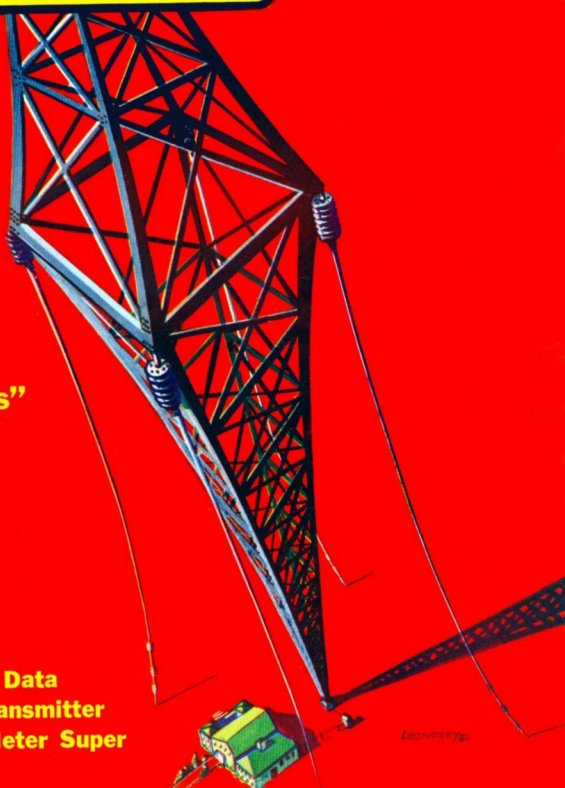
AIDS FOR THE DEAF

RADIO NEWS

December
25 Cents

New
"Wire-Less"
Antenna

Servicemen's Data
80 Meter Transmitter
200-2000 Meter Super



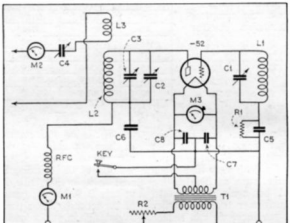
Radio News Designs a New Amateur Transmitter

This series of articles will provide complete constructional data on the new transmitter being installed in the RADIO NEWS laboratory. This month the description covers the basic, single-tube circuit, which in itself is a highly efficient transmitter. Next month the power supply, and in following months the transmitter, finally winding up as a full-fledged, crystal-controlled, multi-tube transmitter for c.w. and phone will be described

By Nat Pomeranz*

THESE articles are primarily meant for that class of radio amateurs who have absorbed a working knowledge of transmitting circuits and operating by experimenting with the usual 210 transmitter and now wish to step into a higher powered class. The transmitter to be described has been designed for use in amateur communication and short-wave experimental work in the laboratories of RADIO NEWS, under the call letters W2RM.

The beginner in the transmitting end of radio has always been urged to start with a low powered 210 transmitter. This practice is to be commended. It benefits the beginner inasmuch as it eliminates the possibilities of damage being done to expensive equipment and other things which can happen when inexperienced hands are used. It is a boon to the transmitting fraternity in general since it does away with high-power signals which are liable to cause excessive interference while the beginner is learning the rudiments of operating.



THE TRANSMITTER CIRCUIT

Figure 1. The tuned-grid-tuned-plate circuit is employed with a so-called "high C" plate circuit, employing relatively high capacity and low inductance to provide more stable signals

Some really good work has and is being done with the "seven and a half watter." Twenty meters with its penchant for carrying low-power signals has rewarded many with long distant two-way communications. But the results are far too inconsistent with the conditions now prevalent. The amateur bands are crowded and fair power is needed for reliable work. The transmitter being described is an ideal one for those who have received a working knowledge of low power work as well as those who are contemplating a new, medium powered outfit.

The fundamental idea of this article and of those which are to follow is to develop, step by step, a really fine transmitter. The circuit herein described will not be the one which will be embodied in our completed transmitter but the parts will all be used. The plans are simple enough. We start off with a three decker transmitter frame of ample size to permit the installation of our final equipment. The top shelf will hold equipment which, for the time being, will be connected up as a self-excited oscillator using

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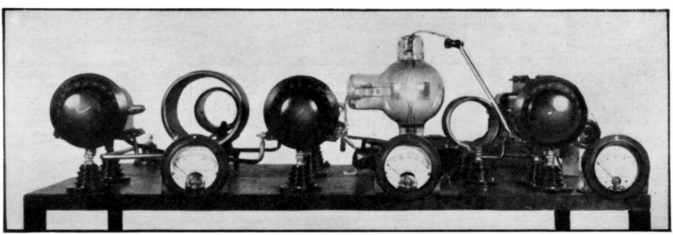


THE FRONT VIEW

With this arrangement all parts are in plain view while operating. Note the porcelain insulators used for mounting all high-frequency circuit parts. These not only provide excellent insulation, but also keep parts up in the open.

the well-known tuned-grid-tuned-plate circuit and employing a type 552 tube, rated at 75 watts. The construction of this will be described in the present article.

