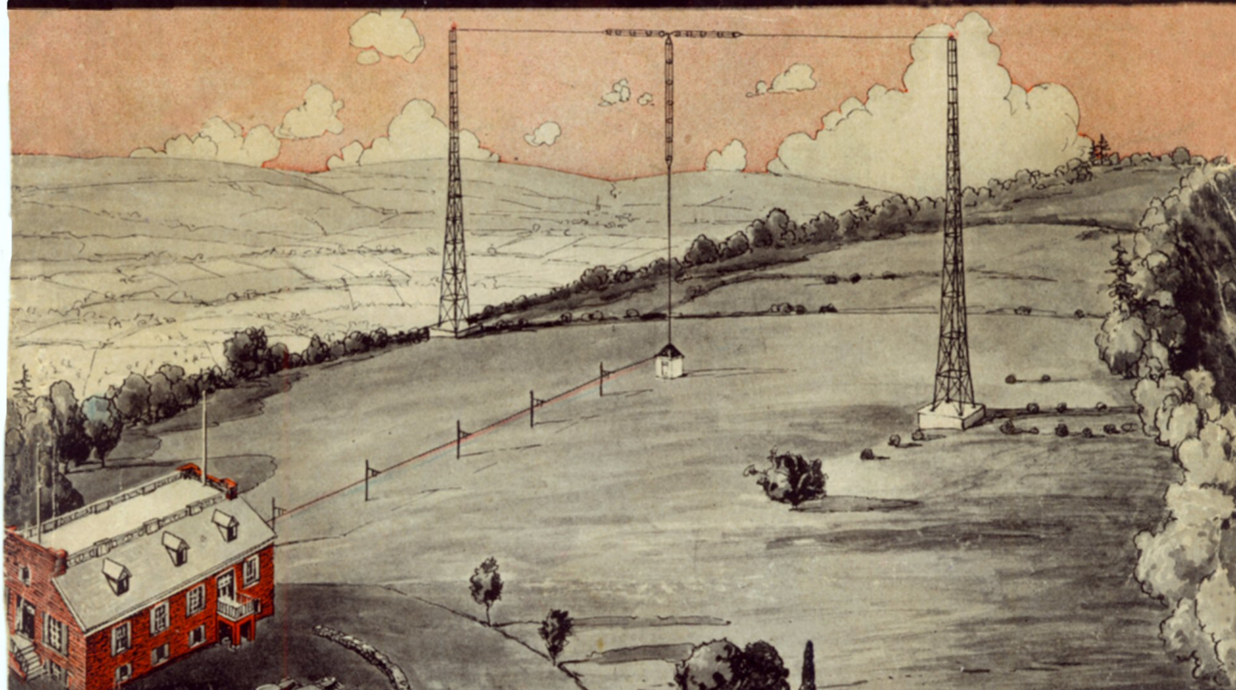


America's Most Modern Broadcasting Station

WTIC

Detailed Description In This Issue

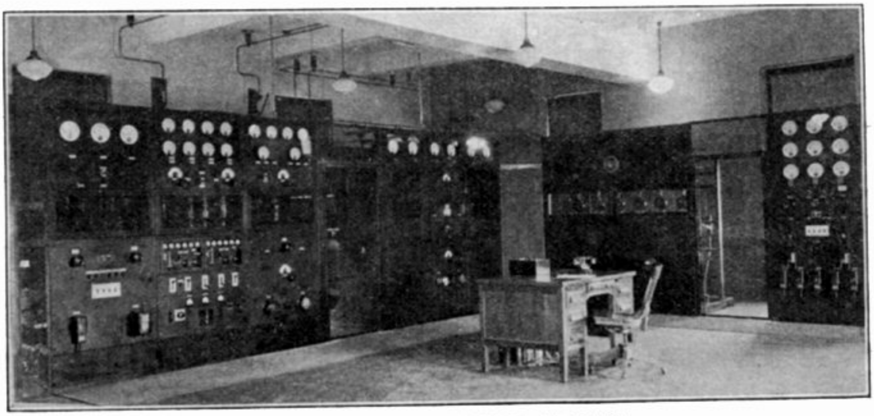
WTIC

A Modern 50-kw. Broadcast Station

We acknowledge the friendly coöperation given by Mr. Walter G. Cowles of the Travelers Broadcasting Service and his technical staff in the preparation of this article. — Editor.

