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
TYPE 105C
1,000,000 WATT AM BROADCAST TRANSMITTER
FOR
SUPER POWER BROADCASTING

Continental Electronics

TELEPHONE
EVERGREEN 1-1127
MANUFACTURING COMPANY
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DALLAS 27, TEXAS
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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 AM-
PLIFIER.

On the left of this three-unit
assembly is the 15 kilovolt rec-
tifier tube assembly. In the cen-
ter section are the bias rectifiers
and to the right the audio and
RF driver. The 15 kilovolt recti-
fier uses the Type GL-870A
mercury vapor tube; this rectifier
has a current capacity, as far as
tubes are concerned, of 225 am-
peres although for 500 kw
operation only about 85 am-
peres 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 posi-
tion 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 fol-
lower 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-357A 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 ar-
ranged 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.
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 bush extending downward from the transformer secondary can be seen. Directly beneath the filament ring type connectors may be the grid connections to the tube. Two connecting strips 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, thiriated 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.
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.
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

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

*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

<table>
<thead>
<tr>
<th>COMPONENT OF TRANS. ASSEMBLY</th>
<th>TUBE TYPE</th>
<th>FUNCTION</th>
<th>TOTAL QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Unit, A (2 units)</td>
<td>6AG7</td>
<td>Crystal Oscillators</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>082</td>
<td>Voltage Regulators</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>807</td>
<td>RF and Audio Amplifiers</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>813</td>
<td>RF Amplifiers</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>845</td>
<td>Audio Driver and Modulators</td>
<td>10</td>
</tr>
<tr>
<td>Modulated Amplifier Unit, B (2 units)</td>
<td>ML-3578</td>
<td>RF Amplifiers</td>
<td>4</td>
</tr>
<tr>
<td>Power Amplifier Unit, C (2 units)</td>
<td>872A</td>
<td>Intermediate Rectifiers</td>
<td>8</td>
</tr>
<tr>
<td>Bias Rectifier Unit, G (2 units)</td>
<td>5Y3</td>
<td>Bias Rectifiers</td>
<td>2</td>
</tr>
<tr>
<td>Main Rectifier Unit, F (2 units)</td>
<td>ML-5682</td>
<td>Modulated RF Amplifiers</td>
<td>2</td>
</tr>
<tr>
<td>Tuning Console, CC (2 units)</td>
<td>ML-5682</td>
<td>RF Power Amplifiers</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>872A</td>
<td>Modulated Amplifier Bias Rectifiers</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>575</td>
<td>Power Amplifier Bias Rectifiers</td>
<td>12</td>
</tr>
<tr>
<td>GL-870</td>
<td>15 Kv Rectifiers</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>2D21</td>
<td>Arcback Indicators</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>6XS</td>
<td>RF Rectifiers (Monitor, Feedback and Carrier Cutoff Protection)</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
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

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