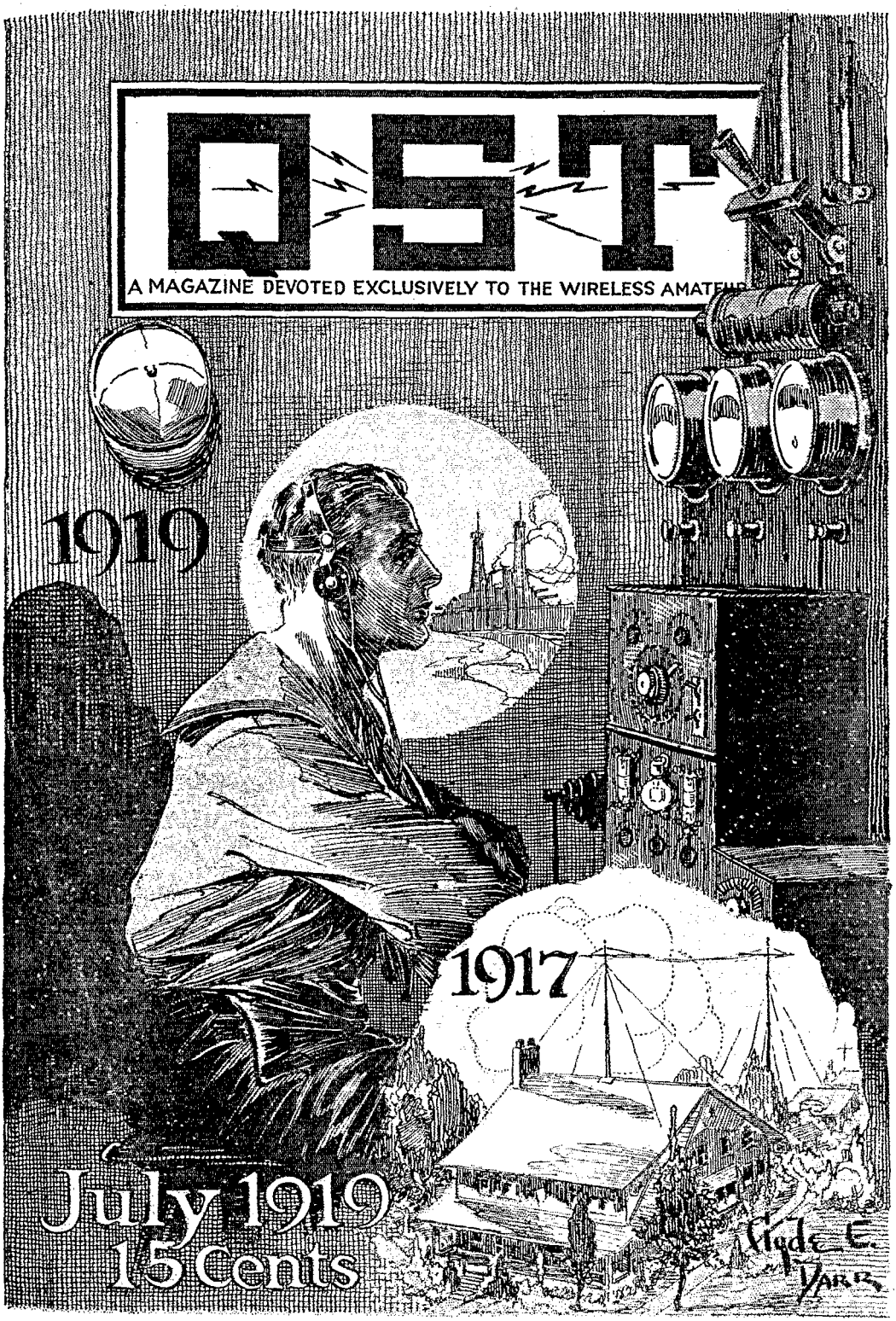

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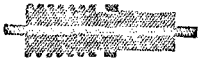

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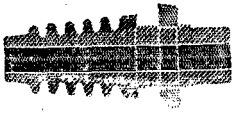

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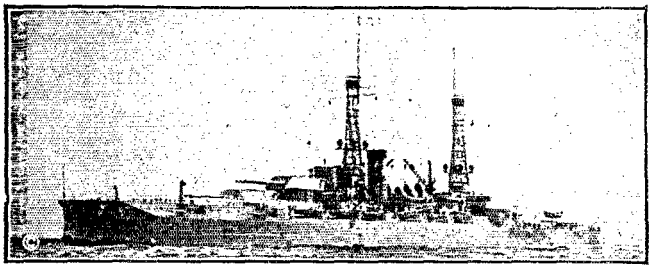

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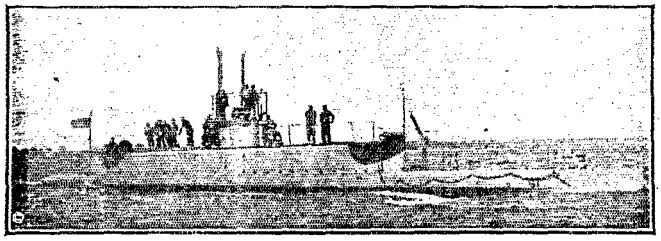

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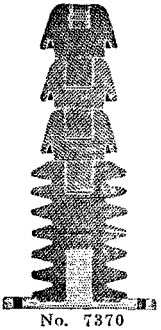

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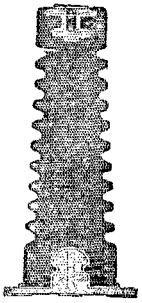

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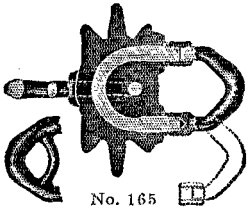

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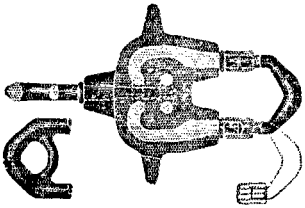

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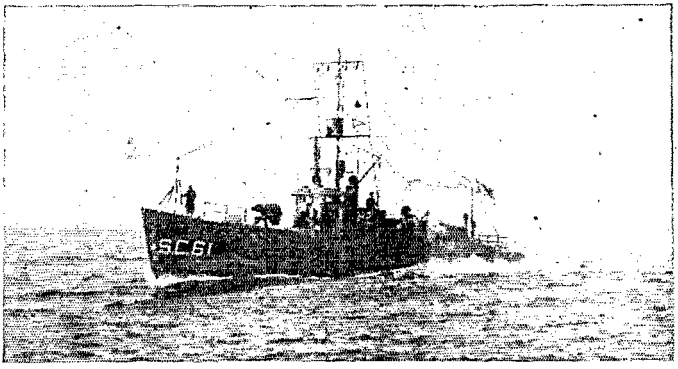

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JULY, 1919

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CONTENTS

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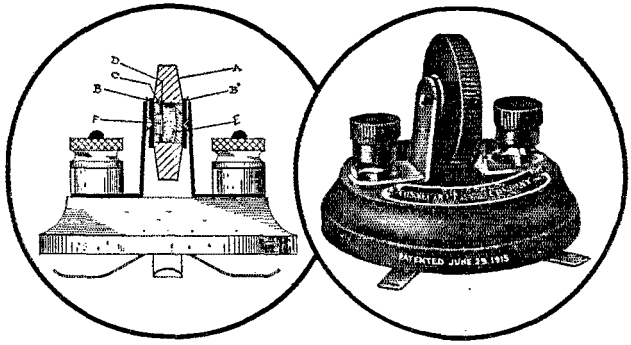

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Q S T
A Magazine Devoted Exclusively to the Radio Amateur

Essentials of V. T. Transmitters

By K. B. Warner

A GREAT cloud of mystery seems to overhang the subject of vacuum-tube transmission in the mind of the average amateur and the writer hopes in this article to explain some of the fundamentals. It is a subject in which we are all vitally interested, and the time to begin studying is at hand, for it is only a question of a short time until small power tubes for the amateur will be available.

A word about the merits of continuous-wave transmission. This is practically an untouched field in the amateur realm, for heretofore the elaborate and expensive apparatus required, and the deep theory involved, have prohibited general experimentation. VT transmission is by continuous waves (hereinafter called C.W.), and, similar to the better-known methods of generating persistent oscillations, such as the Poulsen arc, the G.E.-Alexanderson alternator, etc., but the vacuum tube is the only method adaptable to small powers and has the additional advantages that its generated oscillations are without the irregularity in amplitude characteristic of arcs and, most important, is sufficiently flexible to efficiently generate the high frequencies necessary for operation on amateur wavelengths. Theoretically the decrement of C.W. is zero; practically, the only measurable decrement is caused by the effective resistances of the transmitting and receiving antennae. To put this in the simplest possible language, with VT transmission all our energy is concentrated on as near one wavelength as is possible by any known method. This is the entire secret of its great efficiency; the energy is not distributed over a more or less broad band of wavelengths. The writer has personally seen a distance of 37 miles worked with a small one-tube set with portable antenna 20 ft. high, in daylight, with three watts antenna energy. Radio Utopia is not yet here, however. It would be if all of us used CW, as I can imagine no more feasible way of minimizing QRM than by having everyone's decrement approach zero. The trouble is that a jambing spark station with broad tune will still come in, tho the oscillating VT used in reception will change its note to a hiss, but if it is sufficiently close or powerful its broad tune is to be found all over the tuner the same as in the old days, and will drown out the signals from the feeble CW station which are concentrated on one tune. The practical problems of this situation will have to be worked out as we proceed in the installation of amateur CW. It is new ground for all of us. For instance, two CW transmitting stations may beat upon each other and under certain conditions make a continuous howl in a third receiving station. However, the writer has no doubt that these practical problems will be solved as they arise, and surely we are all interested in so efficient a method of transmission as afforded by VTs.

