INSTRUCTION BOOK

for

Supreme MODEL AF-100
AMATEUR RADIO TRANSMITTER

"Built for the Present . . . and the Future"

Manufactured by

SUPREME TRANSMITTER CORPORATION

New York City, N. Y., U. S. A.

Supreme TRANSMITTER CORPORATION

WARRANTY

We fully guarantee the materials and workmanship in this transmitter to be of the finest quality typifying the highest standards in the industry.

If any part or component, other than a vacuum tube becomes inoperative or defective within 90 days after purchase by the user, full replacement under the standard RMA components guarantee will be made by the manufacturer.

This transmitter has been thoroughly inspected and tested and given Final Approval before being specially wrapped and packed to withstand normal handling in shipment. If the case has been dropped or there are signs that it has been mishandled in transit, claim must be made to the carrier immediately upon receipt.

With proper care and considerate treatment, this transmitter will last many years and serve to give its owner considerable pleasure and enjoyment.

Please read ALL the instructions CAREFULLY. Many Happy QSOs!

SUPREME TRANSMITTER CORPORATION

SAFETY NOTICE

This equipment employs High Voltages which are DANGEROUS if contacted by the operator. The top cover of this transmitter is provided with an Electrical Interlock. However, the operator should ALWAYS GROUND any part of the equipment BEFORE touching it.

CAUTION

IF it is necessary or desired by the operator to INSPECT the color of the vacuum tube plates while the unit is energized, the operator, UNDER NO CIRCUMSTANCES should place his hands inside the unit!

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Supreme TRANSMITTER CORPORATION

INSTRUCTION BOOK

SUPREME AMATEUR RADIO TRANSMITTER

MODEL AF-100

MANUFACTURED BY

SUPREME TRANSMITTER CORPORATION

NEW YORK, NEW YORK

SECTION I

GENERAL DESCRIPTION OF COMPLETE EQUIPMENT

1.1 Summary of Characteristics

1.1.1 Mechanical--Cabinet and Panel construction.

Chassis and panel move forward on runners for removal or inspection. Panel has a gray smooth finish. Cabinet has a gray wrinkle finish. Antenna connections, stand-by, and power connections come through the rear of the cabinet.

1.1.2 Emission--A1, A2, A3, and FM.

1.1.3 Power output--Carrier level 100 watts.

1.1.4 Frequency Range--Covers all amateur bands between 3.5 to 30 megacycles.

1.1.5 Frequency determination--Variable Frequency Oscillator or Pierce Crystal Oscillator.

1.1.6 Frequency Stability-- .02% or better over entire range.

1.1.7 Tuning--From front of panel on all frequencies.

1.1.8 Controls--

A. "V.F.O. Tuning" Dial

B. "Amplifier Tuning" Dial

C. "Modulator Selector" Dial

D. "Oscillator Selector" Dial

E. "Microphone Gain" Control

F. "Band Selector" Dial

G. "Filament On-Off" Switch

H. "Plate On-Off" Switch

I. "Phone-CW" Switch

J. "Transmit-Standby" Switch

1.1.9 Panel Lights:

A. "Filament" On

B. "Plate" On

1.1.10 Keying Speed--50 words per minute

1.1.11 Method of Modulation:

AM: High level Class AB_2

ICW: Variable Frequency Oscillator: High level Class AB_2

FM: Reactance tube modulation

1.1.12 Modulation Capabilities:

AM: 100%

ICW: 100%

FM: 100% = ± 75 kc (variable from 0 to 75 kc)

1.1.13 Input Audio Source: High impedance crystal or dynamic microphone level-60 DB

1.1.14 Audio Frequency Response:

AM: ± 2 DB, 200 to 6,000 cps.

FM: ± 1 DB, 100 to 7,500 cps.

1.1.15 Noise Level:

AM: - 45 db below 100% modulation.

FM: - 60 DB below 100% modulation (± 75 kc)

1.1.16 Audio Frequency Distortion:

AM: 5% at 85% modulation for 100 watt output

FM: 1.5% at 100% modulation

1.1.17 Metering:

Final amplifier plate and grid current; modulator plate current.

1.1.18 Output Circuit:

Balanced or unbalanced transmission line having a characteristic surge impedance of 50 to 600 ohms.

1.1.19 Power Input:

110 to 120 volts, 50/60 cycles, single phase.

CW: 250 watts key down

AM Phone: 350 watts at 100% modulation.

ICW: 350 watts at 100% modulation

Standby: 80 watts

FM: 250 watts.

1.1.20 Power Factor: 90%

1.1.21 Duty Cycle: Continuous

1.2 TUBE COMPLEMENT

Type	Function
1--6AC7	Reactance Tube Modulator
1--6J5	Variable Frequency Oscillator
1--6AC7	Class "A" Amplifier or Crystal Oscillator
1--6L6	80 meter Buffer or 40 meter Doubler, or 30 meter Tripler
1--6L6	20 meter Doubler
1--6L6	15 meter Doubler
1--6L6	10 meter Doubler
1--3D23	Final Amplifier
2--807	Class AB_2 Modulators
1--6J5	Modulator Driver
1--6SJ7	Speech Amplifier
2--866A	High Voltage Rectifiers
1--5R4GY	Low Voltage Rectifier
1--5R4GY	Modulator Rectifier
1--80	Speech Rectifier
1--6X5GT	Bias Rectifier
1--VR 150	Voltage Regulator
1--6SN7GT	Audio Oscillator

1.3 List of Component Units of Radio Transmitter, AF-100. Complete with above listed tubes and five P.A. tank coils for the bands covered.

