St., Reading, Pa.	3AAI
Carl Kunsman,	519 Penn. St., Reading, Pa.	3AAF
R. M. Lacey,	11 Mills St., Morristown, N. J.	3ABG
Ralph Hartman,	440 Mulberry St., Reading, Pa.	3ABO
Walter Hoffman,	4014 Green St., Reading, Pa.	3AEN
Edw. Beeler,	2432 W. Morris St., Philadelphia	3AEQ
Harold Monyer,	1034 Court St., Reading, Pa.	3AFH
Russell Kutz,	330 No. 10th St., Reading, Pa.	3AGC
R. L. Wilson,	1706 Race St., Philadelphia	3AJM
Elmer Jones,	Wyncote, Mont. Co., Penna.	3AKU
W. K. Koch,	1521 N. 17th St., Philadelphia	3ALL
W. Russell Scargle,	801 Baltimore Ave., East Lansdowne, Pa.	3AMY

FOURTH DISTRICT

C. J. and Eugene White,	510 Park Ave., LaGrange, Ga.	4DT
A. C. Robinson,	1503 University Ave., Gainesville, Fla.	4DW
Frank Dodd,	Vernon St., LaGrange, Ga.	4DX
Henry H. Pike,	Park Ave, LaGrange, Ga.	4DY
A. J. Cook,	Flat Shoals Road, RFD, Atlanta, Ga.	4EE
W. C. Ether	Woodruff, S. C.	4EG
G. G. Trammel,	25 Milledge Ave., Atlanta, Ga.	4EI
Thurston Hatcher,	142 Adams St., Decatur, Ga.	4EK
R. L. McCall,	99 E. Merritts Ave., Atlanta, Ga.	4EM
Charles Kelly,	Moreland Ave., Atlanta, Ga.	4EO
Bela Winterkorn,	Glenwood Ave., Atlanta, Ga.	4EQ
H. H. Snyder,	211 Central Ave., Atlanta, Ga.	4FM
T. Green,	707 S. Boulevard, Atlanta, Ga.	4FQ
Georgia School of Technology	Atlanta, Ga.	4YA
Knights of Columbus Radio School, Marist College, Atlanta, Ga.		4YJ

FIFTH DISTRICT

G. M. Cornelius,	Seminary Hill, Ft. Worth, Tex.	5LC
Bryce Ballinger,	Box 747, Miami, Okla.	5LO
Geo. Johnston,	1457 Milner Crescent, Birmingham, Ala.	5LP
Guy W. Neel,	Dublin, Texas (Ex-5BI),	5LR

SIXTH DISTRICT

C. R. Henry,	626 3d St., Napa, Cal.	6ACA
M. P. Gilliland,	117 Foothill St., Pasadena, Cal.	6ACB
W. D. Johnson,	4346 Townsend Ave., Oakland, Cal.	6ACC
A. L. Walker,	6th & Lay Sts., Winnemucca, Nevada	6ACD
W. H. Westerman,	3219B Adeline St., Berkeley, Cal.	6ACE
E. Pack,	6451 San Pablo Ave., Oakland	6ACF
M. H. Hurt,	289 W. 14th St., Riverside, Cal.	6ACG

C. E. Thompson,	1876 15th St., San Francisco (Portable Station)	6ACH
I. A. Coffey,	75 E. Santa Clara St., San Jose, Cal.	6ACI
M. H. Hurt,	289 W. 14th St., Riverside, Cal.	6ACJ
L. H. Atkinson,	1306 Filmore St., San Francisco	6ACK
A. Brooks,	432 Lyon St., San Francisco	6ACL
L. Newman,	1700 Sonoma Ave., Berkeley, Cal.	6ACM
R. W. Kerrigan,	2843 Harrison St., San Francisco	6ACN
H. C. Robom,	2069 O'Farrel St., San Francisco	6ACO
R. K. Salisbury,	400 Wilcox Ave., Oroville, Cal.	6ACP
H. W. Scribner,	23 Presidio Terrace, San Francisco	6ACQ
T. A. Work, Jr.,	181 Central Ave., Pacific Grove, Cal.	6ACR
H. F. Thornton,	Arcata, Cal.	6ACS

SEVENTH DISTRICT

Melvin Van Scoyoc,	Orting, Wash.	7JS
Norman R. Hood,	1022 So. Ash St., Casper, Wyo.	7KX
Carl V. Finch	201 S. 6th St., Bozeman, Mont.	7MR

EIGHTH DISTRICT

Following reissued calls; cancel assignments in Call Book:

Ralph Gaylord,	338 Sackett St., Cuyahoga Falls, Ohio	8HE
Beaver High School,	2d & Market, Beaver, Pa.	8MR
B. T. Dreyer,	1516 Montclair Ave., Detroit	6KH
Wm. McKenzie,	430 Floyd St., Toledo, O.	8KO
F. A. Hamel,	200 Martin St., Amherst, O.	8QH
R. W. French,	1675 Pilgrim Pl., Akron, O.	8UQ
Chas. C. Davis,	411 Poplar St., Fenton, Mich.	8ADY
Bellevue High School,	Bellevue, Pa.	8AGY
Thos. B. Keller,	1362 W. 76th St., Cleveland, O.	8AJO