There is nothing complex in the basic theory of such transmission. Consider a simple inductive-feedback oscillating receiving hookup as shown in Fig.1 This is a miniature transmitter, for oscillating energy exists in the plate circuit, the power furnished by the B battery, and the circuit

is coupled to the antenna so that a small amount of energy is actually being radiated. The ordinary receiving tube, however, is not capable of handling much energy, and as the oscillations are in the plate circuit, the hookup can be improved to better transfer them to the antenna. Such a circuit is shown in Fig. 2. Note that the grid and plate circuit inductances L1 and L2 are coupled electromagnetically to the antenna inductance. These first mentioned circuits are aperiodic, and the period is therefore determined by the constants of the antenna circuit alone. The action is very simple. Consider a surge in the plate current. An EMF is induced in the antenna coil and the resultant current in turn induces an EMF in the grid circuit, which if made in the proper direction will react on the circuit thru the characteristics of the tube in such a manner as to sustain the operations at a frequency dependent entirely on the antenna circuit.

Now there is no great reason why inductive coupling should be necessary between plate and antenna, and increased efficiency is obtained by the direct coupling shown in the simpler circuit of Fig. 3, the action of which is otherwise quite the same.

We hear much these days about capacity feed-back. This is a subject on which books may be written, but the fundamental idea can be obtained from Fig. 4. Circuit A is a symbolic representation of inductive feedback as just explained, the oscillating circuit consisting of the whole inductance and its distributed capacity, C, and the necessary coupled inductances of the grid and plate circuits represented by the (aperiodic) inductances L1 and L2 on either side of the filament connection. Now notice Circuit B, in which the only change is to move the filament connection to the center of total capacity instead of the cen-

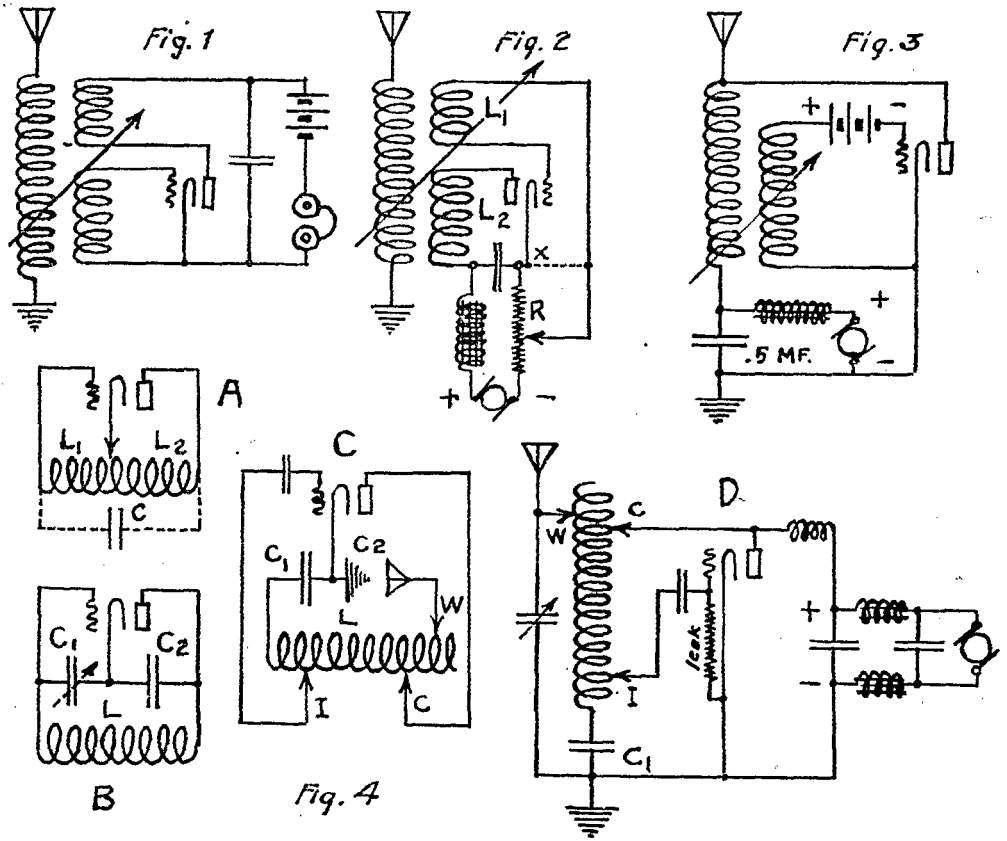

Fig. 4

ter of inductance. The only oscillating circuit present is L-C1-C2. A change in the plate-filament current imposes a charge on C2, which discharges thru the oscillating circuit, in doing which it charges C1, and the potentials thereon, being transmitted direct to the grid, are such (if the phase relationship is right) as to continue the circuit in an oscillating condition thru the characteristics of the tube. If C1 is made variable, a very convenient method of varying the impressed grid potential is made available, and this will control the amplitude of the generated oscillations. Now in Circuit A, the aerial and ground would be connected to the extremities of the inductance, the antenna capacity thus adding to the distributed capacity illustrated. In Circuit B, condenser C2 is actually formed by the antenna system, and in this manner the entire oscillating energy is directly introduced into the radiator. Circuit C is an evolution from this, and shows several methods of control. If the antenna tap W is made variable, we have a means of varying L-C1-C2 and so controlling the wavelength. For practical working it is necessary to control the voltages impressed across the condensers. Circuit B showed how this could be done in the case of C1 by making it mechanically variable, but this is not possible where the capacity is formed by the antenna. However, we may vary the effective capacity by the insertion of more or less series inductance, the reactance of which is directly opposed to the reactance of condensers. This is shown by taps C and I in Circuit C, which serve to introduce a variable inductance in series with C2 and C1 respectively; thus controlling, in the first case, the oscillations set up by a change in plate current, and in the second case, the amplitude of the potential transferred to the grid for the purpose of sustaining the operations. A more understandable hookup embodying these features is shown in Circuit D. The theory of the capacitive feedback is very beautiful, but its successful operation presupposes an antenna of practically all capacity—little inductance or high-frequency resistance. It is probably this last factor which has presented the greatest handicap to its satisfactory functioning on very small antennae, and the tendency in design of small sets seems now to be firmly established in favor of the electromagnetic.

This is not a technical article; rather is it designed to set forth the practical fundementals for amateur construction, but the numerical values of the different factors in the set will depend entirely on the tubes used.

Do not overlook the fact that for oscillation generation the tube is functioning on the straight portion of its characteristic curve, exactly like an amplifier. If the normal free grid potential is not the value requisite to shift the axis of oscillation to the center of the straight portion (and it probably will not be), it will be necessary to impose a permanent negative potential upon the grid sufficient to shift the axis to the correct point. This is extremely important, for if in such a case the grid were allowed to become momentarily positive, an excessive current would flow and the tube be burned out. Fig. 3 illustrates the simplest method of obtaining the desired results: by the insertion of a series battery of the correct voltage. Another way is shown in Fig. 2 where a resistance R is introduced in the negative leg of the power supply and the grid-circuit connection shifted from the normal point X to a position along the resistance R where the drop is sufficient to give the required negative potential. Values of grid condensers, if necessary, and their attendant leaks, will vary with the tubes, and should be available from the manufacturers. Bear in mind that if a grid condenser is used simply to insulate the grid from the plate potential as in some hookups, a shunt leak will not suffice: the leak must be bridged from the grid direct to the filament, or it would partially defeat the purpose of the condenser. Iron-core choke coils of high inductance are necessary in the power supply to prevent the passage of oscillating energy. As the voltages employed are quite small in comparison with spark transmitters, standard air variable condensers, and inductances not a great deal different from receiving coils, will suffice. The power supply is a serious question. Most small

tubes operate on 350 to 500 volts. As the power consumed is small, it should not be difficult to build a high-voltage storage battery capable of being charged in several units in parallel and discharged in series. There is also on the market now a line of small motor-generators, having a standard induction motor for 110 a. c. and the generators being available in different voltages quite suited to the operation of such tubes. When a generator is employed, however, smoothing inductances and capacities will probably be necessary to form a kind of filter-box to iron out the commutator ripple.

Nothing has been said about the location of the telegraphic key. I leave this to the builder. Three methods of its use are familiar. First, the simple "cut-in", which is simply placing the key in the ground-lead and interrupting the CW to form dots and dashes—a proceedure wholly safe at the voltages used. Second, a buzzer chopper can be inserted in the ground lead, and its operating battery controlled by the key, this method producing audio-frequency trains of waves which will be audible on a non-oscillating detector. Third, and by considerable the best method, the compensated, as employed by most commercial CW stations, wherein a very small series inductance in the ground lead (sufficient to change the wavelength by 5 to 10 meters) is shunted when the key is depressed. Other methods will perhaps present themselves, but these are the best. Such a transmitter can also be employed as a simple radiophone by the insertion of a microphone in the ground-lead.

To summarize, then: Above all, know your tubes. Manufacturers should furnish characteristic curves. Study these until you can proceed intelligently in the construction of a set to embody this particular type of tube. A motor-generator and filter-box seems the best source of plate current. The voltages used will be the only determining factor in the inductances, the desired wavelength being known. Electro-magnetic feedback, either inductive or direct, is better in practice than capacitive feedback. Make your tickler coupling variable to control the feedback. Determine, from the grid voltage-plate current curve, the normal potential to be kept upon the grid to bring the operation to the center of the "straight-line" or amplifying portion of its characteristic, and provide a means of keeping the grid definitely at this value in operation.

"Try This on Your Paragon"

FROM abroad has come this unusual hookup, said to be a development of British naval experts, and for which extreme sensitivity and selectivity are claimed.

