SUPER POWER BROADCASTING

The only Company in the world which has built

1,000,000

watt Broadcast Transmitters. Three units in continuous operation for nearly five years.

Continental Electronics

MANUFACTURING COMPANY

TELEPHONE
EVERGREEN 1-1137

4212 S. BUCKNER BLVD.
DALLAS 27, TEXAS

TYPE 105C

1,000,000 WATT AM BROADCAST TRANSMITTER

FOR

SUPER POWER BROADCASTING

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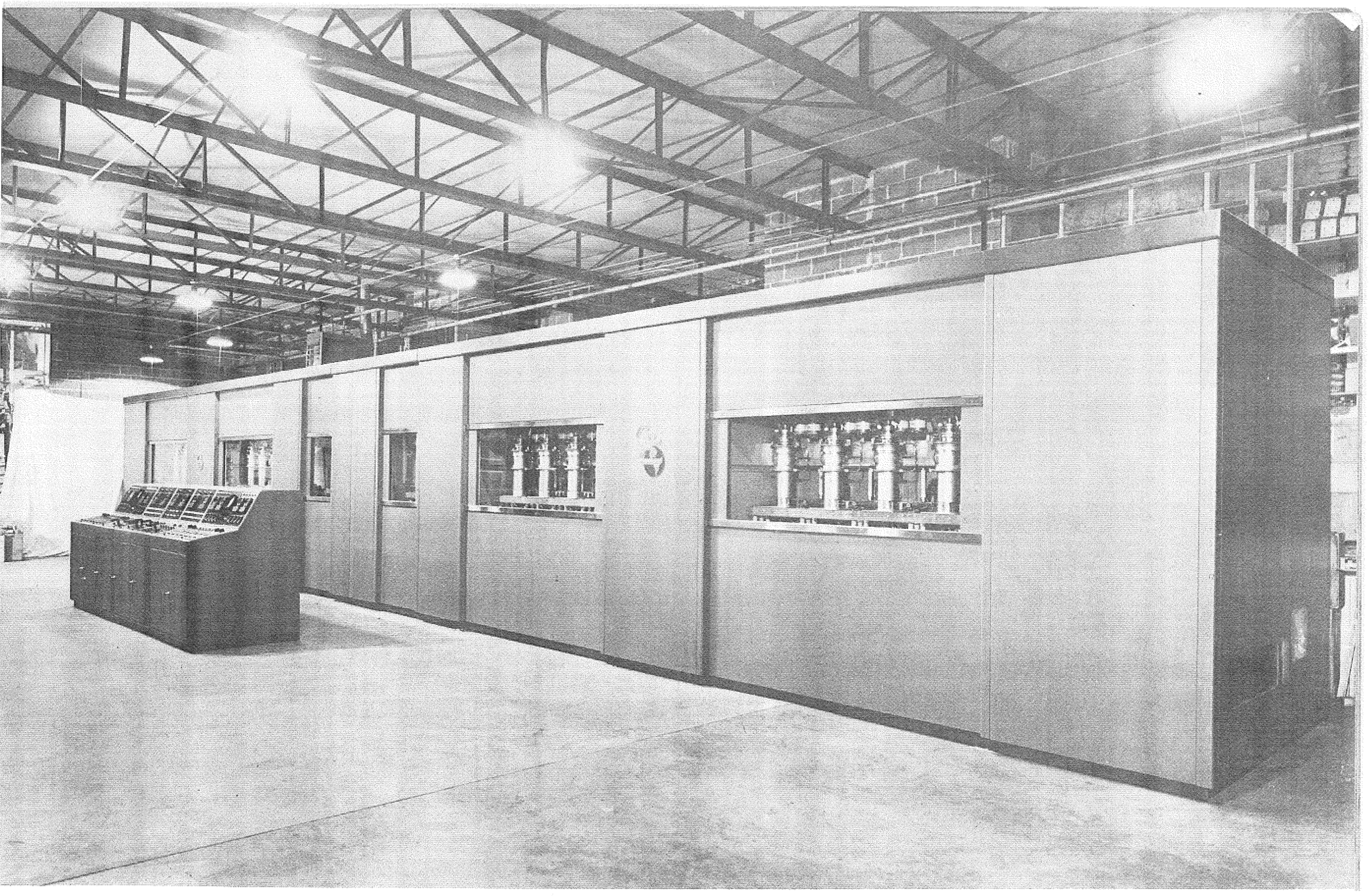


The Main Assembly of the Type 105-C, 1000 kw, Transmitter
Including the Control Console

GENERAL DESCRIPTION

It is believed that the Continental Electronics Type 105 is the most powerful broadcast transmitter equipment in use in the world today. Several of these transmitters have been recently installed and are being operated by the U. S. Information Agency, formerly the Voice of America, in strategic locations outside of the United States.

The engineering design of the Type 105 Transmitter is based on many years of experience in the field of super power radio transmitting equipment. The particular circuit that is used was chosen because of its many inherent advantages when compared to other arrangements for obtaining high power.

Basically, the circuit of the Type 105 Transmitter consists of a crystal controlled RF driver unit that supplies excitation voltage to a modulated amplifier. This same driver unit also contains audio amplifiers and a modulator that supplies audio voltage to this modulated amplifier. Grid bias modulation of this stage is employed and the output of the modulated amplifier drives a high efficiency linear amplifier as the output stage of the transmitter. There are no large audio components in the transmitter. Less than 100 watts of audio power is required from the modulator for 100% modulation.

The Type 105 Transmitter is arranged in two 500 kw halves. Actually two complete drivers, two power supplies, and two 500 kw power amplifiers are supplied, along with switching facilities for a combined operation with a total output of 1,000,000 watts of carrier power. Either of the two halves of the transmitter are capable of independent operation and the control system makes it possible to quickly switch to either of the two 500 kw power outputs in the event that the other requires shut-down for tube change or other service.

GENERAL DESCRIPTION (CONTINUED)

The use of newly-developed high gain, high power tubes in the modulated amplifier and power amplifier of the Type 105 Transmitter results in an excellent over-all conversion efficiency from the power source to the antenna. At carrier only conditions this conversion factor is better than 50% and with modulation this ratio becomes still better. Field experience, to date, indicates that the filament hour expectancy of these large tubes is exceptionally good.

The rectifier tubes used in the transmitter main power supplies are the largest of the conventional Mercury vapor type. Since they are operated at less than one-half of their rated output, extremely long life is expected.