By James J. Lamb, *Technical Editor*

Although most of us are more or less familiar with the generalities of design of modern amateur and commercial radio transmitters, few of us realize that the amateur and commercial fields have so much in common and that the present trend in amateur technical development is paralleling closely the progress in commercial design and practice. Attainment of that frequency stability, maximum distortionless modulation, and reliable transmission considered desirable in amateur radio of today, becomes an absolute necessity in contemporaneous highly-competitive commercial broadcasting. It is not surprising, therefore, to find that the modern commercial transmitter not only contains those features which characterize modern amateur transmitter design but in addition utilizes them to a much greater degree in obtaining that type of performance which we amateurs are finding desirable and which broadcasters are finding necessary. Although the modern commercial designer considers frequency shift in terms of tens-of-cycles-per-second while the amateur thinks in hundreds, and the modern broadcast transmitter is rated in kilowatts while the amateur is restricted to watts, the modern high-power broadcast transmitter contains numerous features of design which can be applied profitably in amateur practice. *QST* presents WTIC's new 50-kw. transmitter, therefore, not only because it marks a milestone in modern radio development but also because it contains so many features whose application can be of inestimable value to the further development of amateur transmitter technique.



THE 50-KW. TRANSMITTER AT WTIC

Everything is within view of the operator. The transmitter proper comprises the panels forming the left side of the right-angle. The rectifier and power-control panel are on the right. The panel at the extreme left carries the UX-866 rectifier units for the crystal-oscillator-amplifier, buffer amplifier, modulated amplifier and modulator on the panel at its right. The 5-kw. amplifier is at the left of the open gate and the 50-kw. stage is at its right. The box on the operator's desk contains the push-button control for the entire transmitter.

WTIC's Location

When one goes about choosing the site for a radio station representing the investment of some hundreds of thousands of dollars, he does not pick the first likely looking spot he comes upon and build his station there. Few indeed are the amateurs who have even the opportunity of choosing the location of their station, let alone determining whether or not it is the Will-o'-the-Wisp "good location" dreamed of. In the selection of the site for WTIC's transmitter lucky chance in choosing a location was not resorted to.

At the direction of the station owners, the Travelers Broadcasting Service (a subsidiary of the Travelers Insurance Company) engineering surveys were made on every suitable appearing piece of ground in the vicinity of Hartford. These surveys were made by the station's engineers and involved not only field strength measurements on a truck-mounted 500-watt portable transmitter but also actual measurements of the fall-of-potential through the ground on the sites considered. After hundreds of measurements had been made on a score of properties, the data were compiled and several locations were found suitable. Of these, the one atop Talcott Mountain, a few miles northwestward of Hartford, was not only found suitable but also available and there the new station was built. WTIC, therefore, may be said to have a "good location." The center of its antenna is at latitude 41° 46′ 34.631″ N. and longitude 72° 48′ 19.958″ W. The two 200-foot steel towers, 400 feet apart, are on a line running S. 78° 8′ 33″ W., and are painted in accordance with the aeronautical regulations of the Department of Commerce. Brainard Field and W1MK are eight miles distant on a compass course S. 60.25° E. from the center-point of the antenna. Flying amateurs who may be "avigating" in the vicinity of Hartford should make good use of this information.

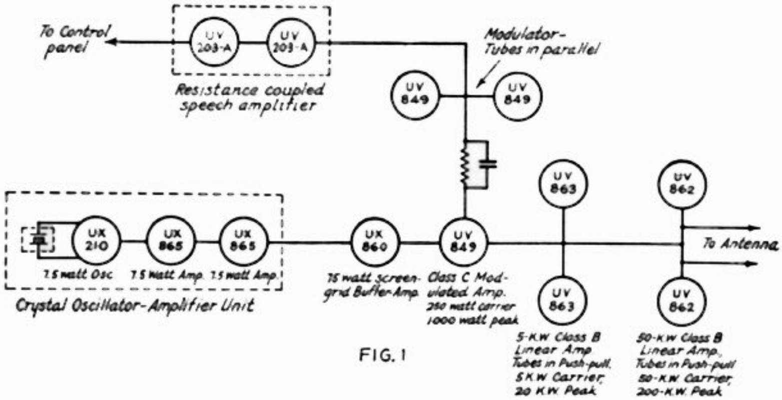


FIG. 1

THE TRANSMITTER

This 50,000-watt transmitter is truly the "last word" in modern design. It is the first high-power commercial transmitter to use 100-kw. tubes; the first to use mercury-vapor-type rectifiers throughout; the first capable of 100-percent undistorted modulation of its full rated 50-kw. carrier output. It employs screen-grid transmitting tubes where they are applicable. It holds to its assigned frequency to within better than 50 parts in a million and has an audio-frequency characteristic "flat" from 30 to 10,000 cycles. The design and construction is, withal, simple and straightforward. There are no trick circuits or principles unknown to amateur radio involved. It exemplifies the finest American radio engineering ability in its most practical form.