At first sight it is difficult to puzzle out the functioning, but we believe we have it. The VT is connected as the coupler between primary and secondary! When signals are being received, an oscillating potential exists across the terminals of the primary, L_1, which potentials are directly conveyed to the grid-filament circuit of the tube. The tube is therefore acting as a radio-frequency amplifier, since the oscillating component of its output current is conveyed to a rectifier for detection. This is not all, however, for in the plate circuit is the inductance L_2—the secondary

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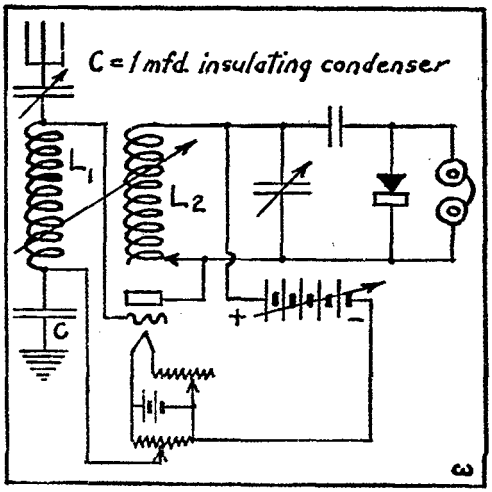

Rotten Undamped

By "The Old Man"

The Old Man improves with age, n'est-ce-pas?—Editor.

SAY, who invented this blamed undamped stuff, anyway? It strikes me as being just about as full of tricks as a flivver with a pint of water in her gasolene. Like most folks, I decided to take a crack at the big undamped when they lifted the lid on receiving. It's a safe bet that a lot of innocents made this same decision, and it's also another safe bet that the ambition to do it was born of the wonderful tales told by the soldier boys about undamped when they came back home.

One brave radio lad swore he was getting everything between Japan and Germany without antenna, without ground, with "two volts plate potential" and a filament so luke warm you couldn't see it in the dark. All he needed seemingly was to put a pair of phones on his head, a pair of sheet iron pants on his legs and lean hard against a steam radiator.

Another one had a hair raiser about a clothes reel in his backyard with galvanized iron wire on it, and a supernatural bulb he had pinched from Uncle Sam which kept him up to the minute on troop transport arrivals. Still another unfolded a tale about the interesting stuff that was coming in off his front door bell wire and a secret hookup he got from the Signal Corps. Everyone of them appeared astonished when it inadvertantly leaked out that you had never got any of the German propaganda from Nauen, or the Bolshevik bunk from Petrograd, and they evinced mild surprise and amusement when you showed that it was news to you that standard inductances could now be bought in a box like candy, and that the old loose coupler was a part of the trousseau of the extinct dodo.

You know how this sort of dope will poison you if you listen to it long enough? Well, I got thoroughly poisoned. I wrote down the name of the concern down east making the inductances that came in a box, and also the name of the maker of the dinky little amplifying transformers, and copied the hookup. Then I strung any old kind of a wire in the backyard, because it seemed that according to what I had been given to understand, the antenna itself was considerably old fashioned. I snaffled a couple of bulbs by the underground route, and after hooking on to the little copper wires which had been poked down into the little radiating slots in the grass plat, I was ready to horn in on the Great Undamped.

It took pretty much all one Sunday to get the layout hooked up. When she was hooked, it came in upon me with a sickening thud that I knew as much about tuning undamped as I did about fishing for barracouda. One of the bulbs was set up as a detector amidst a snarl of wires that would have driven you crazy while the other bulb was hooked in as an amplifier and served to amplify the amplified snarl about ten to one. With this picture puzzle, I butted in on the tuning business.

The first thing she did when I touched her was to give one mighty click and then to blow off steam. She blew from every pore in every tone, pitch, key and language there is to blow in. Some times she would hiss like and old gander and in a minute, she would be going it in basso profundo like an old he gas well. Tuning made her hoot. De-tuning made her gulp, and sizzle like a breakfast that has been started too late. I never heard so much gulping and blowing off steam. She seemed to have a fierce amount of it in her system. Everything I could do made her blow off steam all the harder. Tuning undamped was some nice little trick.

This went on for a spell and I was beginning to wonder which end of her was too hot and what it was she probably

wanted doing the worst, and decided that the trouble with her was that she had bitten off and swallowed more condenser capacity than she was able to chew properly and so I twisted the condenser knob back to zero. ————BANG!———— She expolded square in my ear. Ye Gods! it was some crack.

I thought my block was off and that something big had got adrift this time for sure. Coming at the end of the steam blowing off program and at a time when I was especially impressed by the fact that I was sailing uncharted seas and therefore probably some nervous, it simply scart me stiff. I remember giving a quick glance around to see which end was probably going to come up first, for I fully expected the whole blooming cheese to bust up in a grand blaze of glory, and had visions of grabbing as much of the junk on its way up as I could get hold of so as to save it, when she opened up on a new lay. This time she started to DRUM.

Say, Son, I suppose you know how these new fangled bulbs drum when they start out to show what they can do. Ain-t it the cute little noise! With the head phones down tight, it sort of reminds you of a 4000 H. P., triple expansion, high speed, double back action, pneumatic, automatic riveting hammer running amuck. It certainly hogswaggles your swaggler for fair the first time you get into the game. Undamped! Lord, what would it be if they should moisten it a little.

After taking a walk around the house in the cool night air, and a drink of water, I braced up enough to tackle her again, but this time I cocked the head phones off my ears as far as possible so as to have some ear drums to start business with Monday morning. I listened to as fine a medley of steam blowing off, 14 inch explosions, and circus caliope whistling, as any man has a right to hanker for, and was just beginning to wonder which of the three might be Nauen's fair voice, when somebody began sending on a flute. Real radio signals at that. At last, the glorious music! I WAS GETTING SIGNALS. After two years of silence, the old wires were tinkling again. Of course the first question was, "Who is it?" Like most old timers, I decided not to monkey with the tuning for fear of losing everything. I simply let well enough alone, and began fishing for a lead pencil and a piece of paper. The stuff was coming slowly and rusty as I was, I knew I could take it.

The instant my hand left the condenser knob, she pulled off another new one. Moving my hand busted the combination. The flute went up the flue. Instead of music, the water began to gurgle in the plumbing. Putting my hand back, the flute came back. Winking the left eye, changed it to a piccalo. Crossing the left knee over the right made it an oboe. Miss Undamped sure was a critical lady. You have to keep your mind on your number and also where you put your hands and legs. You hold your hand out and she sings like a flute. You pull your hand in and she gulps like a faulty plumbing job. I got on to her finally and learned her ways. I shoved the condenser far enough ahead to allow for the removal of the hand. Then I thought I was ready to take another shy at the lead pencil.

When I tried to write it down in black and white, it turned out that the gink doing the sending was either crazy or drunk. He was slobbering out a lot of dots and dashes that were all balled up and you could not get started on the darned stuff to save your life. There would be a run of i's, and then there would be a run of s's, and then a run of crazy spaces between a lot of dots that would mix up your old time Morse, and this would be followed by a mixture of dots and badly intoxicated Morse l's. There were signals which were no punctuation marks with whom I had any acquaintance. You could spit on your pencil, sharpen your pencil, use a soft pencil, use a hard pencil, close your eyes, stand up, sit down, open your mouth, and do your darndest, but you could not get a word of that blamed stuff to save your soul.

After getting wringing wet struggling to write it down, I gave it up and announced to the wife that she could go on rustling the newspaper to her heart's content because the Navy Department was conducting its Trans-Atlantic Undamped work with a private and secret code made up of

spaced dots principally and drunken dashes which no decent amateur would stoop low enough to receive.

While this sounded authoritative, I knew secretly that it was bluff. Something was off the track with this undamped dope and so I lighted the old pipe to find out what the trouble was. Setting the condensers in a new place all around and taking a new breath, I started fresh. To my amazement real signals in the good old code rolled in in a way that would make you laugh. Everything seemed completely changed, and I was gumfoozzled. I could take it with ease. It was a lot of stuff about icebergs and growlers, whatever a growler is, and latitude and longitude. After enjoying the mere act of writing it down on paper for some time, it began to dawn upon me that there were two stations going. One of them was sending in decent code the stuff about the growlers, and the other was sending the crazy code at a lower pitch. They seemed to be in step with each other and you could not separate them to save your life. Raising the note raised both notes. Lowering the note lowered both notes. Monkeying one condenser gave them both the squeaks. Monkeying the other condenser put the plumbing on the bum again. Finally by accident, I found a place where I could diminish the crazy stuff enough to get the regular stuff easy. Then, it occurred to me that this crazy business must be the "back lash" that the radio boys had mentioned. Subsequent questioning disclosed that this was a "correct diagnosis" as our Doc. said when the little girl swallowed her first safety pin. I had been trying to read "Back Lash" and said Back Lash cannot be read because it is the stuff that peels off from undamped when you let the key up. I will not attempt to express my opinion at this time regarding a wireless system in which signals are sent out when you let the key up as well as when you put the key down. The postal authorities have laws providing for such. I will say, however, that those of you wireless bugs who have not yet been taken up and introduced to Miss Undamped, better stop, look and listen before you do, or some fine night when you spend two hours trying to read back lash, you will find the dog catchers from the crazy factory waiting outside for you.

Another little peculiarity of this undamped dope is that every station has a spark note of just exactly what you make it yourself. Therefore, every station has just exactly no difference in note or tone from any other station. This is where the notorious heterodyne gerfoozelette gets in its work. When you first locate a station, the latter is either mumbling in a choked-to-death gurgle or is squeaking like a dry bearing. You have to bring him to with a variable until his voice is clear, and then it is all a matter of your own taste whether he is to come in like a 500 cycle quenched or like a bass singer. You suit yourself. The result is that Tuckerton sounds like New Brunswick, and also like Annapolis, and also like everybody else.

This on top of the gay little habit of never signing call letters except at meal times or some other time which you can never locate, makes it necessary to put your trust in an all wise Providence when you try to identify a station sending undamped. With the old spark stuff, you grew to know your Master's Voice, and you could make shift without call letters some times. With this unmoistened stuff, you never know who you are listening to unless by happy chance you happen in at one of the few times in the day when he calls I D O 34 times and signs N F F three.