In forthcoming issues will be found constructional data on building a power supply on the bottom shelf giving approximately 1500 volts of properly filtered, rectified alternating current. As we go along, we will add a crystal oscillator and a buffer-amplifier stage. Then, with a few changes, our self-excited oscillator will become the final amplifier stage of our crystal controlled transmitter. Descriptions of a three stage speech amplifier with a separate power supply and a modulator will complete the job. These ideas will be described in the order named. Finally, we will have a general discussion on the proper type of transmitting antenna and we will probably evolve down to the one which is most widely used, the "zepp." Tuning and operating hints as well as general information will also be included.

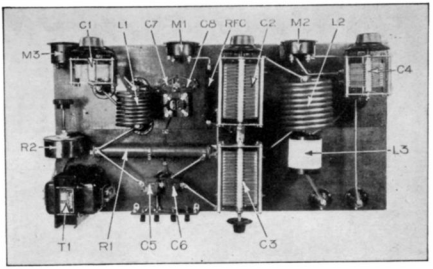
We have, first, to consider the choice of the oscillator tube. Many amateurs that have been contacted seem to be of the opinion that the 50-watter is a much better tube to use than its larger brother, the 552. This, in practical experience, has been found to be untrue. The 552 type tube, with its irregular shape and low capacity arrangement of leads has been found to make for much better connections in a transmitter where short leads are desirable. The 50-watt type tube necessitates the use of a socket where all leads are bunched. The t-g-t-p circuit is not easily adaptable to a 50-watter or even to a 210. Disregarding the physical make-up of the 552, its internal construction is such as to leave little desired for all around amateur purposes. Its low internal capacity makes it the ideal thing for the 14 megacycle band as it does on the 7 megacycle band. On 3.5 or 1.7 megacycles, the tube is found to be as near perfect as wanted.

Another point which concerns the tube is the power to be used on it. It seems to be a general belief that where a tube of this type is used, 2000 volts must be put on its plate. In practical experience it has been found that voltages between 1000 and 1500 showed no appreciable decrease in signal strength over the 2000 volt power. Reports from reliable stations contacted showed that the signal received when using but 1000 volts on the plate was better than when using 2000 volts because the lower power signal was more clean-cut and consistent. Then again a better d.c. note can be procured from a tube which is being under-run in power than when the rated voltage is used.

The writer has also found that a self-excited oscillator works best when the least current is drawn by the plate of the tube for a given plate voltage. The oscillator being described should draw no more than 90 milliamperes when the antenna is connected, and using 1000 volts on the plate. With the antenna, a drain of from 30 to 40 milliamperes should be expected. The methods to be employed in tuning this transmitter so that low current drains can be procured will be described in a later issue.

In 1928, Mr. Ross A. Hull, on a short visit from Australia, introduced the high capacity tank circuit.

(*Continued on page 525*)

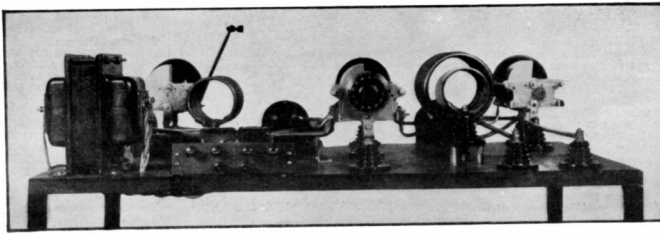


THE LAYOUT

This view shows the location of all parts and the "wiring," which is really copper tubing. All parts are lettered to correspond with those in the parts list at the end of this article

MOST amateur transmitting equipment is designed with low cost as the primary consideration. True, efficiency comes in for a good share of attention, but is likely to be sacrifieed at points to keep costs low. In designing a new transmitter for use in experimental transmission work in the Radio News laboratory, it was decided to strive for efficiency above all else, keeping costs down at the same time to the minimum required for best operating results. It is felt that a transmitter such as this will be of intense interest to a great many amateurs who now have low-power transmitters, but who have gone far enough in the game to feel the need of greater power and more careful design. The complete description of the transmitter will therefore be given, in the form of constructional and operating articles, of which this is the first.

—The Editors.