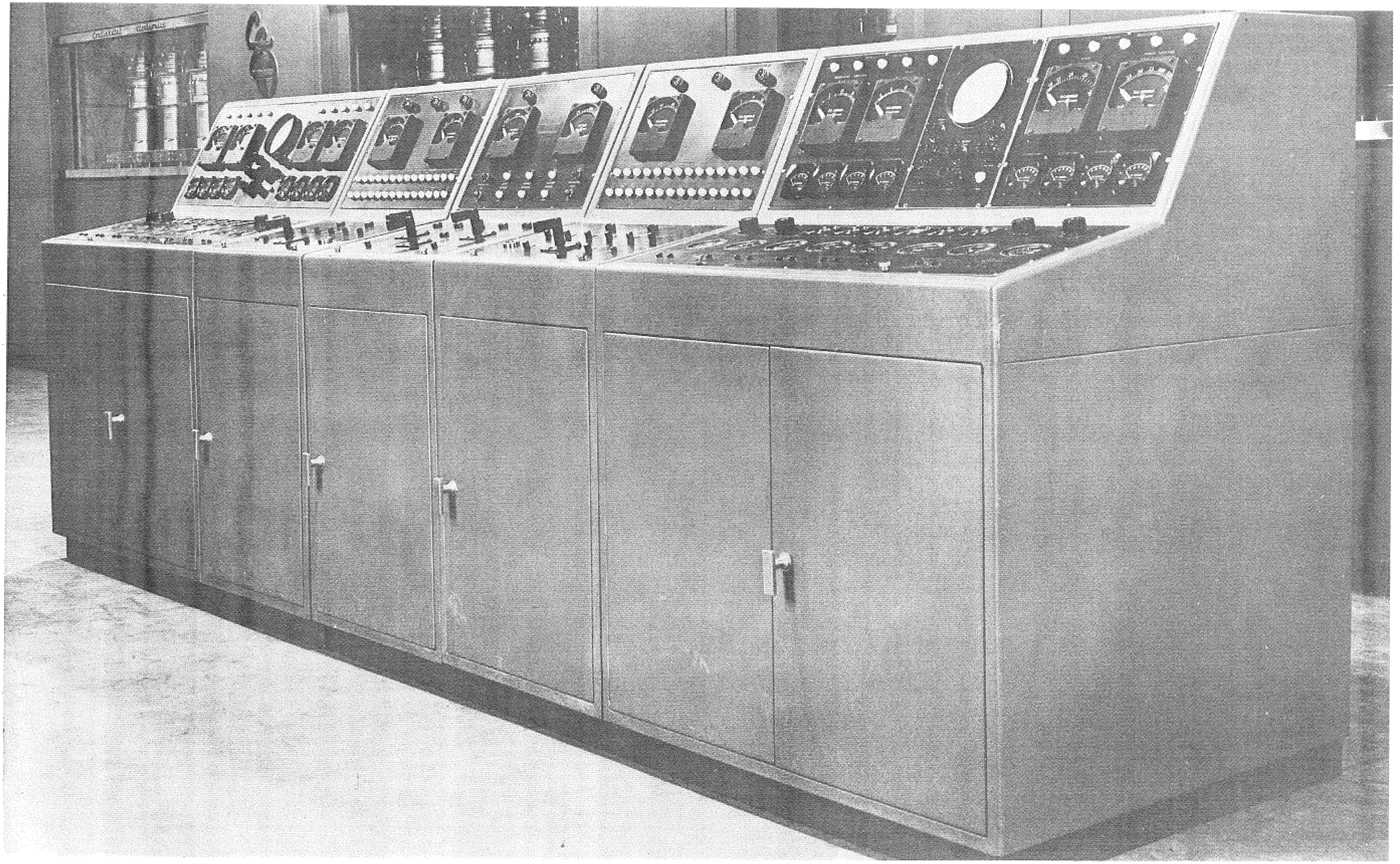
In the Type 105 Transmitter equipment all tuning and power controls, all supervision and all metering is centralized on a Control Console. Circuit elements that require adjustments in tuning are operated through push button servo-mechanisms with associated individual indicators. This control console also contains all of the meters and supervisory pilot lights associated with the various operational functions of the control and protection circuits.

The performance characteristics of the Type 105 Transmitter exceed the requirements for AM Broadcasting in the U.S.A., as set forth in the FCC's Standards of Good Engineering Practice. A set of typical measured performance data is shown on page 16.

RF DRIVER, AUDIO AMPLIFIER AND MODULATOR, AND MAIN RECTIFIER ASSEMBLY FOR ONE 500 KW POWER AMPLIFIER.

On the left of this three-unit assembly is the 15 kilovolt rectifier tube assembly. In the center section are the bias rectifiers and to the right the audio and RF driver. The 15 kilovolt rectifier uses the Type GL-870A mercury vapor tube; this rectifier has a current capacity, as far as tubes are concerned, of 225 amperes although for 500 kw operation only about 85 amperes are used with full modulation. The bias rectifier unit in the center contains three-phase rectifies for power amplifiers bias, and a single phase rectifier for the modulated amplifier. A position for spare tubes is provided on each side in the upper row. The audio amplifier consists of two 807's followed by an 845 driver, and this is followed by four 845's connected in parallel as a cathode follower for grid bias modulating the ML-5682 in the main transmitter assembly. In the radio frequency system an 807 Buffer followed by an 813 drives two ML-357B tubes. These provide an output up to 2 kw for driving the modulated amplifier.

Physically, the end units of the Driver Assembly for the Number 2 500 kw Power Amplifier are arranged in reverse order for convenience and symmetry of wiring and operation.