The stuff that these big stations send also gets your goat after awhile, and makes you wonder what the poor gink doing the sending sits on in order to keep himself awake. There will be a run of stuff about PVT John Smith or Patrick Kelly or Angelo Spitinyourfaceski Nr 423981246 of the 365943th Inf. Co. 691415 reported killed in action Jany 43 but who writes home to his folks every Saturday afternoon and whose whereabouts are unknown and whatell anyway. After using up all the scrap paper in the house, this kind of stuff palls on you after a while. Some times another station will be sending each word twice at the rate of twelve a minute, falling asleep in every sentence and repeating. This gives you a pain in the neck after

(Concluded on page 22)

Loop Aerials

By Dr. Radio

Editorial note: This very interesting article by Dr. Radio is not a construction article, but instead, a discussion of the general principles involved in the new form of antenna. QST will have a real construction article on "Loops" in an early issue. In the meantime, the present article is a splendid preparation for what is to come.—Editor.

LOOP aerials are unquestionably destined to play an important part in amateur radio communications in the future. The first use of the loop will probably be for receiving while transmitting by means of a loop may be expected to follow closely. For the benefit of those who have not yet seen one, it may be said that a Loop Aerial is simply a large coil of wire located convenient to the station instruments and connected to the latter by leading the terminals of the coil to a variable condenser and the audion.

The principal use of loops today is for receiving undamped long waves. It is used just about in the manner that a wave meter coil is used, allowing of course for the glorified dimensions of the coil. These coils are built in some cases of very moderate dimensions, while in other cases, the coil is many feet long on each side. For some purposes, a very few turns of wire are best and in other cases, a large number of turns are used. This matter of dimensions and number of turns, is so important that we venture into the mathematics of the problem, because there is no other satisfactory way of conveying information which would enable an amateur to design a loop proper for his particular purpose.

It has been demonstrated that the greatest amount of current is received, according to the number of turns on the coil, the area of the coils, and the inductance of the coil. These three particular factors are in direct proportion. In inverse proportion the current in the loop varies as the resistance and the square of the wave length. These values stand to each other and each may be derived from the following formula which is not nearly as fearful as it looks:

$$I_r = \frac{1184\ h_s\ h_r\ l_r\ N_r\ I_s}{R\ \lambda^2\ d}$$

I_r is the current received. h_s is the height of the transmitting antenna in meters. h_r is the height of the receiving loop in meters. l_r is the length of the receiving loop in meters. N_r is the number of turns on the receiving loop. I_s is the current in the transmitting loop. R is the resistance of the receiving coil. λ^2 is the wave length in meters squared. d is

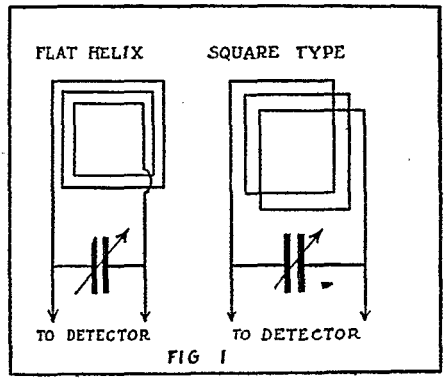

FIG 1

the distance apart of the transmitting aerial and the receiving loop in meters.

In case use of this formula is to be made for reception of signals originating at a station more than one hundred kilometers from the receiving station, we must multiply by the factor

$$E - 0.000047 \frac{d}{\sqrt{\lambda}}$$

In the above E equals 2.718. d and λ are in meters.

Upon first inspection, one would believe that the increase in resistance with the increase in number of turns, would be made up for by the increase in inductance. This is not the case since the resistance increases rapidly with the wave length and becomes especially great as the wave length approaches the fundamental of the coil. It seems desirable to build the loops so that their natural period will be about one-half or one-third of the wave lengths to be received. For extremely short waves, the coils should have few turns. For long waves, the coils should have less area but should make up for this in having a great number of turns. For example:—To receive 600 meter signals, a coil can be built on a square frame measuring six feet on each side and having four turns of wire one-quarter inch apart. This coil will have a fundamental, or natural period, in the neighborhood of 170 meters. It will be necessary to use a condenser with such a coil in order to reach resonance precisely.

For receiving long wave signals, it would be better if the coil were wound upon a square frame measuring four feet on each side and having thirty turns of wire spaced one-eighth inch apart.

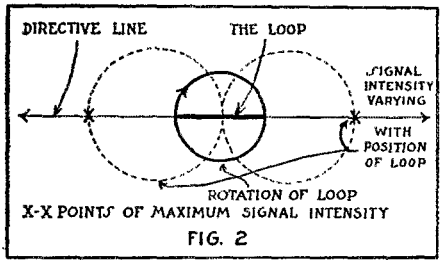

FIG. 2

It has been found that the capacity of a coil of fixed dimensions increases with the number of turns. However, as the number of turns becomes greater, the increase in capacity occurs at a less rate. The closeness of the turns to each other also affects the capacity in that the closer the turns, the greater the capacity. Conversely, as the turns are spaced with greater distance apart, the capacity falls off until finally a point is reached where greater spacing makes negligible change in capacity.

In constructing these so-called loops, or coils, it will be found that they may be conveniently wound upon a square form of either the flat spiral type or the regular helical coil type. Examples of each of these are shown in Fig. 1.

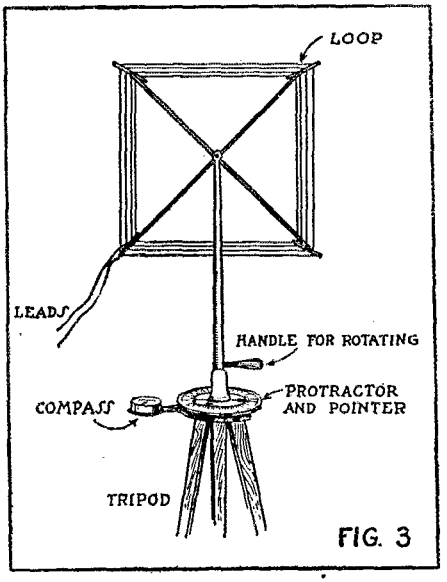

FIG. 3

The directive quality which these coils possess to a marked degree may be easily understood by considering that they represent the natural conclusion of the "L" type antenna. The "L" is simply developed until it completes the circle. Such a coil becomes directive along the plane of its winding. This directive property is roughly indicated in Fig. 2. The intensity of the signals becomes equal for each 180 degrees of rotation. It is of course impossible to tell from which of two directions the signals are coming. There is generally, however, other data available to an operator which will guide him in deciding which of the two is the probable direction of the sending station.

The loop antenna is best tuned with a variable condenser. To determine direction, the loop is revolved slowly through a complete circle and the two points of maximum signal strength determined. The line joining these two points gives the line pointing toward or away from the transmitting station.

It has been said that the direction of the sending station may be determined to within 2% of accuracy where the loop has been correctly designed. To obtain values with as great an accuracy as this, it is essential that the loop should be used where there is no chance of the incoming waves being distorted by large bodies of metal or other objects such as trees, buildings, etc. Probably values in the neighborhood of 15% from accuracy may be had by the ordinary amateur.

Loops may be built after the manner of a compass, and by comparing with the needle of a magnetic compass, direction may be very nicely plotted upon a map. Allowance must be made in this case, however, for the variation of true north from magnetic north, and also for the probable error of observation in the loop. See Fig. 3.

In using loops for radiators of energy, we open an entirely new question. It is better to make an individual study of this in a later article. A great opportunity is open to the amateur in this field, especially since the convenience of the loop antenna as compared with the usual outdoor antenna is considered. No doubt when amateur stations are again permitted to transmit, we shall hear of some extremely interesting achievements in transmitting from an indoor loop antenna.

Renovating Hard Rubber Panels

A Very Timely Tip

The following method of renovating hard rubber panels which have become green from age and exposure to the light and air was developed by the writer as a result of numerous trials to renovate his receiver after its long sojourn in the attic.

When the rubber has become rough from "blooming" it should be polished by the liberal use of Bon Ami and water applied in the same manner as in cleaning windows, except that after the rubbing has smoothed the rubber, the Bon Ami should be removed by the liberal use of water applied with a soft rag.

The next step is to thoroughly dry the panel or other piece of hard rubber and apply a liberal coat of the best grain alcohol obtainable. The writer used medicated alcohol as purchased in any drug store. The rubber is then allowed to become dry after which it is polished by rubbing with a soft black cotton rag which has been dampened with caster oil. A further application of a dry soft black rag and plenty of elbow grease will give wonderful results and amply repay for the trouble and labor.

If the panel has figures, letters, scales, etc. cut or stamped in the rubber and filled with white which has become cracked or yellow with age, it can be renewed in the following manner.

After the panel has been polished with Bon Ami and before the alcohol has been applied, remove all the white from the figures, etc., with a pen or other sharp instrument and wash them out carefully with alcohol to remove all traces of grease or oil. When dry they can be readily filled with white ink by means of a sharp pointed pen.

Panels on which the figures have been renovated as directed should be allowed to dry for twenty four hours before proceeding with the rest of the renovating process as described above. When these instructions are followed the application of the alcohol and the subsequent polishing with the castor oil will have no effect on the figures other than to brighten them somewhat.

Any of the readers of this article who may be curious about the color of the rag used in the process are at liberty to write to the Old Man for an explanation as he will no doubt be able to supply the correct one.

Contributed by
H. L. Stanley.

(Editor's note: We rather imagine the Old Man, with his refreshing logic, would point out to us that black lint from a black rag wouldn't show on a black panel. Simple, isn't it?)

OUR LOAN

Somebody asked us, when we began fixing to resume QST, how we expected to raise the money to do it. We confess that the question had been lurking in the background of our minds, but we had kept it in the background. When the idea of borrowing money from our own members and issuing certificates of indebtedness was suggested, as the means for raising our needed money, some one else asked if we thought the members would "come across". After one swift mental review of amateur radio and the splendid spirit of brotherly feeling manifested throughout the length and breadth of the land by our membership, we unhesitatingly replied that there was no doubt about it. They would "come across".