1.4 DESCRIPTION OF TRANSMITTER UNIT.

1.4.1 General Description

The Supreme Model AF-100 Radio Transmitter is a complete self-contained unit incorporating all types of emission permitted the amateur. It is designed to operate directly from the 50/60 cycle, single phase, 110 to 120 volts A. C. main. It provides facilities for transmitting amplitude modulated telephony, frequency modulated telephony, continuous wave telegraphy, and modulated continuous wave telegraphy on any frequency lying within the amateur bands of:

3.5 to 4 megacycles
7 to 7.3 megacycles
14 to 14.4 megacycles
21 to 21.5 megacycles
27.185 to 27.455 megacycles, and
28 to 29.7 megacycles.

Frequency control is effected either by means of a continuously variable, stabilized master oscillator, or by a crystal controlled oscillator. Facilities are included for two crystal controlled frequencies within the range of the transmitter. The transmitter is capable of delivering a carrier power of 100 watts to the transmission line on AM phone, FM phone, CW, or ICW.

The antenna system may be any antenna capable of being matched to a balanced or unbalanced transmission line having a characteristic surge impedance of 50 to 600 ohms, or any antenna whose resistive and reactive components will not be greater than 600 ohms.

The equipment consists of a complete master oscillator or crystal controlled transmitter and Class "AB_2" modulators enclosed in a single unit of cabinet construction. The transmitter is A.C. operated requiring no batteries for microphone, relay, bias or other circuit applications. The power required from the line is approximately 350 watts at 100% modulation at a power factor of approximately 90%. The voltage of the line or supply may vary between the limits of 110 to 120 volts. However, it is preferable that the supply voltage should remain constant within plus or minus 5% of a nominal value between the limits specified. The power supply frequency may be either 50 or 60 cycles per second.

This transmitter is equipped with thorough protection from all high voltages for the operator by means of an interlock switch which opens up the primary of the high voltage plate supply upon lifting the top cover of the transmitter cabinet. No exposed parts carry any dangerous voltages.

The cabinet is provided with louvres on both sides and perforated metal on the top cover. These openings are adequate to maintain the transmitter at the proper ambient operating temperature.

This unit is designed, insofar as possible, for operation by both new operators

as well as those with a fair amount of experience. To accomplish this degree of operational simplicity, the number of actual tuning controls necessary for the operation of this transmitter has been reduced to a minimum by the use of a circuit arrangement in which the oscillator and its harmonics will cover the complete amateur bands. To further increase the ease of operation, the buffer and doubler stages are gang tuned with the oscillator dial and automatically track with the oscillator. The circuit arrangement of the doubler stages is such that one switch automatically switches the proper tube and its associated tank circuit to the desired band of operation. It is only necessary to plug in the proper coil in the final amplifier to cover any frequency in the amateur bands.

Three milliameters on the front panel provide the means for metering the grid and plate circuits of the final amplifier tube and the plate current drawn by the modulator tubes. The grid meter of the final amplifier stage clearly indicates the condition of operation of all the buffer and doubler stages driving the final amplifier. These three meters, along with the filament and plate pilot light indicators, give the operator a comprehensive picture of the overall operation of the transmitter. An examination of Figure I, the complete schematic diagram of this unit, will further help to clarify the circuit functions of the meter and the pilot lights.

All circuits are housed in a single chassis mounted horizontally in a desk type cabinet. The chassis is securely bolted to the cabinet by means of two 10-32 screws which pass up through the bottom of the cabinet and engage two weld nuts on the lip of the chassis proper. The panel is fastened to the front lip of the chassis with six 10-32 binding head screws and that, in turn, is screwed to the rabbit in the cabinet with ten 10-32 binding head screws. The whole unit makes up a sturdy rigid construction. All tubes are accessible for replacement upon opening the top cover of the cabinet, which automatically breaks the primary circuit of the high voltage plate transformer.

The transmitter provides a carrier of at least 100 watts throughout the complete frequency spectrum which it is designed to cover. The carrier may be 100% amplitude modulated with either voice or tone modulation and may also be frequency modulated, either narrow, medium, or wide band FM. The carrier frequency may be any frequency within the following bands:

3.5 to 4 megacycles
7 to 7.3 megacycles
14 to 14.4 megacycles
21 to 21.5 megacycles
27.185 to 27.455 megacycles, and
28 to 29.7 megacycles

and may be either master oscillator or crystal controlled as selected by a switch on the front panel.

The transmitter employs a highly stable Variable Frequency Oscillator feeding a Class "A" amplifier which, in turn, drives a buffer amplifier, doubler or tripler, depending upon the particular band in use, followed by a plate modulated Class "C" final amplifier using a 3D23 tetrode. All radio frequency stages use well shielded beam tetrodes requiring no neutralization. Three stages of audio amplification are employed. These consist of a 6SJ7 speech amplifier and a 6J5 Class "A" driver stage driving a pair of 807 tetrodes operating in Class "AB_2". A 6AC7 reactance tube modulator directly modulates the 6J5 variable frequency

oscillator bringing about either narrow, medium, or wide band FM. A 6SN7 square wave generator feeding a 6J5 Class "A" driver provides the means for modulated keying of the carrier, (ICW).