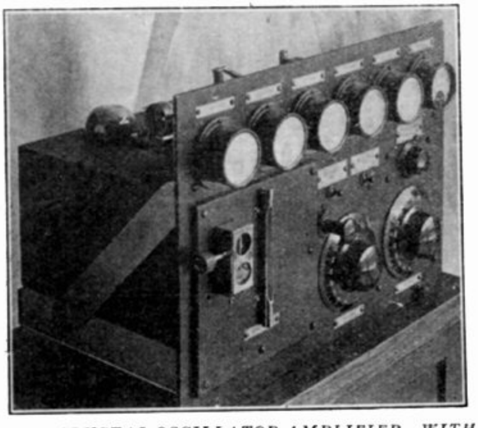
It must be confessed that "50,000 watts output" has a formidable sound and the amateur in expectation of viewing for the first time a transmitter of such rating is likely to find himself prematurely overawed. Surprisingly enough, his actual sensation is quite other than that of awe, for a hurried glance along the panels picks out UX-866's in profusion and a 75-watt UX-860 in the company of a trio of UV-849's. Inquiry reveals that there is a UX-210 and a pair of UV-865's in the crystal oscillator-amplifier unit and a glance behind the panels shows a pair of Cardwell transmitting condensers, edge-wise and flat-wound copper strip inductances, and other familiar adjuncts of ham radio. The big transmitter becomes less formidable as further examination introduces additional familiar features and more old friends of amateur radio are found contributing their share toward the ultimate 50 kilowatts of output. The amateur begins to feel at home. Why, this might be just a glorified ham transmitter! It may not be such a mystery as one at first supposed. And, true enough, it isn't.

Fig. 1 shows the tube arrangement of the entire transmitter in block-diagram form. Starting with a few watts of output from the crystal-controlled UX-210 oscillator, progressing up through the Class-C UX-849 modulated amplifier and finally the 50-kw. linear amplifier, a 50,000-watt carrier (with 200,000 watts of peak power) is delivered to the antenna system.

THE FREQUENCY CONTROL AND PRIMARY EXCITATION UNIT

The frequency-control unit consists of not only the crystal oscillator with its associated "oven" and temperature-control equipment but also a two-stage screen-grid amplifier. The crystal, mounted in the oven, is not of itself calibrated as of such a frequency at a given temperature but the calibration is for the unit as a whole, amplifier included. This in itself is an unusual feature and not in accordance with general practice. The practicability of the arrangement is obvious, however, since the units are in duplicate and in event of failure of one unit due to fracture of the crystal or anything else destroying the accuracy of calibration, the other can be immediately switched in its place and the defective unit shipped back to the laboratory for repair and recalibration. By this practice there is no chance of the frequency of a crystal as specified by the laboratory being affected by association with circuits or loads at variance with those for which it was calibrated. While such precautions as to frequency calibration and maintenance are by no means necessary in amateur radio, they are of prime importance in services requiring close adherence of assigned frequencies.

The crystal mounting also is unusual, although here again sheer practicality is evidenced. Extremely accurate temperature control has been found difficult in actual service, and methods of minimizing frequency shift with change in temperature have been found valuable as adjuncts to temperature control. The mounting of



THE CRYSTAL-OSCILLATOR-AMPLIFIER WITH ITS OUTER SHIELD REMOVED

Two of these units are used in the transmitter. The small panel projecting from the front has mounted on it the thermoregulator adjustment and thermometer for indicating the oven temperature. The oven is immediately behind this panel.

the crystal plays an important part in maintaining constant frequency with slight variations in temperature and the mounting used in this transmitter is such that a comparatively coarse control of temperature is accompanied by negligible frequency drift. The mounting is of the air-gap type, the gap being determined by quartz spacers between the upper and lower plates. The gap is maintained constant by virtue of the identical temperature co-efficient of expansion possessed by both the oscillating crystal and the quartz spacers. The spacers are thicker than the crystal by the length of the air-gap. Fig. 2 illustrates the principle of the mounting used. In an actual test

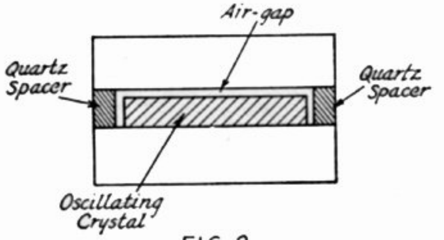


FIG. 2

extending over a considerable period, the frequency of the transmitter did not vary in excess of 20 cycles from the assigned frequency. The 20-cycle shift occurred during the first hour, after which zero beat was maintained for the remaining hours of the test. The temperature of the oven varied over a range of approximately 1.8° (C.) during the run.

The oven is of comparatively simple construction and comprises several outer walls of heat-insulating material with an inner compartment of aluminum. Within this compartment are mounted the crystal holder, the element of the thermoregulator whose adjustment is mounted on the front panel, the bulb of the thermometer, and the heater unit. The oven, in turn, is contained in the shield housing the oscillator and its associated amplifier.

