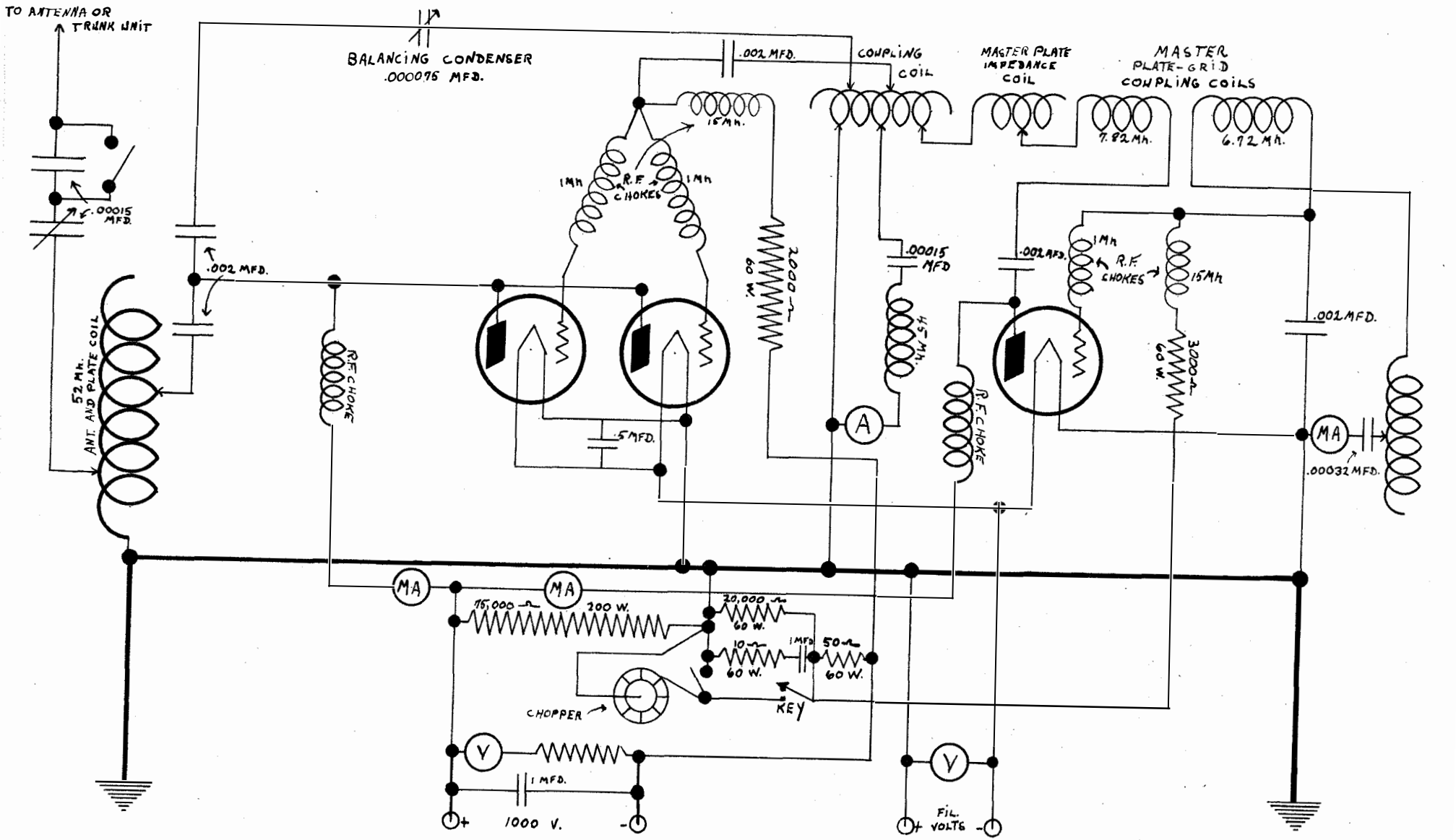

MODELS TV TW TX TRANSMITTERS

TWENTYTHIRD WEEK. G.B.Todd,RMlc.
MODELS TV, TW, & TX TRANSMITTERS.