A single phase full-wave rectifier using a type 5R4GY tube and associated two section condenser input low-pass filter delivers 350 volts D.C. for the plate supply of all the low powered RF stages.

A VR/150 voltage regulator tube supplies the plate voltage for the 6J5 oscillator, 6AC7 reactance modulator, and the screen of the 6AC7 Class "A" amplifier. Series dropping and bleeder resistor networks are used where necessary.

A single phase full-wave rectifier using a pair of mercury vapor tubes, type 866A, and associated single section choke input low-pass filter delivers 1,400 volts D.C. for the plate supply of the final Class "C" amplifier.

The speech amplifier, modulator and tone oscillator sections of this transmitter are fed from two separate rectifier sources. The plate voltage for the modulator is supplied from a single phase full-wave rectifier using a 5R4GY and associated condenser input two section low-pass filter deliver 600 volts D.C. The screens of the modulator tubes, as well as the speech amplifier, driver and tone oscillator, are fed from a single phase full-wave rectifier also using a condenser input two section filter using a full-wave 80 rectifier tube.

The bias for the complete transmitter is obtained from a 6X5GT rectifier connected to one side of the secondary of the plate and filament transformer supplying the plate voltage for the low powered R.F. section and uses a resistance capacity type filter.

An examination of Figure I shows the use of beam tetrodes in the buffer multiplier and final amplifier stages making neutralization unnecessary. The circuit arrangement and mechanical layout of these stages is such that no signs of regeneration can be detected in any of these stages, making for a very clean and stable unit. The use of a Class "A" amplifier stage immediately after the oscillator and the subsequent use of screen grid tubes provide extremely good isolation of the oscillator circuit from the output circuit. In most cases, this isolation is augmented by the fact that the buffer stages following the Class "A" amplifier act as multipliers of the oscillator frequency.

Separate plate coils are used in the buffer and multiplier stages for each frequency range. These stages are automatically tuned upon the rotation of the oscillator dial and are selected by means of the "Band Selector" Switch.

SECTION II

DETAILED DESCRIPTION OF PRINCIPAL COMPONENT UNITS.

2.1 Radio Frequency Oscillator, Buffer Multiplier, Final Amplifier, Modulator, and Speech Amplifier Stages.

2.1.1 Variable Frequency Oscillator

The Variable Frequency Oscillator used in this transmitter is of the grid-plate type oscillator. The main tank circuit (refer to Figure 1) consisting of L102, C110, C111, C112, and C114 is placed in the grid circuit of the oscillator tube, V102. The voltage necessary to drive the grid of V103, Class "A" buffer tube, is taken from the plate circuit of the oscillator. The coupling between the plate and grid coils of V102 is just sufficient to maintain stable oscillation. Obtaining the driving voltage for the Class "A" amplifier tube from the plate circuit of the oscillator tube aids in keeping the ultimate "Q" of the grid tank circuit of V102 very high. As a result, the oscillator is highly stable in its operation. The oscillator tank circuit covers a frequency range of 3.4--4 megacycles and is controlled by variations of capacitor (C110) which is driven by a planetary drive mechanism. The coupling capacitor, (C122) controls the value of the driving voltage applied to the grid of the Class "A" amplifier so that the Class "A" amplifier tube will always be operating under Class "A" conditions.

2.1.2 Class "A" Amplifier and Crystal Oscillator

When Switch S102 (refer to Figure II) is placed in the V.F.O. position, tube V103 acts as a Class "A" amplifier. Its tank circuit consists of the slug tuned inductance L104, the input and output capacities of V103 and V201, and the stray distributed wiring capacities. R110 is placed in series with the tank coil L104 of the Class "A" amplifier tube to obtain an effective broad band amplifier. This Class "A" amplifier operates over the same frequency range as that covered by the oscillator stage.

When the "Oscillator Selector" switch S102 is turned to either the "Xtal 1" or "Xtal 2" position, the Class "A" amplifier becomes a Pierce crystal oscillator in which any one of two crystals may be selected. The choke coil L103 now replaces the tank coil L104 and the crystals are placed between the plate and grid of V103. It is unnecessary to tune this type of crystal oscillator and any crystal lying between the limits of 3.4 to 4 megacycles may be used. The driving voltage and the plate voltage of the oscillator tube are automatically disconnected from V103 when S102 is placed in either crystal position. Keying is accomplished in the grid circuits of both V102 and V103 simultaneously. With the key in the Up position, a high bias voltage is applied to the grids of V102 and V103 which effectively cuts those tubes off. When the key is depressed, the bias is removed from these tubes and they operate in a normal manner.

2.1.3 Reactance Tube Modulator

Referring to Figure I, it can be seen that the reactance tube modulator V101 is connected directly across the tank circuit of the oscillator tube. The circuit constants are such that the tube operates on the linear portion of its Gm characteristic. The phase shifting network consisting of C107, R106, and L105 are so chosen that inductive reactive injections occur in the tank circuit of

the oscillator tube and vary with the application of an audio modulating voltage to the grid of V101. It can be seen that the quadrature voltage and the audio modulating voltage are applied simultaneously to the same grid. The value of the quadrature voltage applied to the grid of V101 can be varied by varying the capacity of C107. An R.F. filter network consisting of R101, R102 and C102 effectively prevents the R.F. voltage on the grid of V101 from getting back to the plate circuit of the audio driver tube V402. The audio modulating voltage applied to the grid of V101 is controlled by the "Microphone Gain" control R409 which, in turn, controls the effective frequency swing of the oscillator tube V103. The plate voltage for the reactance tube modulator, V101, can only be applied when the "Modulation Selector" switch, S101, is placed in the "FM" position.