The oscillator tube is a UX-210 with 180 volts on its plate and employs grid-leak bias. The crystal is connected between the grid and filament and the plate tank is tuned to the frequency of the crystal, 1060 kc., by a variable condenser. The output of the crystal oscillator is capacitively coupled to the control grid of the first of the two succeeding stages of screen-grid amplification. These amplifiers each use one UX-865, 7½-watt screen-grid tube with 500 volts on its plate, and grid-leak bias. Screen-grid voltage is obtained from the plate supply through suitable resistors. The plate power for the whole unit is obtained from a UX-866 mercury-vapor rectifier and filter unit mounted on the panel at the left of that on which the crystal-oscillator-amplifier is mounted. The input to the second amplifier is capacitively coupled to the plate tank of the first amplifier; both plate tanks are tuned by means of variable condensers. The crystal-oscillator-amplifier unit is the only completely shielded section of the whole transmitter; a decidedly interesting feature. The ovens of both units are heated from the house-lighting circuit and are left running continuously to insure constancy of temperature. Immediately below the two units are the switches for throwing either into service.

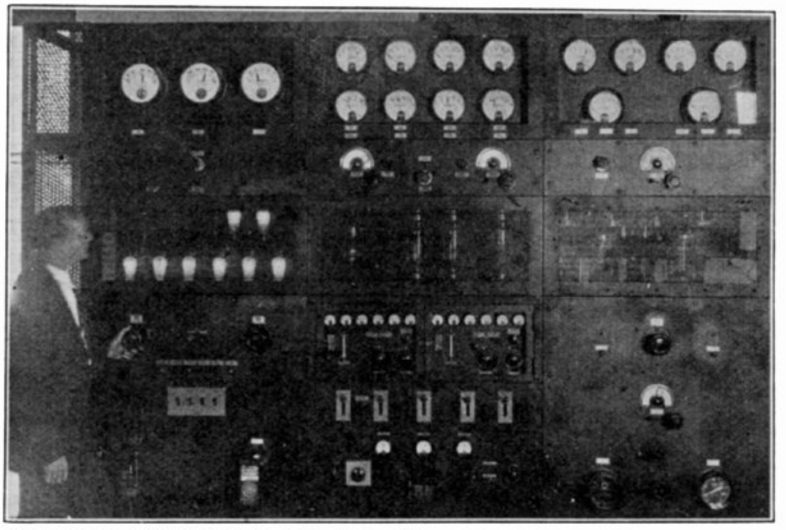
BUFFER AMPLIFIER, MODULATED AMPLIFIER AND MODULATOR

The output of the second screen-grid amplifier is capacitively coupled to the control-grid of the UX-860, 75-watt screen-grid buffer-amplifier which is mounted in the compartment above the crystal-oscillator-amplifier units. Excitation is sufficient to cause this tube to draw 250 watts from the plate supply at a plate voltage of 3000. It is nearly biased to cut-off, bias voltage being obtained from the station grid-bias generator. Screen-grid voltage of 750 volts is obtained from the plate supply through a suitable resistor. The plate supply for the buffer-amplifier, as well as for the UV-849 modulators and modulated amplifier, is obtained from the three-phase series rectifier using six UX-866 tubes mounted on the left end panel. The plate tank inductance is of copper ribbon wound on a hard-wood strip form and is tuned by a 7200-volt Cardwell transmitting condenser.

The buffer-amplifier must furnish a healthy kick to the grid circuit of the modulated Class-C amplifier to supply the grid losses and insure grid saturation. The UX-860, capacitively coupled to the grid circuit of the Class-C, UV-849 modulated amplifier, does this without difficulty. Plate input to the UV-849 is 300 watts at 2000 volts with the grid biased well beyond cut-off. Plate current is supplied to the modulated amplifier and two UV-849 modulator tubes through a common modulation choke; plate voltage on the modulator tubes is 3000 and this is dropped to 2000 for the modulated amplifier through a suitable resistor which is by-passed by a large fixed condenser. This arrangement is essential to the realization of 100% modulation and has been described previously in *QST*. The Class-C amplifier is neutralized to prevent self-excited oscillation. Its plate tank is similar to that of the buffer-amplifier; a copper-strip inductance tuned by a Cardwell transmitting condenser.

Two UV-849 tubes in parallel are used in the modulator. At first consideration the use of two tubes may seem unnecessary, but their desirability becomes apparent when the ratings and characteristics of the UV-849 are consulted. The load resistance of the modulator is the plate resistance of the modulated amplifier and the conditions for maximum output are satisfied when the load resistance is twice the plate resistance. The plate resistance of the two modulator tubes in parallel is practically half the plate resistance of the single amplifier. Maximum modulator output, therefore, should be obtainable. Moreover, the use of two tubes in the modulator makes possible complete modulation of the Class-C amplifier output without overloading the modulator tubes. The plate input to each modulator tube is 100 milliamperes at 3000 volts, a total input of 600 watts. Their grids are biased so that they operate on the linear portion of their characteristic. Sufficient grid-swing is possible to vary the modulated amplifier plate potential between zero and twice the operating voltage without noticeable distortion. Non-inductive resistors are connected in the modulator grid leads to prevent oscillation at ultra-high radio frequencies. Negative grid-bias voltage is obtained from the bias generator.