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QUESTION #1. Describe the Model "TV" transmitter.

ANSWER #1. The Model TV vacuum-tube transmitter is a 100 watt master-oscillator power-amplifier set designed to work within a frequency range of from 2000 to 3000 kilocycles for inter-fleet work.

QUESTION #2. Describe the master-oscillator used in the Model TV transmitter.

ANSWER #2. The master-oscillator circuit of the Model TV transmitter is a tuned grid circuit using a single 50-watt tube. The tuning is accomplished by means of varying the inductance rather than by varying the capacity. The inductance is varied by changing the number of turns in the coil by means of a tap switch on the front of the panel. The fine variations are made by rotating an aluminum disk in the field of this coil. When the surface of the disk is perpendicular to the plane of the winding, the effect on the inductance is small; however, when the surface of the disk is parallel to the plane of the winding, large eddy currents are induced, which reduce the effective inductance of the coil. In these sets the disk is equivalent to about two turns of winding on the coil, so it is possible to get any value of inductance within the range for which the coil is designed. The capacity in the grid-tuned circuit consists of two condensers in series - one, 0.002 across which is bridged the grid-filament capacity, and the other 0.00032. As the grid-filament input impedance is the largest variable in a vacuum tube, it is quite desirable to connect it across a low impedance in order that the variation which obtains with variations in voltages, tubes, etc., will have a minimum effect on the tuning of the circuit. If, as in this case, the low impedance is connected in series with a high impedance to accomplish the tuning, these variations will have a still smaller effect on the tuning. As this set is designed the plate and filament supply voltages may be varied as much as 10 per cent, or tubes may be changed with negligible effect on the frequency. The plate is coupled to the grid circuit by means of a coupling coil connected in series with the grid variable inductance. The voltage produced by this master is transferred to the amplifier by means of a tuned intermediate or tank circuit. Part of the inductance of this circuit is connected in series with the plate circuit of the master tube. If the intermediate circuit is in tune with the master frequency, the radio-frequency current flowing in the plate circuit will induce currents in the intermediate circuit. Large changes in the intermediate circuit will produce small changes in the master frequency, due to the changes produced in the plate circuit impedance of the master circuit. Small changes, however, such as would be produced by variations in the amplifier circuit which is connected to the intermediate circuit will produce only negligible variations.

QUESTION #3. Explain the difference between the "TV," "TW," and "TX" transmitters.

ANSWER #3. The three transmitters, Models TV, TW, and TX are identical in most respects. The TV and TW differ only in respect to the supply voltage, while the TX is exactly the same as the TV, except for the fact that the TV is designed to work at the base of the transmitting antenna trunk with a transmission line, while the TX is designed for use with an antenna connected directly to the set. The only difference in the transmitter units of the TX and TV-TW is that in the TV and TW the current transformer is not within the transmitter unit.

QUESTION #4. Describe the power supply to the radio-frequency circuits in the Model TW transmitter.

ANSWER #4. The plate direct-current supply is in parallel with the radio-frequency circuit. Radio-frequency chokes are inserted in the high-voltage leads to prevent the radio-frequency from backing up on those leads, and blocking condensers are inserted in the lead to the radio-frequency circuits to keep the direct current from going to ground via that route rather than through the tubes. The grid bias voltage for the master tube is obtained by means of a grid leak. The amplifier grid bias is obtained by means of a grid leak and from the drop in voltage across a resistor in series with the negative high-voltage supply line. The feed of these voltages is parallel; chokes and blocking condensers are used in the same manner as in the plate feed. As these sets are designed to work over a large frequency band with a minimum of adjustment, it has been found desirable to insert in the radio-frequency plate circuit a loading inductance. This extra impedance prevents excessive plate-current flow and makes good operation possible in frequencies differing largely from the one on which adjustment was made for maximum efficiency. The filaments are lighted from direct current, furnished by a separate generator. The filament voltage is controlled by varying the generator field by resistance. All filaments are in parallel. The positive side of the generator is grounded. A ½ microfarad bypass condenser is placed across the filament line.