We were right. The fellows have come across in a manner that makes our hearts glow. Every single letter that contains a check, breathes the spirit of good fellowship and an honest desire to help as much as possible. A letter sometimes contains a check for $500.00 and its neighbor a frazzled old one-dollar bill. The latter represents just as fine a spirit and is appreciated just as much as the former. There have been a lot of the big checks and at this writing Treasurer Runyon informs us that the loan is over half subscribed, and that we can push along with the knowledge that our finances are in such shape that we can get the good old ship safely in the water and give her a good push. But we must "finish the job". We want every amateur to feel that he is invited and expected in on this thing. One of the Certificates of Indebtedness is not only a bond of indebtedness, but also a bond of union. The more of us who join in to build up the A.R.R.L. after two years of war, the better it will be for amateur wireless generally.

TRANSMITTING

According to our notions, amateur transmitting will be liberated just as soon as those German persons sign the peace treaty that has been pushed to them. If we are right, transmitting will be allowable in the very near future, because those aforesaid German persons will probably realize about the time this QST gets into print, that something is liable to drop if they do not sign. While it is not always clear that the Hun knows when he is well off, yet from diverse and sundry jolts which have been administered to him lately, it would seem that there is a good chance of his getting next to the idea that his health would not suffer if he signed up P.D.Q.. Then the all-absorbing and vital question arises, "does a state of peace exist?" If it does, then the Navy Department is committed in writing to remove the restrictions on amateur transmitting. The only fly in the ointment is whether our distinguished but at times troublesome United States Senate must ratify the peace treaty before "a state of peace exists". There's the rub. If we amateurs must possess our souls in patience until the Senate ratifies the peace treaty, we may see our condensers grow mouldy

before the brush discharge gives them a chance to clean up. Just the same, amateur transmitting is on its way, and we do not think any of us are making mistakes in setting up our transmitting masts with this expectation.

YOUR NEW EDITOR

Our readers have no doubt noticed by this time a strange name signing itself Editor. Our old Editor, Mr. Clarence D. Tuska, has felt that he had such a burden of outside interests as to regretfully compel him to resign from his A.R.R.L. duties. The story of Mr. Tuska's splendid pioneering is too well known to need repetition: how he and Mr. Maxim conceived the idea of creating a magazine which would be purely of amateur radio, for amateurs, conducted by amateurs; of the long, hard uphill fight over new ground, back in QST's early days; until at last we amateurs found ourselves possessed of a splendid organ thru which to express ourselves, get together and progress. Mr. Tuska was the first secretary of the A.R.R.L. and how successfully he discharged the duties of that office is known to us all. Too much credit can never be given him for the splendid energy and self-sacrifice with which he devoted himself to the work of QST and the league. QST of course is what it is because it filled a crying need and has met with your hearty support, but aside from that support QST owes its present success wholly to the untiring efforts of Clarence D. Tuska. We wish him all luck in his new work.

KENNETH B. WARNER

Your new Editor is a western chap (at least they call it "west" up here, altho "west" had always meant "the other side of the Rockies" to him heretofore), and before the War gloried in the calls of 9JT and, later, 9FW. Ever an enthusiastic amateur and an ardent member and supporter of the A.R.R.L., he finds great pleasure in his present duties as Secretary, and Editor of QST. Immense fields of activity and progress are before the amateurs now; and that he may succeed in his work in the upbuilding of a greater and closer-cemented A.R.R.L. and a bigger and better QST in the pathways established by our friend Tuska, is the humble and sincere wish of

YOUR NEW EDITOR.

LONG WAVE RECEPTION

The days of the long, clumsy, laboriously-wound coils once so prominent a part of amateur long-wave receiving sets have past. No longer will such sets present the general appearance of a pipe-organ with their towering columns of inductances containing miles of fine pink, green and white wire; no longer will we have switches operated by four-foot handles; no longer will our signals change their note an octave because some careless individual in the room crossed his legs over the other knee. In place of these old-fashioned coils the modern amateur long-wave station will use concentrated inductances, which are now made available by at least two manufacturers at a price that nearly every amateur can afford. They are neat, compact, electrically efficient, and have surprisingly low resistance and distributed capacity. All any amateur needs these days for the tuning system of an efficient set is a few of these inductances and a few ordinary variables. The set can be made extremely neat and compact, for no longer do we

have the troublesome high-potential fields at the tops of our coils; and if variable inductances are used, no mechanical means for varying coupling are necessary.

We have prepared an interesting article on the construction of such a set, but unfortunately lack of space forbids its publication this month. Watch for it in the next QST.

The advent of efficient concentrated inductances in the amateur field represents the greatest single improvement in amateur long-wave reception since the discovery of the oscillating audion.

TWO REAL BOOKS

We have been tempted many times to recommend certain radio books to our readers but, due to the fact that we were operating a Book Department, it was necessary to refrain from anything which might smack of merchandizing motives. Book Department or no Book Department, however, two books have recently appeared which we can recommend and no one will doubt them, because they are sold by our good Uncle Sam. When Uncle Sam tackles the job of book publishing, it is for the education of his citizens and not for any financial gain to the Treasury Department.

Of the two books which have recently come out, one is Circular No. 74 of the Bureau of Standards, entitled "Radio Instruments and Measurements". Copies may be had of the Superintendent of Documents, Government Printing Office, Washington, D. C., at 60 cents each. The second book is entitled "The Principles Underlying Radio Communication"—a Signal Corps document—and is available at 55 cents per copy from the Superintendent of Documents.

Both of these books should be included in the library of every progressive amateur. It is needless to say that they are inexpensive. Besides this virtue, they are the very latest word in radio engineering. The one on radio communication contains 355 pages, and covers radio up to date. An especially worthy part of the book is Chapter 6, which has thirty pages on vacuum tubes. Circular No. 74 is an engineering book of 341 pages. It contains a great deal of valuable data, the laboratory aspect of vacuum tube work being considered fully, and with a particularly interesting section on the measurement of inductance. The amateur will find it a very interesting and valuable text.

HIGH-POWER TRANSMITTING VS. HIGH-POWER RECEIVING

It is interesting to start up the old cob, get the old chair tilted at the correct angle, and endeavor to visualize what amateur radio will be like a few years hence. Who dares to predict? We don't. Too many sweeping innovations in radio have been given to the world in the past few years for us to venture to prophesy what an amateur station will look like five years from now.

Are we likely to outgrow our old spark sets? We think so. The imperative necessity of developing low-powered efficient sets for wartime use has brot VT transmission almost within our reach. As soon as the tube situation clears up so that small power tubes can be obtained by the amateur, we think this method of transmission will find great favor. There is no gainsaying the efficiency of undamped transmission. We used to figure that it took a half kilowatt to work fifty miles regularly. Compare that with the performance of wartime portable sets, which can regularly cover fifty miles in daylight with five watts in an antenna twenty feet high! The equipment? A single small oscillating power tube for transmitting, a VT autodyne detector and VT amplifier for receiving equipment. Dr. Radio has told us of the progress made in multi-step amplifiers, which are now entirely practi-

(Concluded on page 23)

A.R.R.L. Bonds

Establish Your Name in the Amateur W

No. 60 SERIES A $ 100.00

Certificate of Indebtedness

The American Radio Relay League, Inc.

THE AMERICAN RADIO RELAY LEAGUE, INC., a Corporation duly organized and existing under and by virtue of the Laws of the State of Connecticut, having its office and place of business in the City of Hartford, County of Hartford, State of Connecticut, hereby certifies that it is indebted unto ARTHUR MONZIG

in the sum of ONE HUNDRED ($100.00) Dollars, for money loaned and advanced unto said Corporation by said person, as hereby appears, on demand and payable to him at its office, in the said City of Hartford, on May 1st 1920, on presentation and surrender of this Certificate, with the right, privilege and option, however, on the part of said Corporation to extend the time of payment of this Certificate for two year additional, and with the further right on the part of the Corporation to pay interest thereon, as the whole of the sum hereby agreed to be paid or to make a partial payment to be applied proportionately to the reduction of this Certificate, and of all other outstanding Certificates of this issue.

This Certificate shall bear interest from the date hereof at the rate of 5% per annum payable semi-annually on the 1st day of May and November in every year until the said principal sum shall be wholly paid.

In Witness Whereof, the American Radio Relay League, Inc. has caused these presents to be executed for it and in its name this 1st day of May 1919, by its President and Treasurer, pursuant to and in conformity with a Resolution of the Board of Directors of said Corporation duly adopted at a special Meeting of said Board of Directors, duly held at New York City on May 2nd, 1919.

The American Radio Relay League, Inc.

C. A. Ranger Secretary Hiram Percy Maxim President

The Bond Issue is coming along great, and we are confident you fellows are going to loan the A.R.R.L. the funds necessary to make our good old QST what we all want it to be. Quite a bit over half of the authorized amount has been issued at this writing, but there is lots of room left.

For the benefit of those of us who have not seen the earlier articles on A.R.R.L. Bonds, we want to tell again about our plans for re-organization and continuing QST. You all know that when our relay work was suddenly stopped in April, 1917, by the War, QST continued many months at the request of our Government, spreading radio gospel, and interesting our membership in enrolling in the various branches of the Service. That we succeeded is ably attested on every hand. But it cost money, for in the mad scramble to get into uniform, dues and subscriptions were forgotten, and with the cessation of amateur activity our advertising support completely "faded out," so that when QST ceased publication in September, 1917, with its destiny fulfilled and its Editor enrolled in the Service, quite a bit of indebtedness had been incurred.