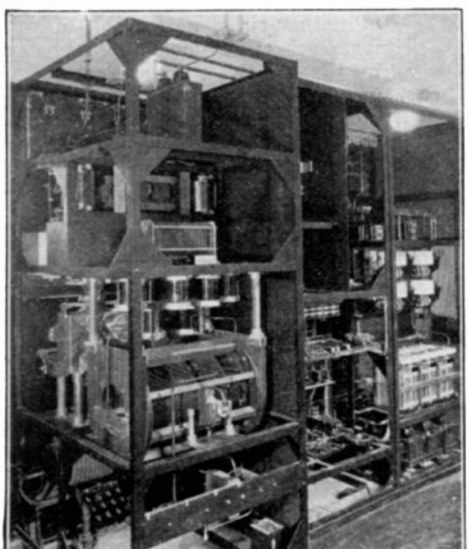
Grid input to the modulator is from a two-stage speech amplifier consisting of two resistance-coupled UV-203-A tubes. This amplifier is at the



THE UX-866 RECTIFIER, MODULATOR AND 5-KW. LINEAR AMPLIFIER UNITS bottom of the modulator panel. Its input comes from the station control-room amplifier which, in turn, is fed by the studio control amplifier at the Travelers' Grove Street building in Hartford. The speech amplifier and modulator system is, to say the least, effective. A "20-db.-down" (0.01-milliwatt) speech amplifier input signal is sufficient to give 100% modulation of the 50-kw. transmitter output.

THE 5-KW. LINEAR AMPLIFIER

The modulated output of the UV-849 excites the first linear amplifier which uses two UV-863, 10-kw. water-cooled tubes in push-pull. Plate power for these tubes is furnished by the 350-kw. 20,000-volt three-phase series mercury-vapor rectifier. The output voltage of the rectifier is dropped to 15,000 for this stage, by resistors. Plate current to both tubes is 1 ampere; total plate input is 15 kw. Filament power is supplied by direct-current generator; the filament voltage is 22 and the current to each tube is 52 amperes. Negative grid bias of 320 volts is supplied from



A PEEK AT THE REAR OF THE 5-KW. STAGE

The plate inductance and the grid coupling coil for the 50-kw. stage input are on the second deck from the bottom. The toaster-like appearing rig on the third deck is the Ohm-spun grid-shunt resistor. One of the neutralizing condensers may be seen just in front of the plate inductance. Part of the rubber tubing coil for cooling water is visible below the first deck.

the bias generator and is fed to the grids from a center-tap on the grid tank inductance.

The grid circuit of this stage is inductively coupled to the plate circuit of the modulated amplifier. The grid coupling coil is connected by a short feed-line to a high-C tank circuit to which the grid leads are, in turn, connected. Across this grid tank and the grids, is connected an Ohm-spun resistor. The circuit is the same as that shown in the description of the linear amplifier of the 'phone transmitter in the April, 1929, issue of *QST*. Grid excitation is controlled by varying the coupling to the modulated amplifier plate

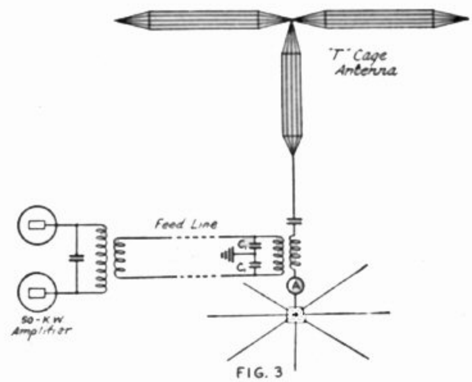
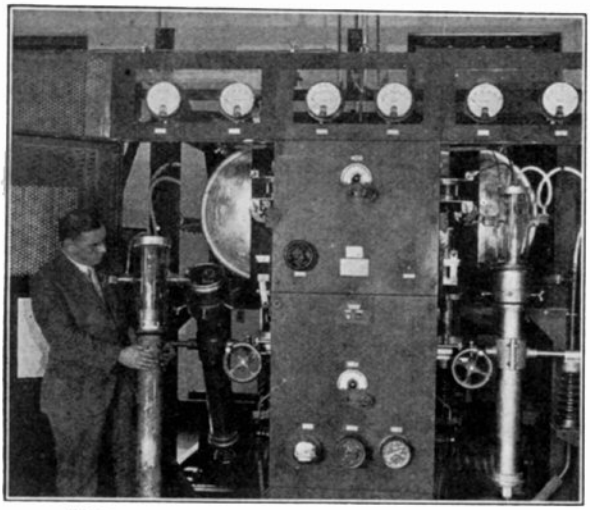


FIG. 3

coil and by regulating the resistance of the Ohm-spun unit.