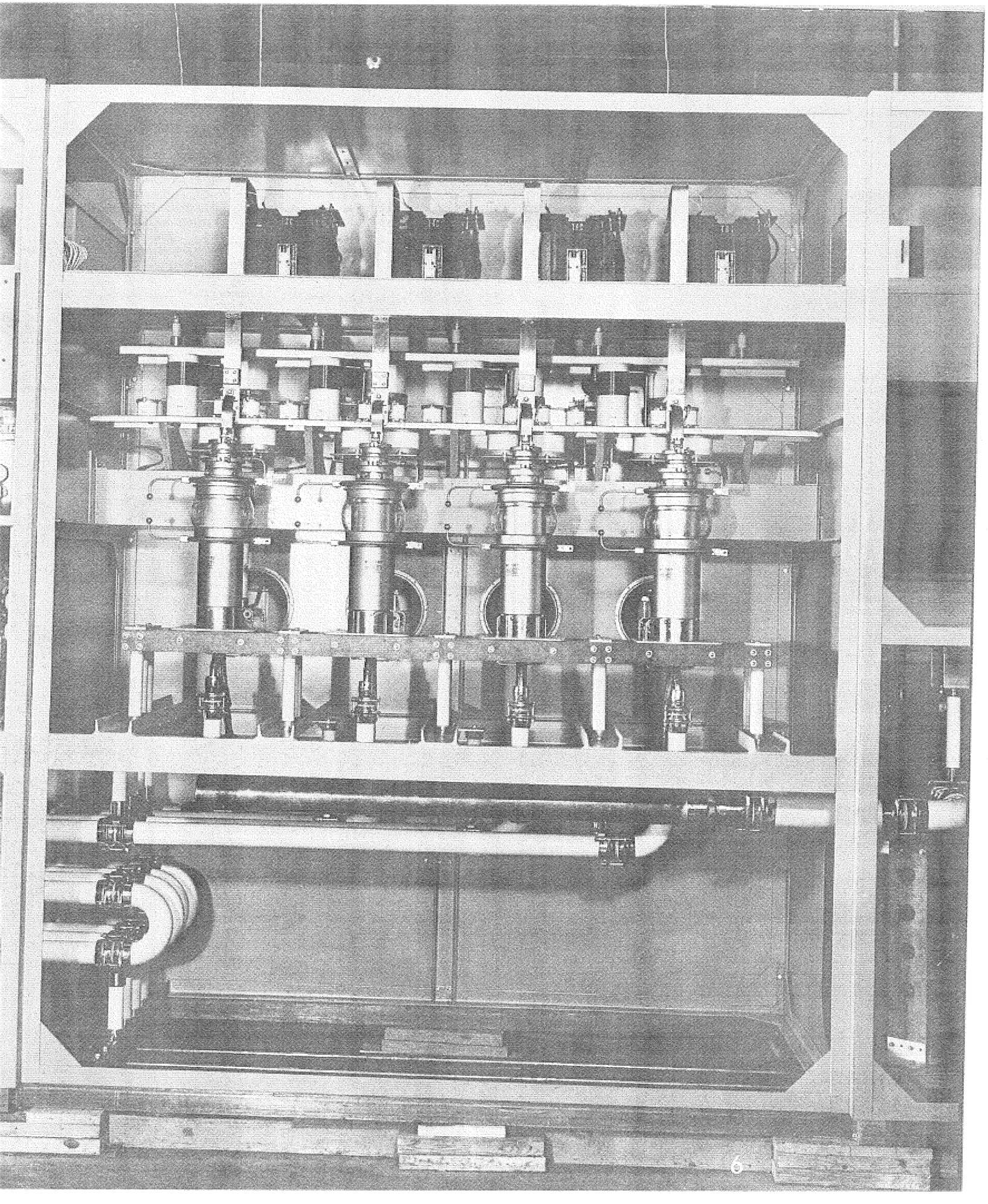


CONTROL CONSOLE

The center section of the operator's Control Console contains all of the power controls and meters. Individual controls for the auxiliaries and a master switch for operating the entire transmitter are incorporated. Facilities are included for operating either half of the transmitter and isolation of the other half. Indicating lamps are used to show the conditions of the sequencing of the various parts of the power and control circuits. Overload lamps indicate the operating conditions in the tube circuits.

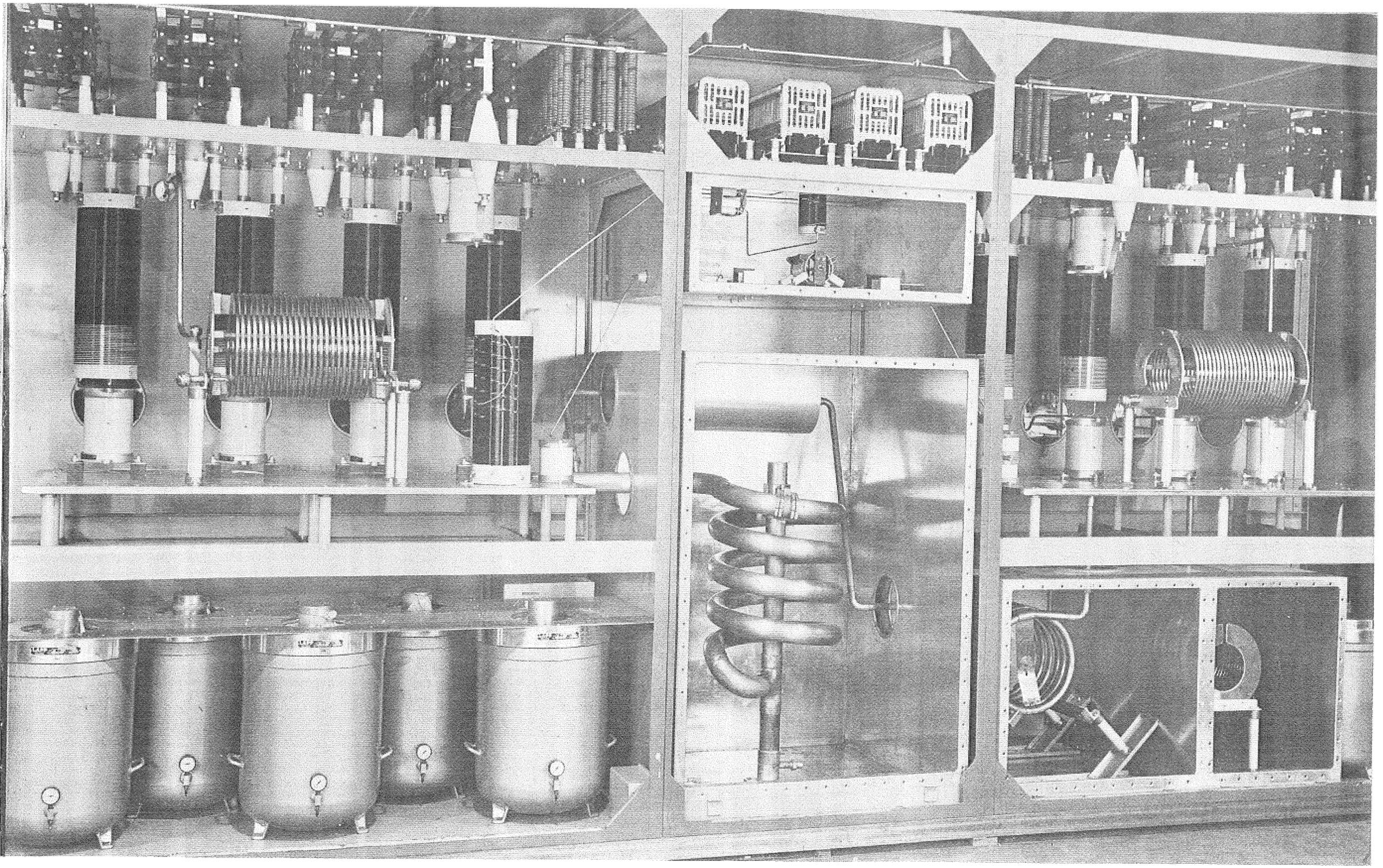
Each of the end sections of the Control Console is associated with one-half of the transmitter. All metering for the Modulated Amplifiers and Power Amplifiers are brought to these end sections. Indicators on these consoles show the position of the various tuning components in the Modulated Amplifier and Power Amplifier; and the tuning motors for these components are push-button controlled from the console.

A cathode ray oscillograph is mounted on each of the end sections of the console. These are used as tuning indicators and for monitoring various points in the circuits of each of the 500 kw RF Amplifiers.