Now the money is coming in and we have got a start. The Secretary is hard at work, and the Operating Department is rapidly perfecting plans for our practical relay work. The first issue of QST has been received with joy, and this is our second—a better one. We aim to make it better every month. We here at Headquarters are plugging hard, often working late into the night, and things are coming along. Our supply of hard work is unlimited. What we want is to be backed up by you chaps. That's the secret of the whole thing. Subscribe to the Bonds, you will have a 5% investment and we will have the money to get started, and QST will continue to brighten our lives monthly. As we grow, our little sinking fund will accumulate, we will retire our bonds, and then in two years we amateurs will have our magazine, devoted as always solely to US AMATEURS and run by us. Amateur wireless is going to be a very important institution in the near future and our League will be self-supporting and an organization free from strings to which we all can turn for mutual help and protection.

Now, we feel that we all need QST, and for many moons we have been waiting for the time when we could get together in its columns and chew the fat, anxiously watching the radio horizon for signs which would indicate that the time was ripe. When the restrictions on receiving were removed and we had assurance that transmitting would be permitted shortly after the signing of Peace, our Board of Direc-

Own a Bond and Be One of Us.

A.R.R.L. Bonds

tion decided that the time had come, and in a series of earnest meetings discussed ways and means by which the funds necessary to re-organize our A.R.R.L. and resume QST and carry it until it became self-supporting, could be raised. The things necessary to be done were the establishment of an office for the Secretary with funds to pursue his work, and the regeneration of our beloved QST with money enough to see it over the first several months of its new activity. Our Board of Direction computed the required amount at $7500, and for a financial scheme decided upon a loan from our membership, coupled with an earnest plea for the payment of dues immediately. The Loan takes the form of Certificates of Indebtedness, of all denominations from $1 to $200, and bearing interest at 5% per annum. They are acknowledgements by the League of the receipt of the money loaned, with a promise to repay with interest within two years.

We are sure the outfit wants QST, and wants an A.R.R.L. The wonderful spirit of you fellows generally thruout the country serves as continual inspiration to us here in Hartford, and we are pulling mightily. The response has been fine, and we are proud of the old A.R.R.L. spirit. But the job is not yet over. Can't we finish it up this month, fellows? We had a peach of an article on a new VT which we could have put on these two pages, had it not seemed better for our future that we first dispose of our finances and get a good start. If we wind up the deal this month, we'll have just this much more space in QST to devote to other things. If you've loaned once, and can afford more, come in again.

Don't get the idea that this is a donation. It isn't—it's a loan, and the only way we can think of to continue QST for you. We want to make it a popular loan. We want every amateur possible to have one of these bonds. They come in all denominations, to fit all kinds of pocketbooks. Every amount from $1 up is welcome, and we honestly feel that every amateur ought to feel it his duty to loan the A.R.R.L. all he can scrape up, for the sake of our old QST. If we all do that, there can be no question about the outcome.

If you pretend to be anybody in wireless, for goodness sake get into the game with the rest of us and do your bit. There may never come again such an opportunity as the present to establish your name in AMERICAN AMATEUR RADIO. Don't be an outsider. Be an insider, one of us, and in the years to come a member of "THE GOOD OLD CROWD."

BUY YOUR BOND TODAY!

CUT OFF HERE

The Treasurer,
American Radio Relay League,
Hartford, Conn. :

Date.....

I am enclosing $....., which is a loan for two years at 5% interest to the American Radio Relay League, Inc.

Please remit my A. R. R. L. Bond to the following address:

Name .....

Address .....
Street

.....
Town State

On Resuming Transmitting

BEFORE very long we will be again operating. Oh the joy of getting back on the brass! But let's all try to have better stations and operate them better than we did in the old days. We all know there was room for a very great deal of improvement. While radio development has made immense strides since our shutdown, so that much new apparatus and many new principles are becoming available for our work, the greater proportion of us are going to start off with pretty much the same apparatus we so regretfully dismantled in April, 1917. In this month's QST is an interesting article on VT Transmission, which is perhaps the most important development of war-time radio from our standpoint, and it behooves us all to read up on the subject and make use of these new principles. But our immediate desire is to get into practical operation again as soon as the restrictions on sending are removed, and all over the country we are busy at work assembling our transmitters, and this means that we are starting off with the old spark sets.

Now for goodness' sake, fellows, let's apply a little scientific knowledge to this business of resuming. It's practically impossible to get into good operating shape without a wavemeter and a hot-wire-ammeter. Buy one or borrow one, if you haven't them, and get started right. Look up the good articles on scientific design which have appeared in QST, and follow them. What kind of an aerial system are you going to put up? We all have our own ideas, and often we are limited by surroundings, but the old reliable 4-wire T antenna has stood the test of time and is much cheaper to erect than types requiring higher supports. Stranded wire is not necessary if solid wire of sufficient surface is available, but make your aerial have the lowest possible high-frequency resistance if you want to get satisfactory power in it at a coupling which will keep your decrement within the law. This means soldered joints and a lead-in having surface area equal to that of all the wires in the antenna. Ground on to everything you can think of, and make your ground lead short and direct, and as heavy as possible—at least as heavy as your leadin. Build a good substantial oscillation-transformer while you are at it, and use heavy enough ribbon. A 1-KW oscillation transformer wound with ¼ inch ribbon is a joke; it should have 1½ inch in the primary, and at least ¾ inch in the secondary; and the frame should be of good insulating material.

In your closed circuits, be sure you have an efficient condenser, as there is where so much of our losses occur. Low resistance in the electrodes and dielectrics of good quality are essential; and any home-made condenser is improved in efficiency by immersing in oil, which practically eliminates the losses due to surface leakage and brush discharge. A capacity around .008 mfds. is correct for the average 200-meter set using a nonsynchronous rotary. We are cranks about gaps. Dig out the February (1917) QST and read Dr. Radio's article on gap design. The average amateur gap is susceptible to more improvement than any other feature of his set. Do you realize that you can figure out the minute fraction of a second properly required for your electrodes to be in opposition long enough to permit the primary to oscillate a certain desirable number of times, and that in practice they are opposed several hundred times too long in all your gaps and that during this time the secondary feeds back into the primary and causes that double-hump? The first step in the right direction is to cut down the number of revolving studs as much as possible, substituting knife-edge electrodes for the old round ones, and then speed up the disc to maintain the desired spark tone. Each step you make in this direction will improve your efficiency, for it means that the less this feed-back between primary and secondary, the closer the coupling can be for a given decrement and purity and

hence the more amperes you can put in the antenna and stay within the law. Keep your primary circuit leads as short as possible, and make them of heavy ribbon; heavy, because the R.M.S. amperage is surprisingly high, and short, because ribbon means wasted wavelength and you need all you can get in the condenser: the condenser should be of such capacity that 200 meters is obtained when using about 1½ turns of inductance in the primary of the average O-T.

Do a good job when you tune up, for we are assured the radio laws are going to be much more strictly enforced than heretofore. You can excite your aerial circuit with a buzzer and adjust it independently to 200 meters, and then with the set in operation bring the coupling as close as possible without causing a double-humped emission, and the way to determine this is to listen in on a wavemeter loosely coupled to your ground-lead. If you prefer to tune the aerial circuit by the alternative of adjusting it to resonance as indicated by greatest reading on the H.W.A., in the name of the Old Man's Whiskers do it with your coupling loosened up as much as possible and then determine the closest coupling you can use by the wavemeter as above mentioned. Remember above all that a hot-wire-ammeter is the biggest liar in captivity if you ask it how much you are radiating "on 200 meters". The H.W.A. shows the total heating effect as distributed over a broad band of wavelengths, possibly embracing two or three "humps," and is no criterion whatsoever on what you are doing on your alleged "tune". When a chap tells you he has 8 amperes radiation on a ¾-KW set on 200, you can put it down that, no matter how carefully he tuned his circuits independently to 200, he has jammed his coupling as tight as possible and his 8 amperes are spread over the tuners in ten states and causing wails of distress because his decrement is ten times what it should be and louder signals can be obtained at three distinct humps, none of which are anyways near 200 meters. Remember that you too can get the same thing by tightening up your coupling, if the H.W.A. is all you care about, but the Radio Inspector's liable to get you and you want to take satisfaction in the knowledge that if the owners of these ¾-KW 8-amps-in-the-aerial stations would loosen their coupling to where they radiated a pure wave, their decrement would come down where it belonged and most important of all, their radiated energy would be on 200 meters and undoubtedly more of it there on that much-sought tune than when the H.W.A. registered 8 amps. tho it says only 2 amps. now. This is a most important thing to remember, fellows. Greatest H.W.A. indication does not mean greatest range, and generally means the converse, because a receiving set can tune to but one wavelength at a time.

As to receiving, a station that expects to do relaying should surely have a VT detector, because it is reliable and constant, because it is super-sensitive, and because it is necessary with a regenerative receiver. These regenerative receivers, whether home-made or purchased, remain the last word in efficient short-wave reception, and we think it will be quite a while before their performance will be bettered. Our idea of a desirable receiving set for relay work is an efficient regenerative tuner with the necessary variables, a VT detector, possibly one or two stages of audio-frequency VT amplification, and mica-diafram 'phones.

A word about operating. 99.46% of the arguments levelled against amateur operation in the past have been on the grounds that we are nuisances. How about the unnecessary sending you used to do; did you wait the legal 2 minutes between unanswered calls; are you guilty of having sent "de" twice or three times between call letters; do you call a fellow six to ten times instead of three; do you try to send 22 per when nobody can read you when you get over 16; have you ever sent at top speed to a punk whom you knew couldn't copy over 5 per, because it sounded nice and you wanted to impress him? These are fit topics for introspection, and if in our resumption we will all individually resolve to do our own bit toward the minimizing of QRM, and stick to it, we will find operating a great deal easier and more pleasant than when we last threw the old switch out.

The Operating Department

J. O. Smith, Traffic Manager
Rockville Centre, L. I.

THE reorganization of the Operating Department is proceeding in a manner which should be a source of gratification to us all. Our Division Managers and District Superintendents are hard at work, and in every section of the country the activity is at white heat. The organization is rapidly assuming form, so that we are confident of having a strong and efficient traffic body by the time the restrictions on transmitting are removed.