The plate capacitance of the tubes is neutralized by a pair of high-voltage three-plate variable condensers "cross-connected" between grid and plate, plate and grid, of the respective tubes. In neutralizing the amplifier, a low-reading thermocouple ammeter is connected in the tank circuit and, with excitation reduced and plate voltage off, the neutralizing condensers are adjusted for minimum current in the plate tank. The plate inductance is similar in construction to the inductances of the lower stages. It consists of copper edgewise-wound ribbon on a wood-strip form. High-voltage fixed condensers connected across this inductance tune it approximately to resonance while fine tuning is accomplished by means of a rotatable aluminum ring mounted in the plane of the coil turns at the center of the inductance. This ring is referred to as the "flipper." It is rotated by an insulating shaft terminating in a knob on the panel front. With this adjustment, tuning over a range of approximately ten kilocycles is possible. This scheme for fine adjustment is used in all tuned circuits of the transmitter not equipped with variable condensers. It should have many applications in amateur transmitters and no doubt an adaptation of the idea would be applicable to receiver tuning as well. At amateur frequencies, the possible frequency variation would be considerably greater than at the lower broadcasting frequencies because the change in distributed capacity and incutance of the coil would be affected in greater proportion. Perhaps the amateur transmitters and receivers of the future may be visualized as aggregations of fixed condensers and coils tuned by a variety of aluminum rings or discs. While the idea may not be new, its practicality is given weight by the fact that it finds its way into the most modern equipment. The grid tank coil is similarly tuned by an aluminum disc.

Proper excitation of the 5-kw. linear amplifier is obtained by varying the coupling to the modulated amplifier plate inductance and adjusting the grid-shunt resistor until the amplifier carrier output is 5-kw. With carrier power output of this value, a maximum undistorted power output of 20 kw. is possible on the modulation peaks. The excitation adjustment is both critical and important. Distortionless performance on the part of the linear amplifier is impossible unless it is correct. A detailed explanation of the method of adjusting the excitation of the linear amplifier of an amateur 'phone transmitter is given in the April, 1929, issue of *QST*.



THE 50-KW. LINEAR AMPLIFIER WITH THE FRONT-DOORS OPEN

The 100-kw. tube is obviously "man-size." Note how the left-hand tube socket is tipped forward to facilitate insertion of the UV-862. The tubing running to the top of the tubes is for air-blast cooling of the glass grid and filament seals.

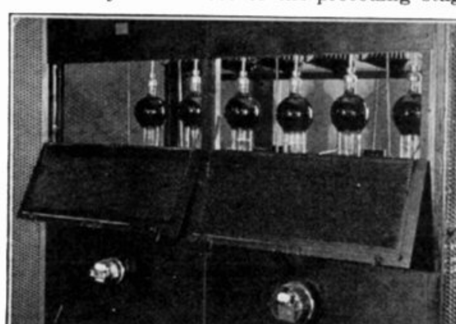
THE 50-KW. OUTPUT LINEAR AMPLIFIER

A 50,000-watt radio frequency linear power amplifier is most decidedly an innovation in the art of radio telephony and has been made a practical actuality as a result of the perfection of the 100-kw. tube. The designation of the rating of the amplifier might well be 200 kw., for its power output on the modulation peaks has this value. Two UV-862, 100-kw. water-cooled tubes in a push-pull circuit do the work.

Of all the interesting features of this amplifier, the UV-862 is undoubtedly the most interesting. To one accustomed to lesser tubes its ratings are almost staggering. Filament current is 207 amperes at a filament voltage of 33. Almost 14 kw. of power is required for heating the filaments of the two tubes; enough power to operate a goodly number of ham transmitters. The plate voltage is 18,000 and seems quite reasonable. But the plate current is around 5 amperes per tube; 10,000 milliamperes plate current for a single push-pull amplifier almost numbs the amateur imagination. Grid bias for Class B operation is 320 volts, a comparatively low value since the tubes have a high amplification factor. Two kilowatts of actual grid excitation are required for the full 50-kw. power output of the amplifier. When the mind has become accustomed to such values, the good old 75-watter seems to shrink to the proportions of a 199.

The heat generated by the filament and plate power consumed is considerable to say the least, and it is obvious that an effective means for rapid cooling of the tube elements must be provided. The heat dissipated by the filament alone would be sufficient to wreck a tube in short order if no means, other than air, were available for cooling. Such catastrophe is made remote by the effective water-cooling system incorporated as an auxiliary to the transmitter and will be described in detail later.