2.1.4 Buffer Multiplier Stages

An examination of Figure I will show that beam tetrode tubes are used in these stages. V201 acts as an 80 meter buffer stage, 40 meter doubler stage, or 30 meter tripler stage. When the "Band Selector" switch, S201, is placed in the 80 meter position, inductance L201 becomes the plate tank coil for tube V201 which, in turn, feeds the grid of the final amplifier tube, V301, directly. When the "Band Selector" switch is turned to the 40 meter position, L202 becomes the tank coil of V201 now acting as a doubler stage which, in turn, drives the final amplifier grid. When the "Band Selector" switch is now turned to the 15 meter position, L203 is placed in parallel with L202, and V201 now becomes a 30 meter tripler driving the grid of V203. When the "Band Selector" switch is turned to the 20 meter position, V201 acts as a 40 meter doubler driving the grid of V202 operating as a 20 meter doubler which, in turn, drives the grid of V301, the final amplifier tube. When the "Band Selector" switch once again is turned to the 15 meter position, as stated above, V201 now becomes a 30 meter tripler driving the grid of V203 acting as a 15 meter doubler which, in turn, excites the grid of V301. When the band selector switch is turned to the 10 meter position, V201 is used as a 40 meter doubler driving V202 as a 20 meter doubler driving V204 as a 10 meter doubler which, in turn, drives the final amplifier tube V301. An examination of Figure I will show that, with the turning of the "Band Selector" switch to the various positions described, the proper tube or tubes and coils are placed in their respective circuits and are slug tuned with all slugs mechanically ganged together and driven through a unique arrangement by the oscillator capacitor shaft. Effectively, therefore, the exciter unit, as such, comprising the oscillator, the Class "A" amplifier, and the four multiplier stages, is single dial tuned. It is only necessary to tune the final amplifier to resonance with the exciter unit in order to select any desired frequency.

2.1.5 Power Amplifier Stage

The power amplifier employs a medium powered beam tetrode tube, type 3D23, working into a split tank arrangement permitting the coupling of balanced or unbalanced loads to that tank circuit. Medium powered tetrodes have a finite value of capacity between the grid and plate and at higher frequencies, particularly in the range of 30 megacycles, this capacity is sufficient to introduce enough feedback from grid to plate to cause a small amount of regeneration regardless of how well shielded the individual components may be. In order to overcome this regeneration, it is usually necessary to introduce a small neutralizing voltage back into the grid of the amplifier tube. The use of a split tank circuit readily permits the injection of that voltage into the grid for neutralizing purposes. Referring to Figure IV, it can be seen that the grid choke, L301, has its cap

in close proximity to the feed-thru insulator carrying the neutralizing voltage from one end of the plate tank circuit back to the grid itself. The stage can be completely neutralized by small variations in the distance between the cap of L301 and the feed-thru insulator. Neutralization of the final amplifier tube through the method described above results in an extremely stable stage. It effectively permits linear modulation of the Class "C" final amplifier and nullifies any tendency toward oscillation or the development of parasitic oscillations of any type.

The complete frequency range of the transmitter is covered in six bands. It is merely necessary to plug in one of five final amplifier tank coils to resonate the final amplifier with the particular band and frequency desired. The eleven and ten meter bands are covered with one coil. It will be noted that clips are supplied with each coupling link. By variations of the number of turns of the link it is possible to match any transmission line having a characteristic surge impedance of 50 to 600 ohms. The load is properly matched to the final amplifier tank circuit when the plate of the final amplifier tube (V301) draws 100 milliamperes at resonance.

2.1.6 Speech Amplifier Modulator

The speech amplifier consists of a pentode Class "A" voltage amplifier stage (V401) using a type 6SJ7 tube driving a Class "A" driver stage (V402) using a 6J5 triode. A high impedance crystal or dynamic microphone may be used to excite the grid of V401. A volume control (R409) controls the level of the voltage into the grid of V402. The plate circuit of V402 is transformer coupled by means of driver transformer T401 into the grids of a pair of 807 modulator tubes (V403 and V404) operating in Class "AB_2". Since grid current is drawn over a very small fraction of the audio cycle by the modulator grids, the 6J5 driver is capable of driving the modulators to full output for 100% modulation with sine wave input. The plates of the modulator tubes (V403 and (V404) are coupled to the radio frequency power amplifier load by means of a modulation transformer (T402). This transformer (T402) has both a plate and screen secondary for simultaneous modulation of the plate and screen of the Class "C" final amplifier (V301). This modulator is capable of complete modulation of the 100 watt carrier. The overall audio frequency response with AM modulation is linear within plus or minus 2 DB from 200 to 6,000 cycles per second.