QUESTION #5. Explain and show diagram of keying system of Model TX transmitter.

ANSWER #5. The key is controlled across a 20,000 resistor, one end of which is grounded. The other end is connected to the negative-generator terminal and amplifier grids, thru a 50-ohm bias resistor and directly to the master grid. There is a 75,000 ohm resistor between the plus generator terminal and ground. With the key open there is a current flow through these resistors, giving rise to a resistance drop across the 20,000 resistor. As the filament is connected to one end through ground and the grids to the other, this bias is applied to the grids.

ANSWER #5. Continued.

As it amounts to about 200 volts negative on the grid, all plate current is shut off. When the key is closed this 20,000 resistor is shorted out. The 75,000 resistor is then placed across the generator and remains idle. The grid leak of the master is grounded, and the grid of the amplifier takes whatever bias is produced by the drop across the 50-resistor, and the set starts oscillation. When the CW chopper switch is thrown to chopper position the chopper motor is started, and the chopper wheel is placed in series with the key. When the key is pressed the set is started and stopped about 1000 times a second, which broadens the transmitted wave. The chopper is for emergency transmission only. A condenser in series with a resistor is placed across the key contacts to prevent sparking of the key.

See back of this week's log work for diagram of TV-TW-TX transmitter showing keying system in detail.

QUESTION #6. Explain how you would remedy the following defects in the TW transmitter:

(a) Motor generator fails to start.
(b) Sparking at brushes.
(c) Motor racing.
(d) No plate current.
(e) No oscillations.

ANSWER #6. If the motor generator fails to start it may be due to any of the following causes:

(1) Open starter.
(2) Burnt out relay coils or resistors.
(3) Burnt out starting resistor.
(4) Open lines.

the remedies for which are given below:

(1) Ring out and determine point of break and repair.
(2) Ditto.
(3) Ditto.
(4) Ditto.

ANSWER #6. Continued.

If sparking occurs at the brushes, it may be due to any of the following causes:

(1) Dirty commutator.
(2) Open or grounded armature.
(3) Worn out or stuck brushes.

the remedies for which are given below:

(1) Clean with fine sandpaper.
(2) Ring out to determine which and repair.
(3) Replace with new brushes.

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If motor races, which is dangerous, it may be due to the following:

(1) Open field or field rheostat.

which may be remedied by:

(1) Ring out and determine which and complete the circuit.

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If there is no plate current, it may be due to any of the following causes:

(1) High voltage fuse out.
(2) Choke open.
(3) Meters open.
(4) Bad tubes.

the remedies for which are as follows:

(1) Test fuse and replace if necessary.
(2) Ring out and complete circuit.
(3) Ditto.
(4) Swap tubes between master oscillator and power amplifier. If no results obtained try new tubes.

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If the set fails to oscillate, it may be due to any of the following causes:

(1) Out of adjustment.
(2) Burnt out tubes.
(3) Open circuits.
    (a) Meters
    (b) Condensers.

which may be remedied as follows:

(1) Check up on all adjustments.
(2) Replace with new tubes.
(3) Inspect all meters and determine which one is open; complete circuit.
    (b) Test condensers with voltmeter and battery.

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PRECAUTIONS REQUIRED IN THE DESIGN AND OPERATION OF VACUUM-TUBE TRANSMITTERS.

Power Supply:- Power-supply circuits for vacuum-tube transmitters should always be provided with fuses, or, in the case of high-power tube equipment, with circuit breakers. These precautions are necessary because it is comparatively easy to stop vacuum tubes from oscillating, and when such a condition exists, the extra power which was being supplied to the antenna, is dissipated in the tube and overloads it. If the fuse or circuit breaker does not open the power circuit, the tube will be destroyed. The overload devices can also take care of any short circuits that may occur in the rectifying or filter circuits.