The circuit arrangement of the 50-kw. amplifier is the same as that of the preceding stage. Its tuning and excitation adjustments are identical with those of the 5-kw. amplifier. Its components differ considerably from those of the preceding stage, however, and details of their construction may be of interest.



SIX MERCURY-VAPOR TYPE TUBES ARE USED IN THE 350-KW. RECTIFIER

This is the first rectifier of its type ever used in a commercial station.

The plate inductance is made up of flat-wound copper strip on notched glass bars fastened to a form of wood ribs and is quite similar in construction to the edge-wise wound inductance of the preceding stage. Proponents of both flat and edge-wise wound coils should be satisfied with the practice in this transmitter, for the two types are found in equal proportions. The plate tank condenser is mounted immediately above the inductance and is in two sections, one on each side.

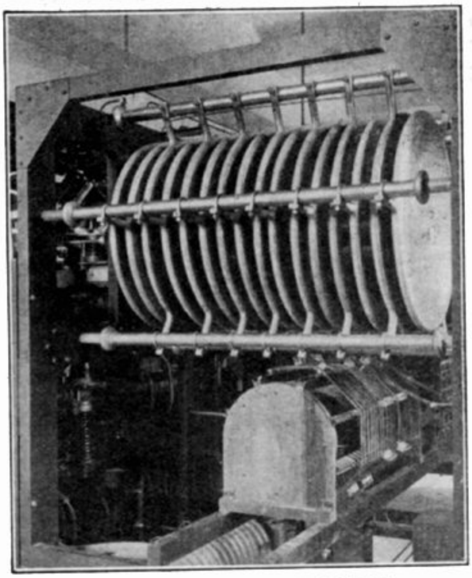
Each section consists of a series of slightly dished aluminum discs. The discs are about 30 inches in diameter and are each equipped with three projecting lugs spaced 120 degrees apart around the circumference for mounting. The plates are fixed on pipe supports which, in turn, are fastened to the frame of the transmitter by insulating pillars. The supports are spaced 60 degrees apart and alternate plates are mounted on and connected to each set of three pipes. The two sections of the condenser are in series across the plate inductance. Each pair of plates has a capacitance of approximately 75 $\mu\mu$fd., the total capacity of the condenser being 750 $\mu\mu$fd. The tank capacitance is varied by the addition or removal of plates and adjustment of the spacing between them. This type of air-dielectric condenser construction has practical application in amateur transmitters; the plates might be aluminum "pie-plates" or discs cut from sheet aluminum and the supports could be threaded rods. Sufficient capacity variation for tuning purposes could be obtained by mounting one end plate on a screw rotated by a knob or small crank. Fine tuning adjustment of the plate circuit is by means of an aluminum disc "flipper" inside the inductance, operated from the panel.

The neutralizing condensers for this stage are most unique. An aluminum disc supported by a large threaded screw and similar to those used in the tank condenser, but without mounting lugs, is capacitively coupled to the front end plate of each section of the tank condenser. The spacing between these plates and the end plates of the tank condenser is variable, the rotation of the screws moving the plates toward or away from the stationary plates. The movable plates are connected to the respective grids of the UV-862 tubes. The neutralizing circuit is identical with that of the 5-kw. stage.

As in the preceding stage, excitation is controlled by input coupling and adjustment of the grid-shunt resistor. Since the output of the preceding stage is 5 kw. and but 2 kw. are required for proper excitation, it is obvious that the grid-shunt resistor is called upon to dissipate a considerable amount of power. While the dissipation of 3 kw. in a resistor may seem to be a wanton waste of good power, it is essential to linear amplification. Good grid-regulation is absolutely necessary and it can be obtained only by making the input resistance of the grid circuit comparatively low and supplying sufficient power, in excess of that dissipated in the resistor, to insure "grid saturation."

THE ANTENNA SYSTEM

Although the construction of a directive antenna system has been considered, that in use at present is of the "T" type, operated against ground and fed by a two-wire transmission line. The schematic plan of the antenna and feed-line is shown in Fig. 3. The input to the transmission



BEHIND THE 100-KW. TUBES

One section of the massive plate-tank condenser dominates the picture. Below it is the plate inductance and feeder-input coupling coil. A coil of tubing for cooling water may be seen below the inductance.

line is inductively coupled to the plate coil of the 50-kw. amplifier. The output terminal equipment is such that the surge impedance of the line is matched to the antenna resistance. The antenna resistance is 65 ohms and the natural frequency is 1140 kc. (380 meters). The value of radio frequency current at the base of the antenna is 27.8 amperes at normal carrier power output.