2.1.7 Tone Generator

A dual triode (V405) is used to generate a variable frequency audio tone varying between 400 and 1,000 cycles. An examination of Figure I will show that the type of circuit used is similar to that of a multivibrator with the exception that the second section of the generator is coupled to the first section through a common cathode resistor (R412). With this type of circuit it is only necessary to vary one arm of the frequency determining network, which consists of C410, R411 and R410 to obtain a fairly wide variation in output frequency. R411, used as a rheostat, controls the frequency of operation of this tone generator. The output voltage of the generator is taken off the plate of the second section of V405 feed thru, the coupling capacitor (C412) and the decoupling resistor (R415) to one side of the potentiometer (R409), thus the microphone gain control (R409) also controls the value of the voltage from the tone generator feeding the grid of the Class "A" driver tube (V402). It is

located at the rear of the cabinet and can be adjusted by the insertion of a screw driver in the slotted shaft provided for that purpose. The generator is keyed simultaneously with the keying of the V.F.O. tube (V102). With the key in the up position, a high negative bias is applied to the #1 grid of V405. With the key closed, the bias is removed and the tube functions in normal fashion. Plate voltage is applied to V405 when the "Modulation Selector" switch is placed in the "ICW" position.

2.2 Rectifiers

2.2.1 Final Amplifier Plate Supply Rectifier

D.C. power is applied to the Class "C" R.F. stage by the use of a single 1400 volt D.C. rectifier. This rectifier uses a conventional single phase full wave circuit with two type 866/A mercury vapor tubes. The output of the rectifier is filtered by means of a single section low-pass filter consisting of the choke (L502) and the capacitor (C501) as the inductive and capacitive elements of the filter. The bleeder resistor (R504) is placed across the output of the filter to improve the regulation of the plate supply.

2.2.2 Oscillator and Doubler 350 Volt Plate Supply and Bias Supply Rectifiers

D.C. power is applied to the oscillator, reactance tube modulator, Class "A" amplifier, and the low power multiplier stages from a single 350 volt rectifier through appropriate bleeder dropping resistors. This rectifier employs a type 5R4GY tube (V505) in a single phase full wave circuit using a two section low pass condenser input filter employing C504, L501, and C505 as the capacitive and inductive arms of this filter. The bleeder resistor (R502) is employed to provide good keying regulation, as well as supplying the plate voltage for the Class "A" amplifier tube (V103), and the screen voltage for the multiplier tubes (V201, V202, V203 and V204). The plate voltage for the plate and screen of the reactance tube modulator V101, the plate of the variable frequency oscillator V102 and the screen of the Class "A" amplifier V103 is obtained from a voltage regulator tube V507 connected across the 350 volt supply through a series dropping resistor R507. The bias for the complete transmitter is obtained from V506 employed as a single phase half wave rectifier using a resistance capacitance type filter. One side of the secondary of the 350 volt plate transformer (T503) is connected to the cathode of V506, and the plates of that tube, through the appropriate dropping resistors and bleeding resistors, are connected to ground. This rectifier supplies minus 100 volts for the grid of the final amplifier tube (V103) and minus 45 volts for the grids of all other tubes in the unit, with the exception of the modulators. The modulator grids are supplied through a bleeder network (R509 and R510) which can be adjusted so that the bias voltage is approximately 32 volts.

2.2.3 Speech Amplifier Modulator 600 Volt Plate Supply Rectifier

D.C. power for the modulator, speech amplifier, and tone generator tubes is obtained through two separate rectifier tubes (V503 and V504) powered by one transformer (T502). Refer to Figure I. A 5R4GY single phase full-wave rectifier with a resistance capacitance type of filter provides the plate voltage for the 807 modulator tubes. C502 and R501 comprise the filter of this rectifier. The screens of the modulator tubes (V403 and V404) are fed through a second rectifier consisting of V503 and a condenser input filter (C503A) L503,

C503B, and bleeder resistor (R503). Approximately 300 volts is delivered by this rectifier system. The output of this rectifier immediately after the filter described above supplies the plate and screen voltage for the speech amplifier and driver tubes (V401 and V402) through a resistance capacitance type filter consisting of C406A, R406, and C406B. The plate voltage for the tone generator tube (V405) is obtained from the same point as that supplying the speech amplifier driver section, and can be clearly seen by an examination of Figure I.

2.3 Control and Power Circuits

The control and power circuits of this transmitter are relatively simple. Through an examination of Figure I, it can be seen that the "Filament" switch (S601), located on the front panel of this unit, controls the voltage supplied to the primaries of all plate and filament transformers. It will likewise be noticed that the "Plate" switch (S602) is in series with the "Filament" switch (S601) and it is necessary to apply filament power before plate power can be applied. The placing of the "Filament" switch (S601) in the "Off" position will remove the line voltage from the primaries of all plate and filament transformers. The filament circuits are completely protected by fuse (F601). In the event of an overload, that fuse will blow which becomes readily apparent by the fact that the "Filament" pilot light (I603) will go off.

The placing of the "Plate" switch (S602) in the "On" position will indicate merely that plate power can be applied to the plates of the tubes and, upon the placing of this switch (S602) in the "On" position, the plate pilot light (I604) will glow. Actual plate power can only be applied when the "Transmit-Standby" switch (S603) is placed in the "Transmit" position. Further examination of Figure I will show that, in the "Standby" position, one leg of this switch is in series with the "Plate" switch (S602) and controls the application of line voltage to the primary of the high voltage plate transformer (T501). The other leg of that switch (S603) controls the bias voltage applied to the grids of every tube in the transmitter. Not only does the "Transmit-Standby" switch (S603) control the primary voltage to T501, but it also controls the bias voltage supplied to all tubes.