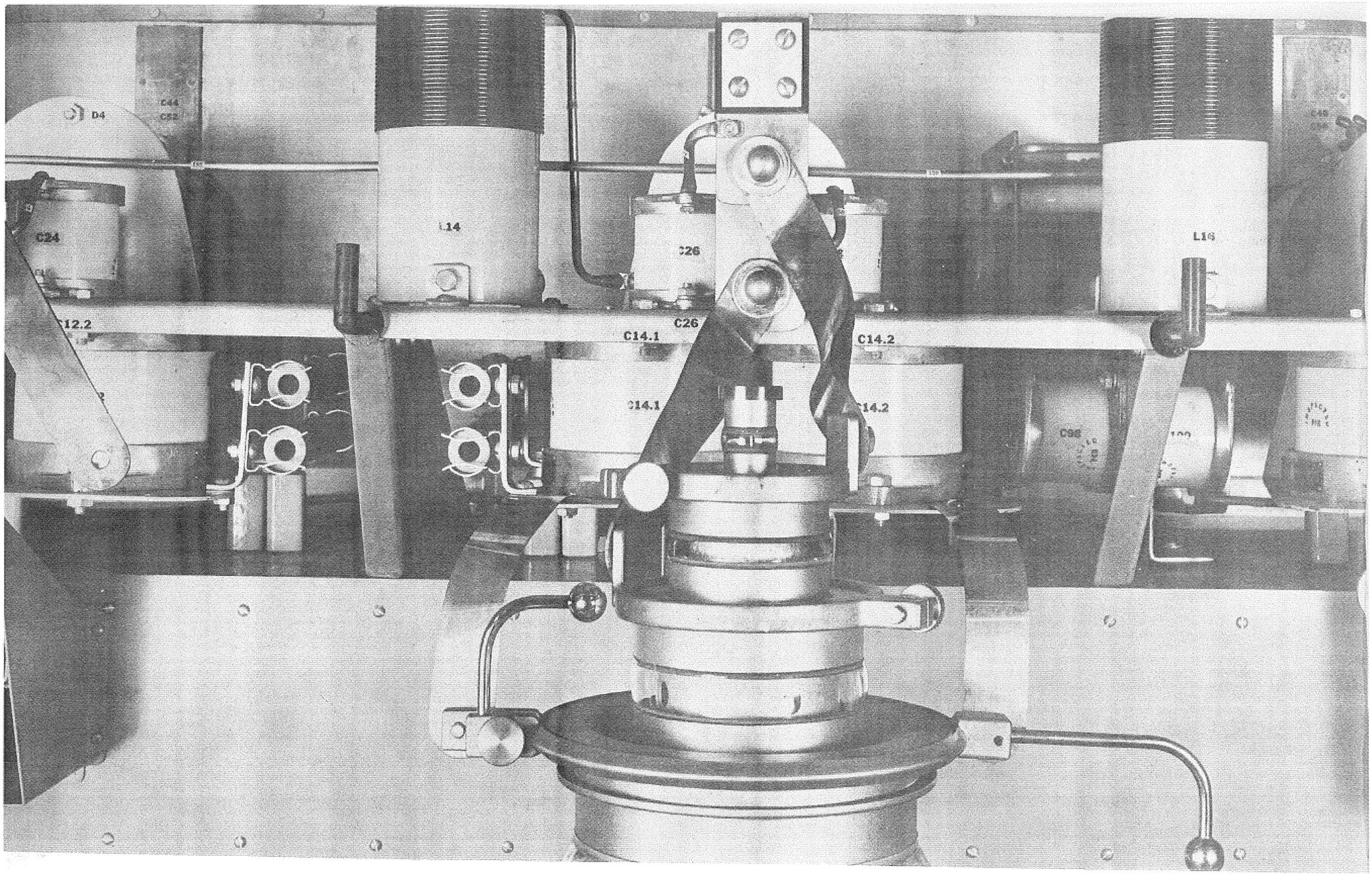
FRONT VIEW OF ONE SECTION OF POWER AMPLIFIER

The assembly of four Type ML-5682 power amplifier tubes is shown with front doors and cabinet trim removed. Porcelain tubing for the cooling water is shown below the tubes and the grid equipment directly above. In the topmost compartment can be seen the individual filament transformers. With the cabinet doors closed, all of the tube compartments become pressurized with cooling air furnished by large blowers located in the extreme end sections of the transmitter cabinet assembly.



REAR VIEW OF ONE 500 KW POWER AMPLIFIER

With the cabinet doors and trim removed this view shows the assembly of all major circuit components for one 500 kw power amplifier. In the lower center section is located the output tank inductor. To the left are shown the five pressurized capacitors used for tuning this inductor. Directly above this capacitor compartment are located the individual plate chokes, blocking capacitors and neutralizing coil for the four peak amplifier tubes. In the lower right-hand section are shown the interplate inductor, carrier tank inductor and the carrier tank tuning capacitor. The section directly above contains the individual plate chokes, blocking capacitors and neutralizing coil for the peak amplifier tubes. The compartment extending along the top of the cabinet contains the plate current limiting resistors, grid loading resistors and various other heat dissipating elements. This compartment is supplied with forced-air ventilation and becomes a cooling duct when the cabinet is closed.