Following are new calls:

Robert F. Counsaime,	102 Norwalk Ave., Buffalo, N. Y.	8ALZ
Palmer H. Craig,	3397 Glenmore Ave., Cincinnati, Ohio	8AMA
Joseph Buehlmann,	78 Garfield St., Lancaster, N. Y.	8AMB
Clarence M. Voll,	152 Johnson St., Buffalo, N. Y.	8AMC
Lloyd W. Laird,	18 N. Race St., Greenville, Pa.	8AMD
Howard B. Blodgett Mouatt,	264 Field St., Rochester, N. Y.	8AME
Harry E. Blewitt,	1032 Orange Ave., Youngstown, Ohio	8AMF
J. Russell Ball,	6514 Darlington Rd., Pittsburgh, Pa.	8AMG
Edw. G. Snyder,	1476 Alabama Ave., Dormont, Pittsburgh, Pa.	8AMH
Benton S. Clark,	715 E. Malden St., Washington, Pa.	8AMI
Lawrence J. Birkel,	564 Clifton St., Springfield, Ohio	8AMJ
Harry Latus,	270 Field St., Rochester, N. Y.	8AMK
Glen S. Whidden,	R. F. D. No. 1, Holt, Mich.	8AML
Charles F. Nichols,	Elm St., Webster, N. Y.	8AMM
J. Bernard Sponsler,	337 High St., Williamsport, Pa.	8AMN
Herbert W. Squires,	121 Court St., Binghampton, N. Y.	8AMO
Richard Voighs,	1314 Clinton St., Sandusky, Ohio	8AMP
Kendrick Ross,	60 Warwick Ave., Rochester, N. Y.	8AMQ
Albert B. Fuller,	238 S. Goodman St., Rochester, N. Y.	8AMR
Albert H. Buch,	Fifth Ave., Tawas City, Mich.	8AMS
Julius Jefferies,	R.F.D. No. 2 Box 20, Letonia, Ohio	8AMT
Jackson K. Sterrett,	1001 Walnut St., Erie, Pa.	8AMU
John D. Graven, Jr.	692 N. Walnut St., Van Wert, Ohio	8AMV
Clarence Gielow,	218 McDonough St., Sandusky, Ohio	8AMW
Robert K. Champion,	517 Park Ave., Williamsport, Pa.	8AMX
Herbert Riley,	7233 Standish St., Pittsburgh, Pa.	8AMY
Hobart R. Avery,	..... Oakfield, N. Y.	8AMZ
Frank P. Oros,	163 Rademacher St., Detroit, Mich.	8ANA
Carl P. Goetz,	1128 Atwood Ave., Cincinnati, Ohio	8ANB
William J. Baldwin,	92 E. Haseltine Ave., Kenmore, N., N. Y.	8ANC
W. B. Ritchie Agnew,	16 Oakland Ave., Washington, Pa.	8AND
Mendell Schneider,	112 Weld St., Rochester, N. Y.	8ANE
Elmer L. Wagner,	308 Mitchell Ave., Butler, Pa.	8ANF
Robert White,	557 Philltppi St., Clarksburg, W. V.	8ANG
Lester R. Reynolds,	522 William St., Buffalo, N. Y.	8ANH
Stephen Harvey,	85 Pearl St., Gloversville, N. Y.	8ANI
Wayland C. Marlow,	Shredded Wheat Co., Niagara Falls, N. Y.	8ANJ
J. L. Greene,	1454 Shady Ave., Pittsburgh, Pa.	8ANK
Millard W. Baldwin, Jr.,	Overlea Farm, Marey, N. Y.	8ANL
Phil H. Rinehart,	South High School, Pittsburgh, Pa.	8ANM
Mark A. Ricci,	108 Reed St., Clairton, Pa.	8ANN
Ralph E. Humes,	884 W. Jefferson St., Springfield, Ohio	8ANO
Fred Sima,	719 W. Michigan Ave., Ypsilanti, Mich.	8ANP

NINTH DISTRICT

Lombard College,	Galesburg, Ill. (N. C. Smith, Opr.)	9XW
L. A. Benson,	4942 Wiesehan Ave., St. Louis, Mo.	9ZB
H. D. Matteson,	334 W. South St., DeKalb, Ill.	9AMR
F. M. Rudich,	1500 S. Ridgeway Ave., Chicago	9AOX
Dale Tetrich,	1326 S. Peoria, Dixon, Ill.	9AUH
H. R. Gibson,	703 N. Elm St., Centralia, Ill.	9AVQ
H. W. Wells,	540 Wauwatosa Ave., Wauwatosa, Wis.	9AYG
R. W. Hitchcock,	41 Arlington Ave., Indianapolis	9AYH
Lee Hamm,	571 Wauwatosa Ave., Wauwatosa, Wis.	9AZM
P. M. Jacobs,	1314 Niedringhaus Ave., Granite City, Ill.	9AZD