The speech amplifier modulator plate transformer (T502) is controlled by switch (S605) which is an integral part of the "Microphone Gain" control located on the front panel. When this switch (S605) is turned to the "Off" position, which is accomplished by turning R409 completely counter clockwise, the line voltage is cut off from the speech amplifier modulator plate transformer (T502) so that no power is being applied to the speech amplifier, modulator and tone generator tubes while the unit is being operated in the "CW" position. A separate plate fuse (F602) affords the needed protection for the high voltage plate transformer (T501) and its associated circuits. In the event that that fuse blows, it will become readily apparent by the fact that the pilot light (I604) will stop glowing.

Upon the application of primary voltage to the plate transformer (T501), the antenna changeover relay (K601) is immediately energized and the output link of the plate tank coil is now connected directly to the antenna feed-thru insulators (E603 and (E604). When the "Transmit-Standby" switch (S603) is placed in the "Standby" position, then the antenna or feeder lines connected to E603 and E604 are tied to the receiver antenna feed-thru insulators (E601 and E602) and a pair of contacts on the antenna changeover relay K601 are tied to terminal board (TB601) shown on Figure V, "Rear View Sketch", which permits normal receiver operation. The two terminals on

TB601 are normally used to break the "E minus" of the receiver when the transmitter is in operation. During the time the transmitter is inoperative, those contacts on K601 are normally closed and permit normal receiver operation.

In the event that the top cover of the transmitter is opened, the interlock switch (S604), which is connected in series with one side of the line, and the primary of the high voltage plate transformer (T501) opens, thus removing the high voltage fro the final amplifier plate tank circuit and plate voltage from the final amplifier tube. Plate voltage can only be applied to the final amplifier when switch (S604) is closed, which means that the cover of the transmitter cabinet must be closed.

The "Phone CW" switch (S606), shown on Figure II, and schematically shown on Figure I, short-circuits the secondary winding of the modulation transformer (T402) when placed in the "CW" position. When placed in the "Phone" position, the short-circuit is removed and the Class "C" final amplifier may be modulated in a normal fashion.

The "Modulation Selector" switch (S101), shown schematically on Figure I, functions in the following manner:

> When that switch is thrown to the "AM" position, the cathodes of the modulator tubes (V403 and V404) are returned to ground, thus applying plate and screen voltage to those tubes, permitting normal modulation of the final amplifier. With switch (S101) in the "AM" position, plate voltage is removed from the tone generator tube (V405) and from the reactance tube modulator (V101). When switch (S101) is thrown to the "ICW" position, plate voltage is then applied to the tone generator tube (V405), and the cathodes of the modulator tubes (V403 and V404) are returned to ground. When switch (S101) is placed in the "FM" position, the cathodes of the modulator tubes are opened, plate voltage is removed from the tone generator tube (V405), and plate voltage is now applied to the reactance modulator tube (V101). In all cases, the microphone gain control (R409) controls the percentage of modulation for any position of the "Modulation Selector" switch.

The "Oscillator Selector" switch (S102), shown on Figure II, and schematically indicated on Figure I, functions in the following manner:

> With S101 thrown to the "V.F.O." position, plate voltage is applied to the oscillator tube (V102), the grid of the class "A" amplifier tube (V103) is coupled to the plate circuit of V102 and the Class "A" tank coil (L104) is tied to the plate of the Class "A" amplifier (V103). When the "Oscillator Selector" switch (S102) is thrown to either "Xtal 1" or "Xtal 2" position, the plate voltage is removed from the oscillator tube (V102), the grid of the Class "A" amplifier tube (V103) is thrown to either crystal position the R.F. choke coil (L103) is placed in the plate circuit of V103 and that tube now acts as a Pierce crystal oscillator.

The function of the "Band Selector" switch (S201) has been clearly described in Section 2.1.4 and needs no further explanation.

SECTION III

INSTALLATION

3.1 Space Required for the Model AF-100

The Model AF-100 is designed for desk top operation. It may be placed in any convenient operating position desired by the user, keeping in mind the fact that the transmitter should be located near the feeder or transmission line and near a source of 110 to 120 50/60 cycle current. It is advisable that no other piece of apparatus be placed on the top of this transmitter, thus shutting off the normal circulation of air through the screen openings in the top cover. Sufficient vents are provided in the transmitter cabinet to maintain all components well within their maximum temperature ratings, and no obstructions should be so placed as to prevent normal air circulation. Except for these limits, the transmitter may be placed in any location convenient to the antenna or transmission lines and external power connections.

3.2 Assembly of Packed Parts

The transmitter is packed and shipped in one crate containing one complete set of (20) tubes placed in their respective sockets and five (5) final amplifier coils which cover the frequency spectrum of this transmitter. The insertion of tubes, crystals, microphone and telegraph key are described elsewhere in these instructions.

3.3 Inspection

After the equipment is installed as described above, all packing materials used during shipment should be removed. The equipment should be carefully inspected for any parts broken or damaged during shipment. Wiring should be checked for bent wiring or connections which may have come loose. All tubes should be checked to see that they are firmly seated in their sockets.

3.4 External Connections

The only external connections necessary to operate this unit are the following:

1. The insertion of the line plug into any convenient outlet.
2. The connection of the antenna or transmission line to the large feed-thru insulators, shown in Figure V (E603 and E604).
3. The connection of two wires from the antenna binding posts of the receiver to the antenna feed-thru insulators (E601) and (E602) on the transmitter.
4. The breaking of the B minus lead of the receiver and connecting two leads to the terminal board (TB601), shown on Figure V.
5. The plugging in of a key plug into the key jack (J601), shown on Figure II.
6. Connecting a microphone connector to the microphone jack (J401), likewise shown on Figure II.