We have no definite information on when we are going to be allowed to resume, but it is to come shortly after the signing of peace, so that it behooves us all to make preparations for rapidly getting our stations in shape for efficient operation. All members of the League who are desirous of having an active part in the traffic work are urged to take up the matter with the Operating Department official in charge of the territory in which they are located. There will be at least two District Superintendents in each state and many vacancies still exist, so that it is desired that all good League workers qualified for such work communicate with their nearest traffic official.

WEST GULF DIVISION

Mr. F. M. Corlett, Manager
1101 East Eighth St., Dallas, Tex.

The West Gulf Division is greatly in need of dependable relay stations located in the vicinity of Wichita Falls or Amarillo, in the North Texas District, and in the vicinity of El Paso and San Angelo in the South Texas District. Stations are also badly needed in the Oklahoma, New Mexico and Arizona Districts. All members, as well as all amateurs in general are requested to write the Division Manager, 1101 East Eighth St., Dallas, Texas, giving him all information concerning their stations, until such time as District Superintendents for their territory are appointed.

The state of Texas has been divided into two districts, and the appointment of Mr. James L. Autry, Jr., 5 Courtlandt Place, Houston, Texas, as Superintendent of the South Texas District is announced.

ROCKY MOUNTAIN DIVISION

Mr. Cedric E. Hart, Manager
Room 1125, Newhouse Hotel
Salt Lake City, Utah

The following appointments have been made in this Division, which comprises the states of Utah, Colorado, Wyoming, Montana and Idaho:

Assistant to the Division Manager—Salisbury Andelin, Richfield, Utah.

Superintendent for District of Northern Utah—Jack Ensign, 80 S St., Salt Lake, Utah.

Superintendent for District of Southern Utah—Ira Kaas, 263 East Seventh Street South, Salt Lake, Utah.

I have hooks out in Colorado, Wyoming, Montana and Idaho for officers but have made no appointments in these states as yet. I wish to invite correspondence from all of our division amateurs, especially in the above states. They may address either Mr. Andelin or myself. All amateurs in Utah are requested to communicate at once with their respective District Superintendents.

Another List of Long-Wave Stations

ENSIGN Chas. A. Service, Jr., Manager of the Atlantic Division of the A. R. R. L. Operating Department and at this writing still in uniform in the office of the Naval Communication Service, Washington, has compiled for QST the following list of high-power radio stations of the world. Owing to the scarcity of accurate data at the present time and the changed conditions since we were closed, the great majority of amateurs have little idea about the high powered stations now working, most of whom they can hear if they have good sets, so that QST takes much pleasure in the presentation of this information.

This represents the very latest data that can be gotten. There may be slight inaccuracies in the wavelengths, as these are frequently changed to meet interference problems, but in the main they are known to be correct and when figuring in the ten thousands, a difference of a few hundred meters will make no appreciable difficulty in locating the tune of a particular station.

LOCATION		CALL	WAVELENGTHS
United States and Possessions			
Annapolis, Md.	(Undamped)	NSS	16,900
Arlington, Va.	(Undamped)	NAA	6,000
Balboa, Canal Zone	(Undamped)	NBA	7,000
Cavite, Philippines	(Undamped)	NPO	12,000
Guam, Marianna Islands	(Undamped)	NPN	5,000
Pearl Harbor, Hawaii	(Undamped)	NPM	11,000
New Brunswick, N. J.	(Undamped)	NFF	13,600
San Diego, Cal.	(Undamped)	NPL	13,300 and 9,800
San Francisco, Cal.	(Undamped)	NPG	8,600 and 4,800
Tuckerton, N. J.	(Undamped)	NW,W	9,200
Sayville, Long Island	(Undamped)	NDD	11,600 and 9,800
Tutuila, Samoa	(Undamped)	NPU	6,000 and 3,000
Marion, Mass.	(Undamped)	WSO	Undetermined
British			
Apia, Samoa	(Damped)	VMG	2,000
Barrington Psg., N. S.	(Undamped)	VCU	5,000
Bermuda, W. I.	(Undamped)	BZR	5,000
Carnarvon, Wales	(Undamped)	MUU	14,000
Christiana, Jamaica	(Undamped)	BZQ	5,000
Clifden, Ireland	(Damped)	MFT	6,000
Glace Bay, N. S.	(Damped)	GB	7,500
Hong Kong, China	(Undamped)	BXY	5,000
Horsea, England	(Undamped)	BYC	4,500
Nauru, Pacific Ocean	(Damped)	VKT	2,200
Poldhu, Ireland	(Damped)	MPD	2,800
Punta Delgada, Azores	(Undamped)	BWP	2,000
Rabaul, Pacific Ocean	(Damped)	VJZ	2,900
Singapore, Malay Peninsular	(Undamped)	VPW	3,400
St. Johns, Newfoundland	(Undamped)	BZM	5,000
Yap, Pacific Ocean	(Damped)	——	1,800
French			
Eiffel Tower	(Undamped)	FL	10,000
Lyons	(Undamped)	YN	15,500
Nantes	(Undamped)	UA	9,000 and 11,000

		CALL	WAVELENGTHS
Italian			
Coltano	(Damped)	ICI	6,500
Rome	(Undamped)	IDO	11,000
Germany			
Berlin	(Damped)	LP	5,500
Hanover (Eilvese)	(Undamped)	OUI	15,000
Nauen	(Undamped)	POZ	12,600
Miscellaneous			
Mexico City, Mexico	(Damped)	XDA	4,000
Petrograd, Russia	(Damped)	TSR	5,000 and 7,000
Stavanger, Norway	(Undamped)	LCM	9,500 and 12,000
Java, Dutch East Indies	(Undamped)	PMM-PMX	6,100

We have received many requests from our readers regarding schedules of radiotelephone stations. At the present time there are no stations, naval or otherwise, which have regular business by radiophone, but there are a number which are carrying on experiments from time to time. The best known is New Brunswick, on a wave length of 16,000 meters. Tests were recently being held with the "George Washington" enroute from Europe, and very satisfactory communication established, as reported in the newspapers. These tests have been discontinued, except at irregular times or for special purposes.

In addition, the various naval and army air stations carry on experimental communication with planes in the air. The navy uses wavelengths of 345, 825, and 1600 meters. The army uses all wavelengths between 200 and 550. There is of course no schedule for such communication, as it depends on whether any plane equipped with radiophone is in the air. Such communication can often be heard for several hundred miles. The work is being carried on at a number of army flying posts and at the following naval air stations on the Atlantic Coast: Chatham, Mass.; Montauk and Rockaway, L. I.; Cape May, N. J.; Hampton Roads, Va.; Moorehead City, N. C.; Brunswick, Ga.; Miami, Key West and Pensacola, Fla. Amateurs within two hundred miles will probably hear these radiophone stations.

Rotten Undamped

(Concluded from page 9)

a while also. It makes you hanker for the old 600 meter commercial going at 20 per and containing the human interest stuff, or better still, the good old 200 meter amateur stuff with a smile in every word.

It is too early for me to pass judgment upon the new undamped system. But at this writing, yours truly harks back with loving rememberance to a 500 cycle quenched or the good old rotary no two of which can be made to sound alike. And thus having unloaded these choice sentiments off my chest, I will proceed to wait impatiently for the next QST. In the meantime, 73 all around to the boys and tell them for me to beware of the dog—gone undamped.

T. O. M.

"Try This on Your Paragon"

(Concluded from page 6)

of the conventional loose-coupler—and not only is this coupled to the antenna circuit so that regeneration by electromagnetic feedback takes place, accounting for the sensitivity, but in addition energy from the antenna circuit is transferred by induction direct to this secondary or plate circuit. This would result in extreme selectivity, for the question of phase relationships is involved and the slightest differences in frequencies would cause the two currents to partially oppose instead of adding. A VT would of course be a better rectifier than the crystal shown, but it is claimed that the circuit as shown is superior to the common inductively-coupled autodyne with single tube.

The Editor would like to hear from experimenters who try this circuit.

(Concluded from page 15)

cable and make possible the ready reception of signals we couldn't begin to hear before. As we begin to use such receiving equipment isn't it possible that it will prove better to use low powered transmitters and spend our money on amplifiers? Remember that this applies to spark sets as well as undamped.

On the other hand, as undamped transmission becomes general we may experience many new difficulties. It is admittedly very difficult to tune to CW at the extremely high frequencies we will be using. We may have a hard time eliminating howls when two nearby transmitters beat upon each other, when the ether becomes crowded with amateur CW all concentrated on 200 meters. We believe all these difficulties will be solved, but it may be so hard that we will prefer to stick to our sparks. Our idealists will immediately rave at this atavistic viewpoint, because the efficient CW offers a possible solution of the interference problem, and everyone will welcome a general reduction in transmitting power if less power will do the work. But who is so bold as to say that the limit has been reached in the improvement of spark sets, and that the interference problem may not be unexpectedly solved by some practical method of tuning to spark notes, or to varying decrements, or by some means we don't even dream of now?

One thing we can predict: we're all going to see some immensely interesting progress in amateur radio in the immediate future.

CLASSIFIED ADVERTISMENTS

FOR SALE—Clapp Eastham Type X loose coupler; write for description. Paul C. Elliott, 162 East 66th Street, New York.

TELEGRAPHY (both Morse and Wireless) AND RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School—est. 45 years. Catalog free. Dodges Institute, 28th St., Valparaiso, Ind.

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Both wire and wireless, and Station Agency taught thoroughly and quickly, BIG WAGES NOW PAID, some of our recent graduates procuring $138.00 per month to start. Great opportunities for advancement. Our school the oldest and largest—annual enrollment 600 students. Endorsed by railway, telegraph, wireless and government officials. Expenses low—chance to earn part. Catalag free. Write.

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SCORE 100% EFFICIENCY IN ACTUAL USE.