When tube (Kenetron) rectifiers are used, it is only necessary to heat the filament to the proper brilliancy, as specified by the tube manufacturer. The best practice in this respect is to use a voltmeter across the filament terminals and to keep the voltage supply at a definite working voltage throughout the entire operating life of the tube. Chemical rectifiers need very little attention if care is taken to keep foreign matter out of the electrolyte. The filter system should not prove to be a source of trouble, provided that the choke coils and the condenser have been designed to withstand the working voltages and currents. A slight generator hum may appear from time to time due to a momentary reduction in the supply voltage to the filaments of the vacuum tubes. This voltage change permits the emission of a hum which sounds like a combined generator and a 120-cycle hum, assuming in this case that 60-cycle filament heating supply is used.

Oscillation generating circuit:- If the plate of the vacuum tube in the oscillation generating circuit becomes too hot, as indicated by an increase in the coloring of the plate, this means that the plate or grid coupling is not correct. Increase, or decrease the number of turns in the plate circuit until the coloring disappears. If this change does not remedy the trouble, change the amount of capacity in the grid tuning condenser until the coloring disappears. Finally, if these changes do not reduce the heating of the plate, inspect the antenna system to see if the antenna is grounded or open circuited. The radio-frequency choke coils should give no trouble if they are kept free from dirt and moisture. The same holds for the coil system, the condensers, and the resistance in the grid circuit.

When designing the coil system for the oscillation generating circuit, special care should be taken to select insulating material which has low dielectric losses. The location of this material in the oscillatory circuit should also be carefully chosen. Porcelain, hard rubber, kiln-dried paraffined wood, and the best grade of phenolic base insulating material are recommended for use in the oscillating circuit, the preference of material being given in the order named.

It is possible to blister and burn up specimens of various insulating compounds by placing them in the field of a coil carrying radio-frequency currents. Present practice shows a preference for kiln-dried wood, boiled in paraffin, and porcelain, for use as insulation in the coil system of the oscillatory circuit. Do not

use iron or steel screws or bolts for securing parts of the oscillation circuit; also make sure that no closed metallic loops are within coupling distance of the coil system. If such a loop exists it is advisable to open-circuit the loop either by cutting out a portion of the metal or by inserting mica or bakelite bushings between parts which hold the loop circuit together.

The capacity effect of leads from the oscillatory circuit to metal parts of the transmitter panel and frame should be reduced to a minimum by supporting high-voltage leads at a maximum distance from grounded metal parts. If this precaution is not taken, losses will occur in the transmitter, due to the distribution of output current between the capacity within the transmitter and that of the antenna. For this reason, the transmitter should be designed so that a minimum amount of capacity exists between the oscillatory circuit and the grounded parts of the transmitter. The filament should be heated to the required brilliancy, as indicated by the voltmeter. Any increase in filament brilliancy over that specified greatly reduces the life of the filament, thereby increasing maintenance costs.

Modulation circuits:- The main precaution to be observed in the modulation circuit is to keep the grid and microphone batteries in good condition at all times. It is also advisable to operate radio-telephone transmitters at reduced power rather than at increased power, because the extra power dissipated in the plate circuit of the modulation tubes greatly shortens the life of the tube. This is due to two causes; the increased temperature of the plate may be sufficient to cause it to collapse or to melt, with consequent destruction of the tube; or the increase in power is accompanied by increased filament temperature, which results in shortening the life of the filament. The increase in radiated power obtained by overloading the tubes does not produce an appreciable increase in received signal strength and, in certain cases, such an increase may even cause a decided decrease in signal strength. The latter would most likely be due to excessive heating of the plates of the tubes, with a consequent reduction in overall efficiency of the transmitter.