VIEWED FROM THE REAR

All power connections and the transformer are grouped at one end, remote from the antenna and plate circuits. The filament and voltmeter circuits are wired with twisted pair, run underneath the shelf.

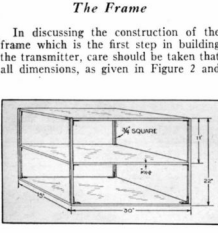
such as has been adopted for this transmitter, to the American amateur. Prior to that year, "high c" circuits were being used with much success by our Antipodal brothers. Upon publication of this idea, the writer incorporated it in a new tuned-grid-tuned-plate transmitter, then under construction.

This idea of using as little inductance and as much capacity as possible in a tank circuit did everything Mr. Hull claimed for it. It produced a note and steadiness found only in crystal controlled transmitters and completely eliminated "wobbulation" of the transmitted signal. It made a signal which was sharp, clean-cut and stable. In other words, it gave the effect of crystal controlled operation with the added flexibility of being able to change frequency at a moment's notice.

Since then, "high c" tanks have been used at W2WK-W2APD. Sixty-four foreign countries distributed over the six continents of the world have been contacted, four continents on voice. Naval Reserve work was carried on with signal quality that won the praise of Lieut. Reinartz, W1QP, who operates the Master Control Station (NDF) of the Third Naval District. All this above-the-average work was done from a location in the heart of New York City, one which is considered poor for work on the higher frequencies. Never was an input of more than 80 watts used on the 552 tube.

The Frame

In discussing the construction of the frame which is the first step in building the transmitter, care should be taken that all dimensions, as given in Figure 2 and



THE WOOD FRAMEWORK

Figure 2. The transmitter described here is confined to the top shelf. The lower shelves will be used for the power supply and later additions to the transmitter

in the text, are strictly adhered to. Although from all outward appearances this large space is not now needed, our finished outfit will utilize every available bit of room.

There will be no panels on the transmitter. It has been found that panels only serve their purpose in providing a convenient mounting place for meters and condensers. Often, such a procedure is more harmful than practical. A panel obstructs a full view of equipment —and sometimes disastrous things happen to equipment when not kept under observation. It is a good transmitter which has its equipment in a position

where each individual part is easily accessible. This makes for instant repair, if necessary.

Three boards, of a wood which will not warp easily, 30 inches long, 15 inches wide by ¾ inch thick are needed. Drawing boards, cut down to this size are good as they are so made as to lessen the danger of warping. Where lumber 30 by 15 inches cannot be readily obtained, two pieces 7½ by 30 inches can be placed together and held in place by strips on the undersides. One of these boards which is to be used as the middle shelf should have a square of ¾ of an inch sawed out at each corner.

Four strips, ¾ of an inch square and 20½ inches long are needed for the uprights. These should be of a good hardwood, well seasoned, since they are subject to the most strain.

The frame is first nailed together with thin wire nails. Then brass angles are placed on each upright, under the top and middle shelves and on top of the bottom shelf. These brackets should be securely screwed to the uprights and shelves. The resulting frame will be secure and rugged. It may be finished with shellac, insulating varnish, or a vegetable stain. As a final touch, rubber feet may be placed on the four uprights, if desired.

Laying Out the Parts

Too much cannot be said about the placement of parts. They should be placed exactly as shown in the model, where they have been arranged so as to lessen the effects of stray fields and provide the shortest possible leads between the parts.

A standard UX type socket is used for the 552 tube. This effects a saving in the cost of a special socket for this type of tube. The plate lead is brought to a convenient point on the plate condenser, C2, while the grid lead is brought to a binding post as shown on the photographs. In eliminating the regular transmitting socket, our grid and plate leads are materially shortened.

Most of the equipment is mounted on General Radio stand-off insulators. This provides a minimum of loss and keeps the apparatus out in the open. Another feature of using these insulators is that they bring the coils and variable condensers up near the leads on the tube and thereby shorten these leads.

Two Cardwell transmitting condensers, type T–199, each having a total capacity of .00033 mfd. are placed in parallel (C2, C3) to provide the high capacity necessary for the "high c" tank circuit. These condensers are the double spaced type and will safely stand the voltage encountered here. A .0005 mfd. receiving condenser is used in the grid tank since a transmitting condenser of the double spaced type is not necessary in this circuit. A Cardwell transmitting condenser, type 164–B, with a maximum capacity of .00022 mfd., C4, is used in the antenna feed wire proper.

Both the grid and plate stopping condensers, C5 and C6, are fixed condensers, with a voltage rating of 5000 to provide an ample safety factor. The two filament bypass condensers, C7 and C8, are placed as near to the tube socket as possible. This eliminates a considerable amount of sparking at the key.