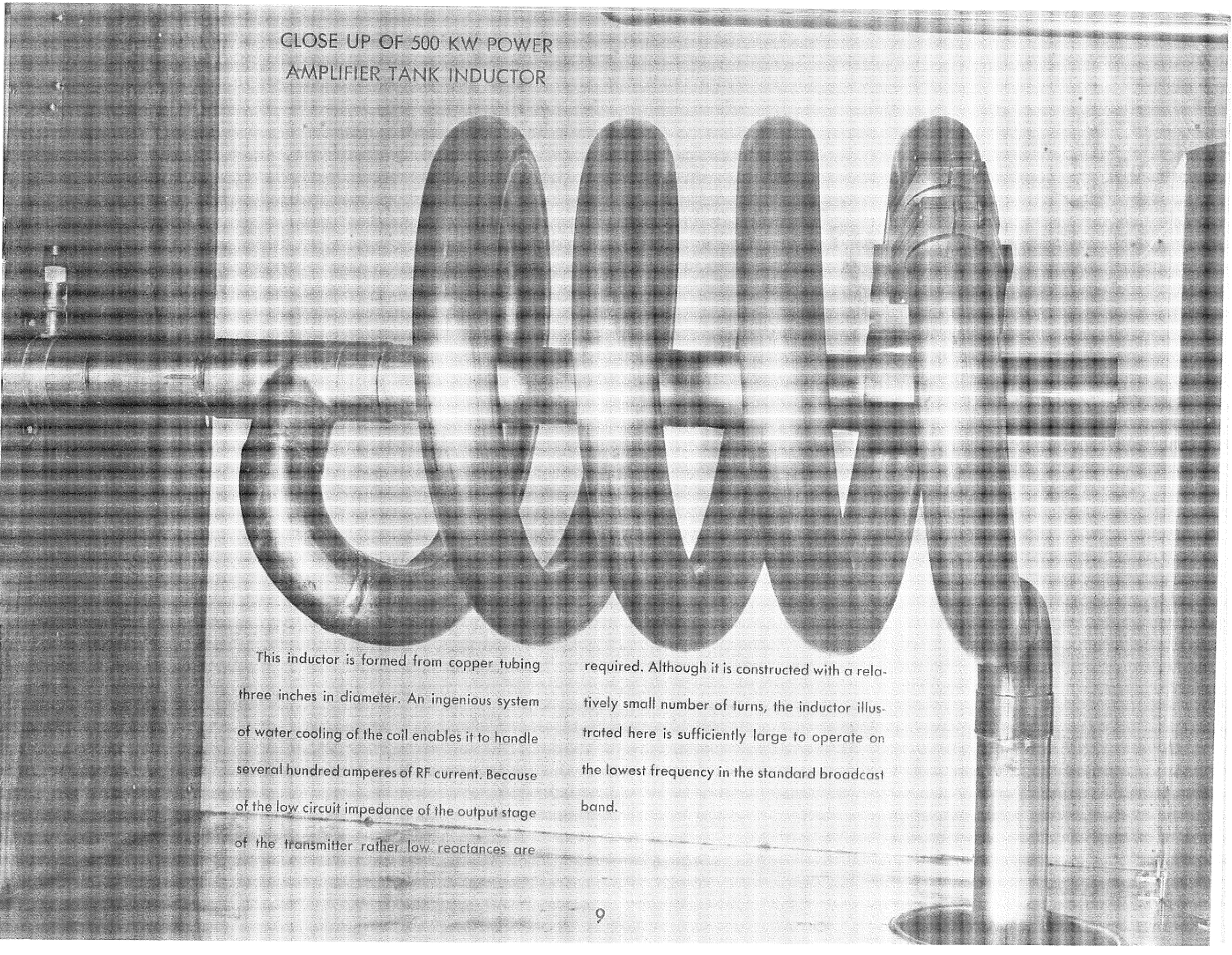
CLOSE UP VIEW OF POWER AMPLIFIER TUBE

The upper portion of one Type ML-5682 power amplifier tube together with the details of its circuit arrangement is shown. The filament bypass capacitors are mounted directly behind the tube on the upper shelf. The connections to the filament transformer buss extending downward from the transformer secondary can be seen. Directly beneath the filament ringtype connectors may be seen the grid connections to the tube. Two connecting straps are used to reduce inductance in the circuit between the grid of the tube and its grid choke, voltage division capacitors and other components mounted on the lower shelf.

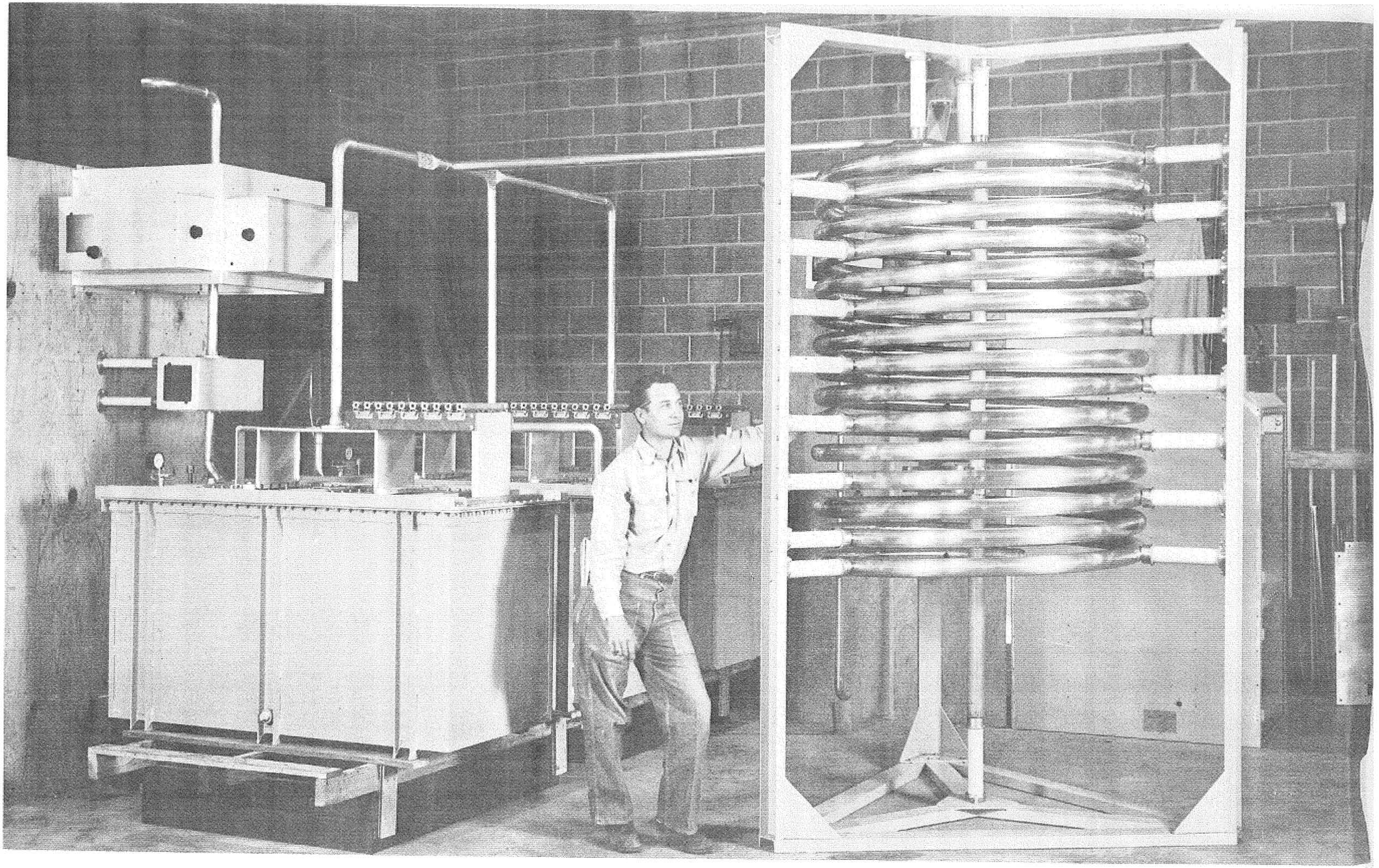
The Type ML-5682 is a coaxial-terminal, thoriated filament triode capable of 250 kw peak output up to 30 megacycles, Mechanically, it features an integral anode water jacket, and a quick-change, leakproof, bayonet type water coupling.