The unit is now ready for operation.

3.5 Insertion of Tubes and Crystals

The tube complement has been given above in Section 1.2 under "General Description of Complete Equipment" and is in place in their respective sockets. The location of the tubes is clearly indicated in Figure III. If crystal control operation of this transmitter is desired, it is only necessary to insert one or two crystals (80 meter band) in the crystal socket (X104). It is important to remember that the crystal holder pins have one-half inch mounting centers. They are inserted vertically in the crystal socket (X104) and the proper pins are indicated by red lines on either side of the crystal socket. Reference is again made to Figure III.

SECTION IV

PREPARATION FOR USE

Before plugging the line cord into a 110-120 50/60 cycles outlet, the "Filament" switch (S601) should be in the "Off" position. The top cover of the transmitter should be opened to be certain that all tubes are tight in their proper sockets. Plate leads to the various tubes should be placed on the tubes and not hanging where they may cause a short-circuit of voltage to ground. It would be advisable to check the A.C. line voltage to make certain that it is the proper value. Before starting the transmitter, the "Plate" switch (S602) should be placed in the "Off" position and an antenna or terminating device should be attached to the feed-thru insulators (E603 and E604), shown on Figure V. It is permissable to perform the preliminary tuning of the transmitter without a transmission line or load provided the "Plate" switch (S602) is in the "Off" position.

SECTION V

OPERATION

5.1 Initial Tuning and Adjustments

Before tuning the transmitter for the first time, the operator should make all preliminary checks outlined above in Section IV "Preparation For Use". In addition, he should familiarize himself with the location and function of all operating controls outlined under Section 2.3.

Before applying any power to the transmitter, the frequency controls may be pre-set to the approximate settings required for the frequency of operation desired. These settings are obtained from the approximate calibration curves listed in the appendix of this book, Figures VI and VII, respectively.

The "Filament" switch (S601), which is located at the bottom center portion of the panel (Figure II), may be turned to the "On" position. In this position the primary of the plate and filament transformer (T503) supplying plate, bias, and filament voltages for the low powered R.F. stages of this transmitter is energized. With the "Filament" switch in the "On" position, the "Filament" pilot light (I603) and the dial indicator lights will go on. The plate, filament, and bias voltages have now been applied to the oscillator tube (V102), the Class "A" amplifier tube (V103), and all the multiplier tubes (V201, V202, V203, and V204), as well as filament voltage to the final amplifier tube (V301).

NOTE:

A minimum interval of thirty seconds must elapse before the "Plate" switch (S602), located at the lower right center portion of the panel (shown in Figure II), is thrown to the "On" position. When this transmitter is placed in operation for the first time, it is advisable that the filaments of the 866/A mercury vapor rectifier tubes (V501 and V502) (refer to Figure III) be permitted to warm up for at least one-half hour before the application of primary voltage to the plate transformer (T501). This is necessary in order to permit the mercury in these tubes to settle to the bottom of the tube itself since the mercury may have splashed over the entire surface of the tube during shipment and arc-back may take place if plate voltage is applied to these tubes before the mercury has completely settled.

In order to obtain complete oscillator stabilization, it is advisable that the oscillator be permitted a warm-up period of at least fifteen minutes before actual transmissions are made. The antenna transmission line or load should now be connected to the feed-thru insulators (E603 and E604) and plate voltage can be applied by throwing the "Plate" switch (S602) to the "On" position. With the "Transmit-Standby" switch (S603) in the "Transmit" position and the telegraph key closed, the final "Amplifier Plate" meter (M601) should be rapidly tuned to resonance, which is indicated by a minimum plate current reading.

SPECIAL NOTE OF CAUTION:

It is extremely important that the final amplifier tank condenser (C306), which is controlled by the amplifier tuning dial located on the right center of the transmitter panel, shown on Figure II, is tuned to resonance within a matter of seconds so

that the plate dissipation rating of the final amplifier tube is not exceeded for an appreciable length of time. It will be noted that the final "Amplifier Grid" meter (M602) will give a grid current indication when the oscillator and multiplier stages have been sufficiently warmed up. The plate current of the final amplifier tube should, at no time, exceed 110 milliamperes when the plate tank circuit is turned to resonance. Normal operation of this transmitter is obtained when the plate current of the final amplifier stage is exactly 100 milliamperes. No neutralization of any of these stages should ever be required in this transmitter. As stated previously in Section 2.1.5, "Power Amplifier Stage" under Section II "Detailed Description of Principal Component Units" neutralization of the final amplifier tank circuit was obtained by placing the cap of the grid choke (L301) in close proximity to the feed-thru insulator carrying the neutralizing voltage from one end of the plate tank circuit back to the grid itself. In the event that the position of this choke has been disturbed and regeneration is indicated by the fact that the grid and plate meters of the final amplifier stage (M602 and M601) do not move at opposites when the amplifier tuning dial is moved through resonance, it will be necessary to adjust the position of this choke until no sign of regeneration is present at the highest frequency of operation: namely, thirty megacycles.

5.2 Operating Procedure

The sequence of operation for the Model AF-100 transmitter for the various types of emission provided in this unit are as follows:

5.2.1 Starting the Transmitter

The "Transmit-Standby" switch (S603) is thrown to the "Transmit" position. The "Filament" switch (S601) is now thrown to the "On" position. A key is inserted in the "Key" jack (J601) and the key closed. An interval of approximately thirty seconds is permitted to elapse and the "Plate" switch (S602) is thrown to the "On" position.