The filament transformer, T, is placed on the top shelf to eliminate long filament leads. A variable filament control, having a resistance of from ¼ to 10 ohms is used (R2) to keep the filament voltage on the tube at approximately 9.5 volts. This can be checked on the 0-15 a.c. voltmeter, M3, which is an essential part of the transmitter and assures long life for the tube.

The 10,000 ohm transmitting grid leak, R1, must have a wattage rating of 100 if excessive over-heating is to be avoided. An over-heated grid leak will cause the signals to "creep" and makes for unsteadiness.

The radio-frequency choke coil, RFC, can be constructed by winding 160 turns of 26 gauge d.c.c. wire on a ¾ inch diameter form. This choke is not very critical at this point. Any commercial r.f. choke designed for use with this tube can be used, if desired.

The Coils

The coils are hand wound, using pieces of iron pipe as the temporary winding forms. Soft drawn copper tubing is used. Care should be taken in winding since copper tubing has a tendency of flattening out if bent sharply. Turns need not be spaced while winding. The edge of a screw driver can later be used to separate them. When the coils are completed the two ends of each coil are flattened and drilled to fit over the screws on the stand-off insulators.

The following table should be followed very closely if the right frequencies are to be covered:

Band		Copper Tubing Outside diam.	Inside Diam. Coil	Number of Turns
3500 k.c.	plate coil L2	⅜ inch	3½ inches	nine
	grid coil L1	¼ "	2⅜ "	thirteen
7000 k.c.	plate coil L2	⅜ "	2⅜ "	five
	grid coil L1	¼ "	2⅜ "	five
14000 k.c.	plate coil L2	⅜ "	2⅜ "	two
	grid coil L1	¼ "	2⅜ "	two
28000 k.c.	plate coil L2	⅜ "	2⅜ "	one
	grid coil L1	¼ "	2⅜ "	one

The antenna coil, L3, is wound on a bakelite form with a diameter of 2½ inches. The form should be approximately 3½ inches long. 25 turns of No. 14 d.c.c. wire are used, with no spacing between the turns. A hole, large enough to fit over the screw in a stand-off insulator is made in one end of the tubing.

With the coil mounted as shown in the photographs, it can be swung from side to side to vary the antenna coupling.

Regarding the antenna coil, it has been found that, by coupling a Hertz or Zeppelin antenna directly to the plate coil, approximately the same current is produced in the antenna. This method of antenna coupling does not, however, give as good a tone or as sharp a signal. The 25 turn antenna coil will be found to work best with almost any type of antenna system.

The Wiring Details

In wiring the transmitter, it must be remembered that the tank circuits are subject to a high current load. Poor soldering work or hook-up wire which is not heavy enough will impair the operation of the circuit. A No. 10 wire should be the smallest used, with two of these wires twisted together to be used in connecting the coils to the variable condensers and to their respective circuits. Quarter inch copper tubing is ideal for r.f. connections and was employed in the model shown in the photographs.

Again stressing the need for short leads, one must be cautioned against the use of right-angle leads. It must be remembered that it is better to have a transmitter that works well rather than one that is prettied up with tricky wiring.

The List of Parts

C1 Cardwell type 123–B receiving condenser, max. cap. 500 mmfds.

C2, C3 Cardwell type T–199 transmitting condensers, max. cap. 330 mmfds.

C4 Cardwell type 164–B transmitting condenser, max. cap. 220 mmfds.

C5 Aerovox .00025 mfd. fixed mica transmitting condenser, 5000 volt breakdown.

C6 Aerovox .002 mfd. fixed mica transmitting condenser, 5000-volt breakdown.

C7, C8 Aerovox .002 mfd. mica fixed receiving type condensers.

L1, L2, L3 9 transmitting coils, (see text).

M1 Weston model 301P D.C. plate milliammeter 0-300 mil. range.

M2 Weston model 425 R.F. Thermo-Ammeter, 0–3 amp. range.

M3 Weston model 476 A.C. Filament voltmeter, 0–15 volt range.

R1 Electrad 10,000 ohm center-tapped grid leak, 100 watts rating, mounted.

R2 Clarostat super power filament control.

RFC Radio frequency choke coil (see text).

T1 Thordarson type T–2383 12 volt filament transformer, 175 watts.

1 Air-gap UX tube socket.

1 DeForest type 552 transmitting tube.

14 General Radio stand-off insulators.

1 Bakelite knob.

3 4" Bakelite dials.

1 Binding post strip with 6 Eby posts.

Assorted hook-up wire or copper tubing, hardware, misc.