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Dependable in Service

Sharp, unblurred, readable signals assured by "BRANDES MATCHED TONE"
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TRIAL OFFER Brandes Wireless Headset sent to you on trial for 10 days. Test it for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphrams, toned exactly alike, strengthen the signals and prevent blurring. If, for any reason, you are dissatisfied, your money back without a question.

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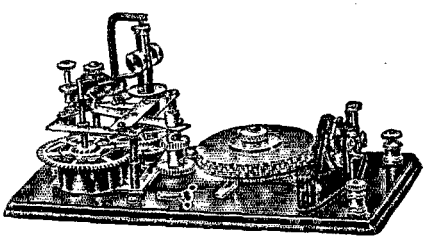
Room 821, 32 Union Square, New York
WIRELESS RECEIVER SPECIALISTS

LEARN THE CODES WITH THE OMNIGRAPH

THE OMNIGRAPH WENT TO WAR—BUT IT'S HOME AGAIN

During the war, scarcity of material and orders from the Government and from the leading Universities, Colleges, Telegraph and Technical Schools, closely connected with the Govt. in teaching the Codes, made it impossible for us to make prompt shipments to individuals and to the trade. **We are now filling orders promptly.**



THE OMNIGRAPH, connected with your Buzzer, or with Buzzer and Head Phones or with Sounder, will send you unlimited Wireless or Morse Code messages, by the hour and at any speed you desire. Impossible to anticipate.

We offer the **Omnigraph** as a positive success and with the strongest of endorsements. It has been adopted by the U. S. Government, Department of Commerce, and is used to test all operators applying for Radio licenses. Many leading Telegraph Schools use **The Omnigraph** to send to their students in preference to hand sending. Ask us for their names if you so desire. We have hundreds of unsolicited testimonials and with permission we are publishing one of them.

The Omnigraph Automatic Transmitter will teach you the Continental and the Morse Codes, **at home, in half the usual time** and at the least possible expense.

205 New Jersey Ave.,
Anglesea, New Jersey.
Feb. 17th, 1919.

The Omnigraph Mfg. Co.,
39 Cortlandt St., New York City.

Dear Sirs:—Received my Omnigraph No. 2 with a set of Morse and an extra set of Continental Dials and wish to thank you for your prompt shipment.

Five minutes after I had received the box, I had it unpacked and working. I cannot praise it too much and a friend of mine as soon as he heard it, said: "Why, man, that sends PERFECT Morse and Wireless." I will give you all the praise that I can. I myself doubted that the machine would do all you stated, but it does all you state AND THEN SOME.

Hoping to be of help to you and wishing you the best of success in your business, I remain

Very truly yours,
(Signed) Thomas W. Braidwood,
Pres. Cape May County Radio Asso.

205 New Jersey Ave.,
Anglesea, New Jersey.
Feb. 20th, 1919.

The Omnigraph Mfg. Co.,
39 Cortlandt St., New York City.

Dear Sirs:—In reply to your letter of 19th inst., I am GLAD to give you permission to use my previous letter in any way you see fit.

Two weeks ago I could not receive enough Morse to understand what a person was saying but today I can receive about ten words per minute on my Typewriter when the OMNIGRAPH is sending.

I have a First Grade Commercial Radio Operator's License and am using the OMNIGRAPH to better my receiving and to fit me for land telegraphy.

Wishing you the best of success for the future, I remain,

Very truly yours,
(Signed) Thomas W. Braidwood, Radio 3 U Z,
Pres. Cape May County Radio Asso.

If you are a beginner, it will make you an operator in the shortest possible time.
If you are already an operator, the OMNIGRAPH will make you a better one.

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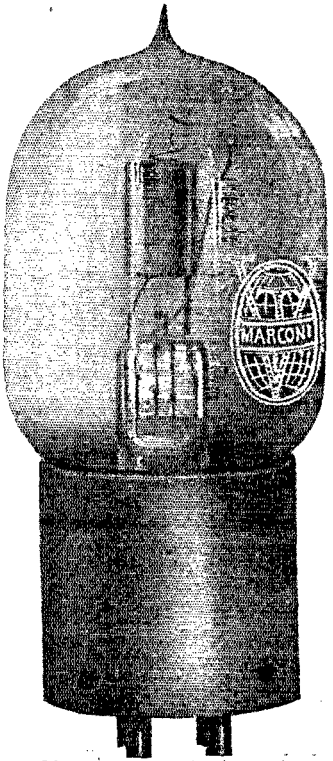
How did you learn to talk? By listening. JUST LISTEN,—THE OMNIGRAPH WILL DO THE TEACHING

The Only Vacuum Tube which Amateurs Can Use



Fleming Pat. No. 803684
DeForest Pat. Nos. 841387-879532

Agreements recently effected have made vacuum tubes available for experimental use. The Marconi V. T. is the only vacuum tube, or audion, which may be sold to amateurs, laboratories, schools of instruction and experimenters.

MARCONI V.T.

$7.00 each

Standard base, $1.50 additional

A highly developed, all-round tube for use as a detector and amplifier in wireless communication. It has practically the same electrical constants as the tube used by the Allied armies and navies throughout the war in continuous wave transmission and reception. The terminals of the elements of the tube are brought out to a 4-prong standardized base, fitting into the standard four-contact bayonet sockets.

Filament current 0.7 ampere. Filament potential, 4 to 6 volts.
Plate potential, 20 to 60 volts for reception.

For lighting filaments a **lead** storage battery is preferable because of its constancy of voltage. Ordinary dry cells or flashlight batteries may be used to provide plate voltage.

The approximate operating life of the MARCONI V. T. is 1,500 hours.

Delivered postpaid in special container insured against breakage to any address upon receipt of purchase price

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Sole Distributors for De Forest Radio Telephone & Telegraph Co.

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Progressive Radio Apparatus

To what reasons can the popularity of De Forest Radio Apparatus be attributed?

Is it because of its consistent performance, excellent workmanship, material, low prices?

These would account for it partly. The real reason must lie in the fact that we have always been in the van. Design and system employed have been so far in advance of others as to overshadow our rivals.

The De Forest Company is one of the recognized successes in the radio field. Our success has been progressive—more than merely financial, because we give better service—more for your dollars—most modern apparatus—than you can obtain elsewhere.

We do not aim to sell the most radio apparatus—only the best. Quantity is a secondary consideration.

We were the first to produce the Audion Amplifier and the Oscillion Undamped Wave Transmitter, and its popularity is attested by its wide use.

Our latest productions, the Honey Comb Coils, Unit Set, Coil Mountings, Two Step Amplifier and Audion Control Box have been greeted with enthusiastic demand far exceeding our expectations.

The Unit Receiver fills the demand for a really efficient receiver for any and all wave lengths of any preferred circuit and design without the usual costly cabinet and expensive assembly.

We have been literally swamped with orders, so do not feel surprised when your dealer tells you it will be necessary to wait a few weeks before you can get delivery.

By placing your order now you will avoid the greater congestion in our factory when the purchasers of this meritorious apparatus of novel design begin enthusiastically recommending it to their friends.

De Forest Radio Tel. & Tel. Co.

1415 Sedgwick Avenue New York City

Wireless Receiving Ban Raised

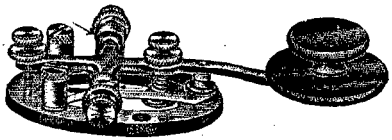
On April 15, 1919, the restriction on Wireless Receiving was formally raised by the U. S. Navy Department and very likely will in the not distant future be removed on transmitting.

Our knowledge and experience in the construction of wireless material place us in a particularly strong position for manufacturing effective, up-to-date apparatus; two of our most recent we show below.

We carry in stock a large complete line of recognized experimental wireless material of all manufactures, and can solicit your orders when in need of this or any other standard electrical devices.

MESCO HAND RADIO KEY

For ¼ and ½ K. W.



List No. 80. Type CAM 833.

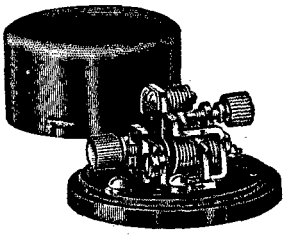
The lever is of phosphor bronze accurately balanced. Bronze will not corrode or deteriorate with age.

The base is the Western Union type and is made of heavy cast brass, well lacquered.

The binding posts have a combination top screw that can be tightened or loosened with the fingers as well as with a screwdriver. Used by Navy Department. The contacts are made of sterling silver ¼ inch in diameter. They are interchangeable and can be readily replaced. The lower contact can be removed without disturbing the insulation and fitting holding it so that it is not necessary to disconnect the key from its base mounting. This is the only key made with this essential feature. Disturbing the insulation which is the weakest point in a key is serious for many reasons. A special phosphor bronze current carrying spring is fastened on the base and lever so that the current is carried by this spring and not by the trunnion screws.

List No. 80, Mesco ½ K. W. Hand Radio Key, Price $3.60

MESCO RADIO BUZZER



This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

It consists of practically a closed circuit field of low reluctance, having a steel armature to which is riveted a strap supporting a movable contact. The armature tension is adjusted by means of a screw with a milled head large enough to be easily and permanently adjusted with the fingers. The stationary contact is adjusted by means of a similar screw. The magnet coils are connected in series with a total D. C. resistance of 3.9 ohms. Shunted across these coils is a resistance having a D. C. value of 3 ohms. This shunt eliminates all sparking such as occurs at the break on ordinary radio buzzers and the energy saved thereby is transferred into any oscillating circuit connected to it, the result being that this buzzer as constructed radiates five times more energy than any other existing type. All connecting wires liable to be broken are eliminated. Contacts are of genuine platinum, which is essential in order to maintain a constant note. The parts are mounted on a Condensate base to insure constancy in operation.

Diameter 2 in., height 1¼ in. The cap is attached to the base by a bayonet joint.

List No. 55, Mesco Radio Buzzer, Price $2.05

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It is pocket size, contains 264 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Wireless Telegraph Material, Electric Toys, Burglar and Fire Alarms Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

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