5.2.2 Stopping the Transmitter

To stop the transmitter, it is advisable to first throw the "Plate" switch to the "Off" position, then throw the "Filament" switch to the "Off" position. This will prevent the simultaneous application of both filament and plate power in the event that the "Filament" switch is once again thrown to the "On" position.

5.2.3 Changing Frequency

To change the frequency of transmission within any one of the six amateur bar it is only necessary to turn the "V.F.O. Tuning" dial to the desired frequency as indicated on the "Oscillator Dial vs. Frequency Chart" (Figure VI) and rapidly turn the "Amplifier Tuning" dial to resonance. The approximate position of the "Amplifier Tuning" dial can be determined by the "Amplifier Dial vs. Frequency Chart" (Figure VII). This procedure for changing frequencies holds for any band of operation and for any type of emission desired.

5.2.4 Changing Bands

To change to a particular band of operation, it is only necessary to turn the "Band Selector" switch (S201) located on the right center portion of the panel, as shown on Figure II, to the band desired. The proper final amplifier plate

tank coil should now be plugged into the jack bar (J301), clearly shown on Figure III.

CAUTION:

In spite of the fact that plate power is automatically removed from the final amplifier tank circuit by the opening of the top cover of the transmitter cabinet, it is advisable that the "Plate" switch (S602) be placed in the "Off" position. The procedure for changing bands also holds true for all types of emission.

5.2.5 CW Transmission

The procedure for starting the transmitter is the same as outlined under 5.2.1. "Starting the Transmitter". The "Phone-CW" switch should now be placed in the "CW" position. The "Modulation Selector" switch should be placed in the "AM" position. The "Oscillator Selector" switch may be placed either in the "V.F.O." position or "Xtal 1" or "Xtal 2" position. A key should be inserted in the "Key" jack. The "Microphone Gain" control should be turned to the "Off" position. The "Transmit-Standby" control should be placed in the "Transmit" position. The "Plate" switch is now turned to the "On" position. The assumption is made that a transmission line or antenna is connected to the feed-thru insulators (E603 and E604). The transmitter is now ready for CW transmissions.

NOTE:

When the "Oscillator Selector" switch is placed in either crystal position, a crystal whose frequency lies between the limits of 3.4 to 4 megacycles should be used. In the event that the grid current of the final amplifier stage as indicated by the grid meter (M602) falls below the minimum values shown under Section 6.1"Table of Typical Operating Voltages and Currents," Section VI, it may be advisable to tune the "V.F.O. Tuning" dial for maximum grid current indication. Normally this condition should never exist.

5.2.6 ICW Operation

The procedure for starting the transmitter is the same as outlined under Section 5.2.1 "Starting the Transmitter", and is identical to the procedure outlined in Section 5.2.5 "CW Operation" with the exception that the "Modulation Selector" switch is thrown to the "ICW" position, the "Phone CW" switch is thrown to the "Phone" position and the "Microphone Gain" control is turned until the "Modulator Plate" current indicator meter (M603) reads 150 milliamperes for 100% modulation with the key closed. An elapse of time of a few seconds will be necessary before the speech amplifier, tone generator and modulator tubes warm up sufficiently for normal "ICW" operation.

NOTE:

The "Oscillator Selector" switch may be turned to the "V.F.O." position or either one of the two crystal positions.

CAUTION:

"ICW" may only be used on those bands specifically set aside for that purpose by the Federal Communications Commission.

5.2.7 AM Phone Transmission

The procedure for starting the transmitter is the same as outlined under 5.2.1 "Starting the Transmitter" and the procedure is that described under 5.2.6 "ICW Operation", which also holds for AM phone transmission, with the exception that the "Modulation Selector" switch is now turned to the "AM" position and the key is removed from the key jack and the microphone is plugged into the "Microphone" connector (J401). 100% modulation is obtained when the "Modulator Plate" current reaches a value of 150 milliamperes on voice peaks. As in the case for ICW operation, the "Oscillator Selector" switch may be thrown to the "V.F.O." or either one of the crystal positions.

NOTE:

AM phone emission can only be used on those portions of the amateur bands set aside for that purpose by the Federal Communications Commission.

5.2.8 FM Transmission

Once again, the procedure for starting the transmitter is the same as outlined under 5.2.1 "Starting the Transmitter". The procedure described in 5.2.7 "AM Phone Transmission" holds but for the following exceptions:

The "Modulation Selector" switch should be thrown to the "FM" position. The "Oscillator Selector" switch should be thrown to the "V.F.O." position.

NOTE:

FM transmissions can only take place with the "Oscillator Selector" switch in the "V.F.O." position. The "Phone-CW" switch should be thrown to the "CW" position. For narrow band FM transmission, the "Microphone Gain" control should be rotated clockwise to approximately one-quarter of its full rotation. In this position, it will be possible for normal AM receivers whose I.F. band widths may vary from plus or minus 3 kilocycles to plus or minus 10 kilocycles to satisfactorily receive these transmissions. In the event that the recipient of these transmissions has the means for receiving wide band FM transmission, such as a limiter and a discriminator, the "Microphone Gain" control should be rotated clockwise to three-quarters of its complete rotation and an FM swing of approximately plus or minus 75 kilocycles in the eleven and ten meter bands will be obtained. It is once again important to remember that FM transmissions can only be made on those bands set aside by the Federal Communications Commission for that purpose.