All components are clearly labeled by circuit symbol numbers for ease in identification.

CLOSE UP OF 500 KW POWER AMPLIFIER TANK INDUCTOR

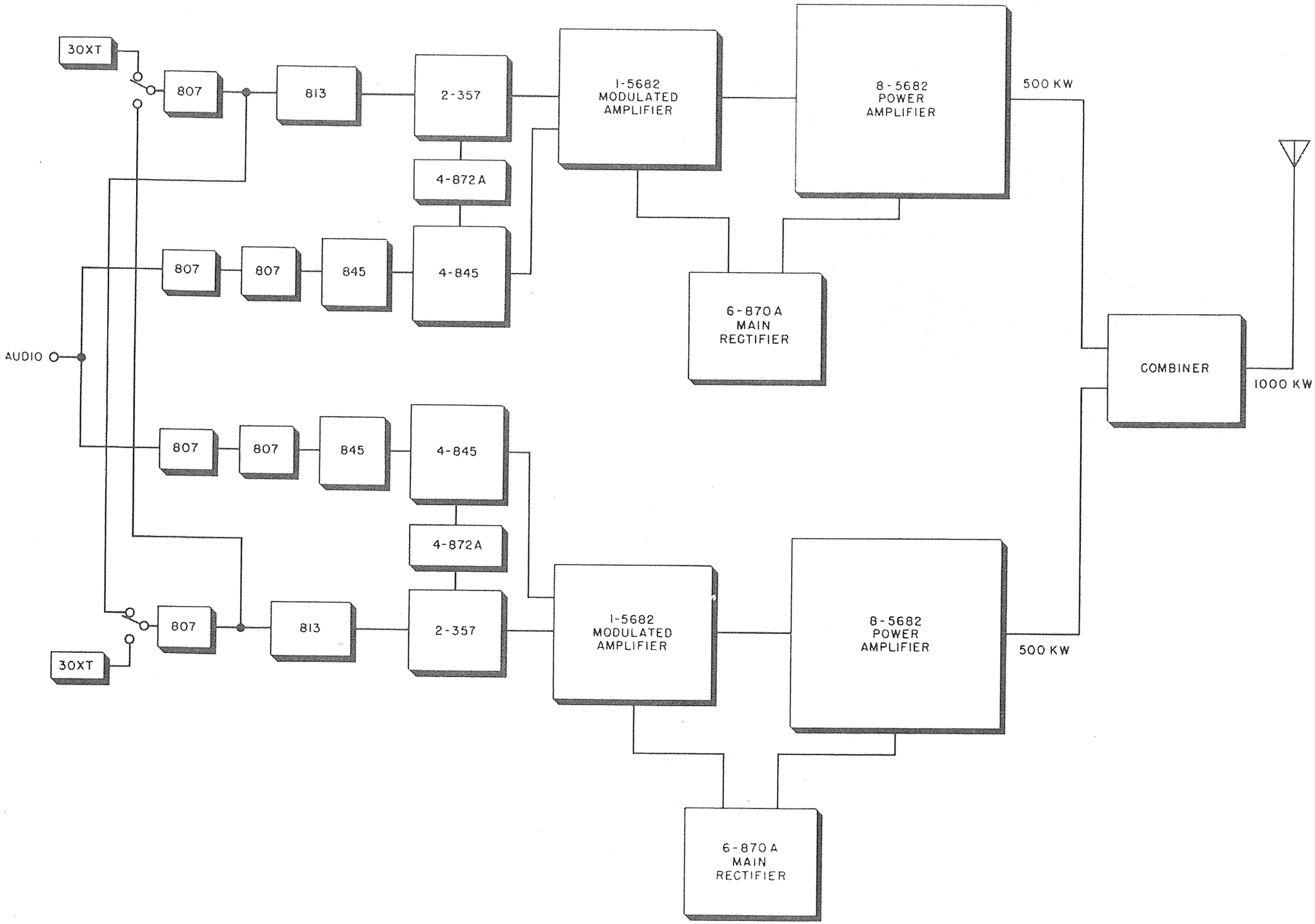


This inductor is formed from copper tubing three inches in diameter. An ingenious system of water cooling of the coil enables it to handle several hundred amperes of RF current. Because of the low circuit impedance of the output stage of the transmitter rather low reactances are required. Although it is constructed with a relatively small number of turns, the inductor illustrated here is sufficiently large to operate on the lowest frequency in the standard broadcast band.