The ground system consists of 200 feet lengths of heavy bare copper wire buried in shallow trenches radiating from a point immediately below the center of the antenna. All wires are connected to a large copper sheet beneath the tuning house. The line terminal equipment and antenna ammeter are in the tuning house.

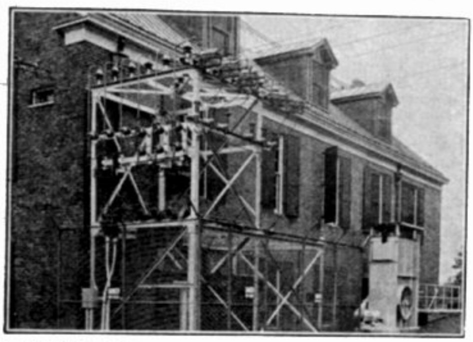
The possibility of even harmonic radiation is eliminated by the use of the antenna-and-ground combination and also by making the line terminal circuit high-C with a ground at the nodal point.

PLATE, FILAMENT AND GRID BIAS SUPPLY

Plate supply for the tubes preceding the UV-863 stage is obtained from rectifier units using the UX-866 type rectifier tubes and that for the UV-

863 and UV-862 tubes is supplied by the 350-kw. unit employing six UV-857 mercury-vapor type rectifiers in a three-phase "series" circuit. This rectifier is the first of its type to be used in a commercial installation. The UV-857 is the jumbo version of the familiar UX-866 and has a peak inverse voltage rating of 20,000 and a peak current rating of 20 amperes. The d.c. output voltage is normally 18,000 and is varied by means of a motor-operated voltage regulator in the 2300-volt primary circuit of the three single-phase plate supply transformers. The output voltage is dropped to 15,000 for the two UV-863 tubes in the 5-kw. stage; the full rectifier output voltage is applied to the plates of the UV-862 tubes in the 50-kw. stage. The rectifier output is filtered by a large reactor and bank of high-voltage condensers.

Filament current for the UV-863 and UV-862 tubes is supplied by a d.c. generator equipped with a filter rather than by step-down transformers. The use of filtered direct current for filament heating is essential for the prevention of hum in the output when heavy filament currents are employed. Several hundred amperes of alternating current flowing through a filament would create a fluctuating field of considerable intensity. Alternating current from step-down transformers is used for filament heating of the rectifier tubes as well as for the filaments of the transmitting tubes of the lower stages.



A VERITABLE SUB-STATION IS REQUIRED TO HANDLE THE STATION'S POWER DEMANDS

Primary power enters the attractive Colonial style station building from the equipment within the fence. The two-wire antenna feed line may be seen at the upper left. The water-cooling radiator with its motor-driven air circulating fan is down right.

Negative grid bias voltage for all tubes following the crystal oscillator-amplifier is supplied by a d.c. generator. This method of obtaining bias insures good voltage regulation.

THE WATER-COOLING SYSTEM AND POWER CONTROL

The development of the water-cooled type tube has made necessary similar developments in the water system involved and this installation has a water system which in itself is a considerable plant. Distilled water only is used and an important unit of the system is the perfectly legal still located in the basement of the station building. The pure water distilled by this unit is put in a storage tank from which it is pumped through the outdoor radiator and the tubes. When the transmitter is shut down and the pumps stop, the water automatically drains from the outside radiator to the storage tank in the basement. This eliminates the danger of a possible freeze-up in cold weather.

The use of distilled water has several advantages over the use of doubtfully pure "tap" water. Corrosion and "scaling" of the copper jackets of the tubes is minimized and the comparatively high resistance of the distilled water permits operation of the plates at high potential with respect to ground with a negligible power loss. The water flows through coils of rubber hose immediately prior to reaching the tube water-jackets and again immediately after leaving them. This increases the length of the water column and of the high-resistance path to ground.

When the transmitter is put into operation, the water pumps automatically start circulation some time before the filament and plate power comes on and the water is kept circulating for some fifteen minutes after the rest of the plant is shut down to insure proper gradual cooling of the tubes.

Power to the transmitter is controlled by an elaborate system of automatic switches which operate in proper sequence and with proper timing. The whole transmitter is controlled by a single push-button start-and-stop switch. Pilot lamps indicate current flow in all important circuits and assist greatly in locating the source of trouble in event of a forced shut-down. The transmitter can be easily controlled by a single operator, although the technical staff of WTIC is made up of three engineers and eight operators at the present time.

CONCLUSION

Obviously, it has been impossible to cover in complete detail every interesting feature of this modern 50-kw. transmitter. An attempt has been made, however, to dwell particularly on those features of greatest interest to the amateur and it is hoped that ingenious experimenters will find ways and means of applying some of the ideas to our game. It is more than probable that many applications will be discovered in addition to those suggested in these pages. Some may prove of great value to amateur radio; all will be worth trying.

Robert S. Coe