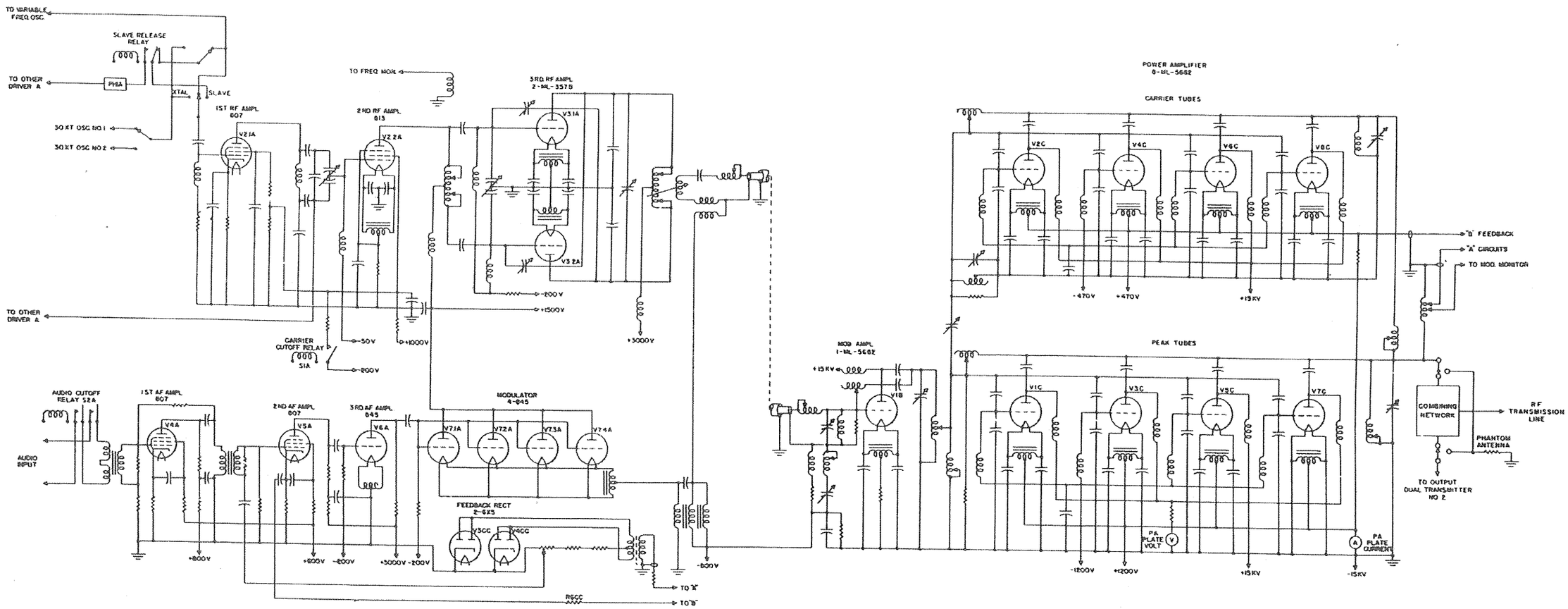


ANTENNA TUNING EQUIPMENT FOR
1,000 KW INSTALLATION

The equipment illustrated was manufactured for one of the VOA one megawatt installations that is now in operation. Since a relatively low frequency is used, rather large values of inductance and capacitance were required for tuning and coupling at the base of the single tower antenna. This equipment, arranged in the configuration of an L-network, required a special inductor and a very large special type of oil-filled capacitor, both units of which have current ratings in the order of 250 amperes.



TYPE 105-C
FUNCTIONAL BLOCK DIAGRAM



TYPE 105-C
SCHEMATIC CIRCUIT DIAGRAM
ONE 500 KW HALF OF TRANSMITTER

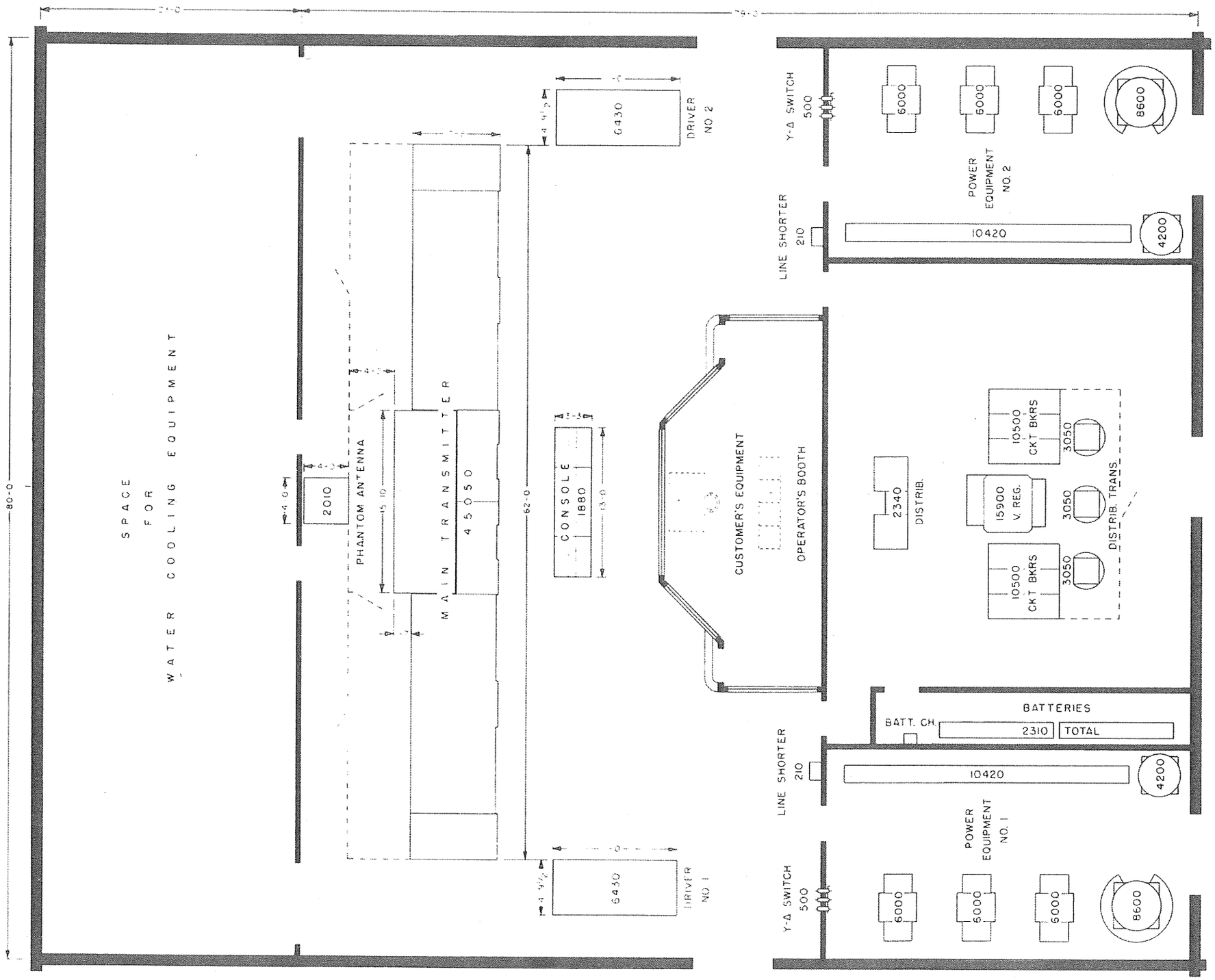
ELECTRICAL SPECIFICATIONS

Carrier Output Power	1,000,000 Watts
Frequency Range	535 to 1605 Kc
Frequency Stability	Assigned Frequency ±10 cps
Type of Modulation	Grid Bias in the Penultimate Stage
Type of Power Amplifier	High Efficiency Linear
Output Impedance	200 ohms, or other specified
Audio Frequency Input Impedance	150 or 600 ohms
Audio Frequency Input Level	+10 dbm ±2 db
Audio Frequency Response	Uniform with ±.50 db from 30 to 10,000 cps
Audio Frequency Distortion	Less than 4% total RMS Distortion when modulated up to 95% with frequencies between 50 and 7500 cps
Residual Carrier Noise	57 db below 100% modulation
Modulation Capability	100% 50-10,000 cps
Power Consumption	Unmodulated-2050 Kw, 100% modulation level-2800 Kw
Power Line Requirements	4,160 V., 60 cycle, 3 phase, 3 wire
	Instantaneous Regulation Not to exceed 5%
	*Voltage Variation Not to exceed ±5%

*An auxiliary voltage regulator is available as optional equipment. With this regulator, operation is possible on a power source with a voltage variation of plus or minus 10%.

TUBE COMPLEMENT

COMPONENT OF TRANS. ASSEMBLY	TUBE TYPE	FUNCTION	TOTAL QUANTITY
Driver Unit, A (2 units)	6AG7	Crystal Oscillators	2
	0B2	Voltage Regulators	2
	807	RF and Audio Amplifiers	6
	813	RF Amplifiers	2
	845	Audio Driver and Modulators	10
	ML-357B	RF Amplifiers	4
	872A	Intermediate Rectifiers	8
	5Y3	Bias Rectifiers	2
Modulated Amplifier Unit, B (2 units)	ML-5682	Modulated RF Amplifiers	2
Power Amplifier Unit, C (2 units)	ML-5682	RF Power Amplifers	16
Bias Rectifier Unit, G (2 units)	872A	Modulated Amplifier Bias Rectifiers	4
	575	Power Amplifier Bias Rectifiers	12
Main Rectifier Unit, F (2 units)	GL-870	15 Kv Rectifiers	12
	2D21	Arcback Indicators	12
Tuning Console, CC (2 units)	6X5	RF Rectifiers (Monitor, Feedback and Carrier Cutoff Protection)	8

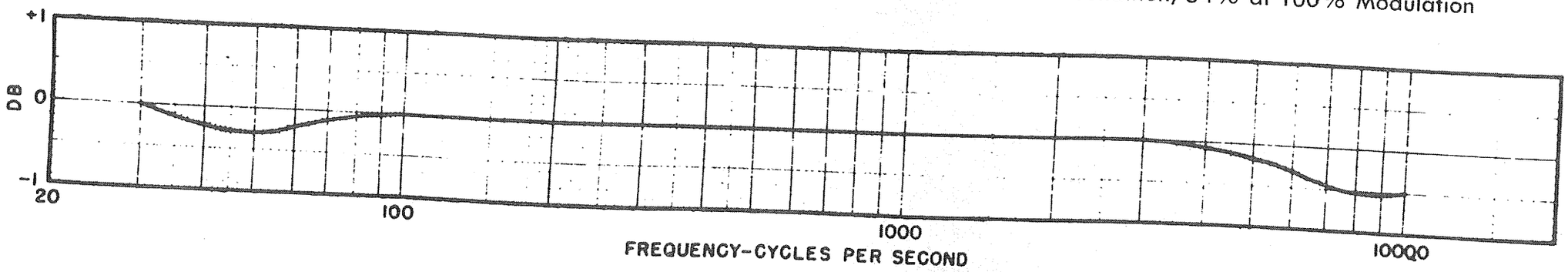


TYPE 105-C
TYPICAL FLOOR PLAN

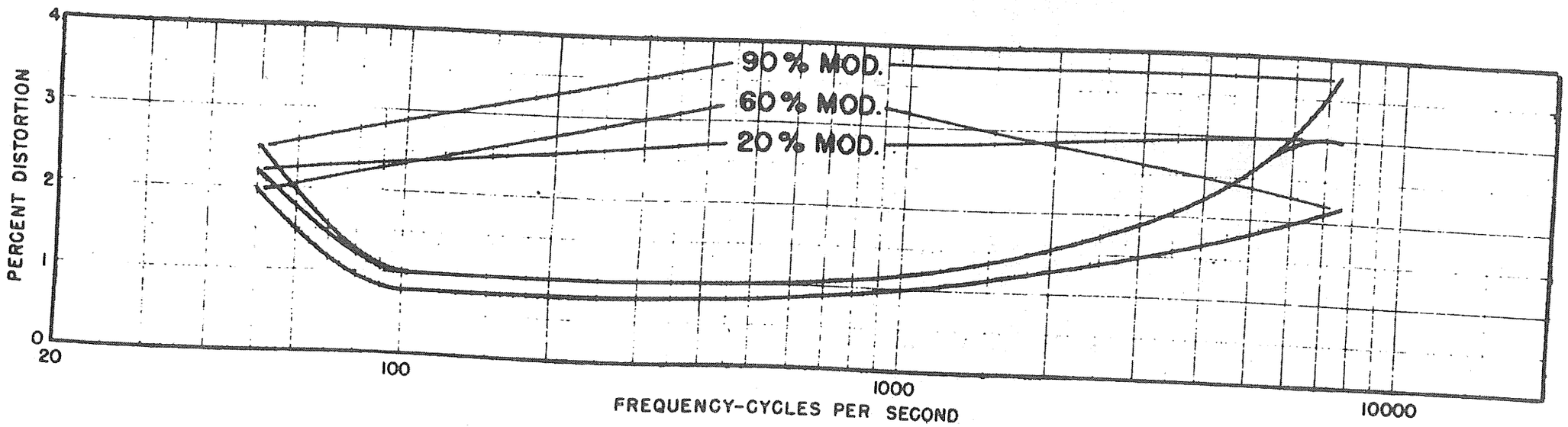
PERFORMANCE DATA

Continental Type 105, 1 Megawatt
AM Standard Broadcast Transmitter
Measured Performance Characteristics

Residual Carrier Noise Level	60 DB below 100% Modulation
Carrier Shift	Zero at any Modulation to 100%
Sustained Tone Modulator Capability	100% at any Frequency from 30 to 10,000 cps
Final Linear Power Amplifier Power Gain	33
Final Linear Power Amplifier Efficiency	62%
Overall Transmitter Efficiency	50% at Carrier Condition, 54% at 100% Modulation



AUDIO FREQUENCY RESPONSE



AUDIO FREQUENCY HARMONIC DISTORTION

The above data shows the measured performance taken on one transmitter operated on a number of frequencies between 540 and 1600 kc. Operating characteristics are consistent over the entire frequency range of the transmitter.

EQUIPMENT OPERATIONAL COST

1. POWER - - -

Assumptions:

a. Power required (average program modulation) = 2200 kw

b. Rate of 1c per kw hour

Then: Hourly rate for power = $ 22.00 = $ 22.00

2. POWER TUBES - - -

Assumptions:

a. 18 Type ML-5682's at $2750 = $49,500.00

b. 12 Type GL-870A's at $1475 = $17,700.00

$67,200.00

c. Filament life of 10,000 hours

Then: Hourly cost for larger tubes = $ 6.72

d. Cost of remaining tubes = $867.70

e. Filament life of 5,000 hours

Then: Hourly cost for larger tubes = $ .16

and Total Hourly cost for all tubes = $ 6.88 = $ 6.88

3. GENERAL MAINTENANCE

Assumptions:

a. Replacement parts (average over 5 year period) = $ 2500.00

b. Miscellaneous to include distilled water, nitrogen gas, lubricant, oil, etc. = $ 1500.00

Total Cost per Year = $ 4000.00

c. 5000 hours of operation per year

Then: Hourly cost of Maintenance = $ .90 $ .90

TOTAL HOURLY OPERATION COST = $ 29.78

THE OUTPUT POWER OF THE AM RADIO TRANSMITTING EQUIPMENT THAT HAS BEEN MANUFACTURED BY CONTINENTAL ELECTRONICS WITHIN THE PAST FIVE YEARS IS EQUIVALENT TO THE TOTAL COMBINED POWER OF ALL THE STANDARD BROADCAST STATIONS IN THE UNITED STATES, PUERTO RICO, HAWAII AND ALASKA.

For Equipment
above and beyond
the usual standards