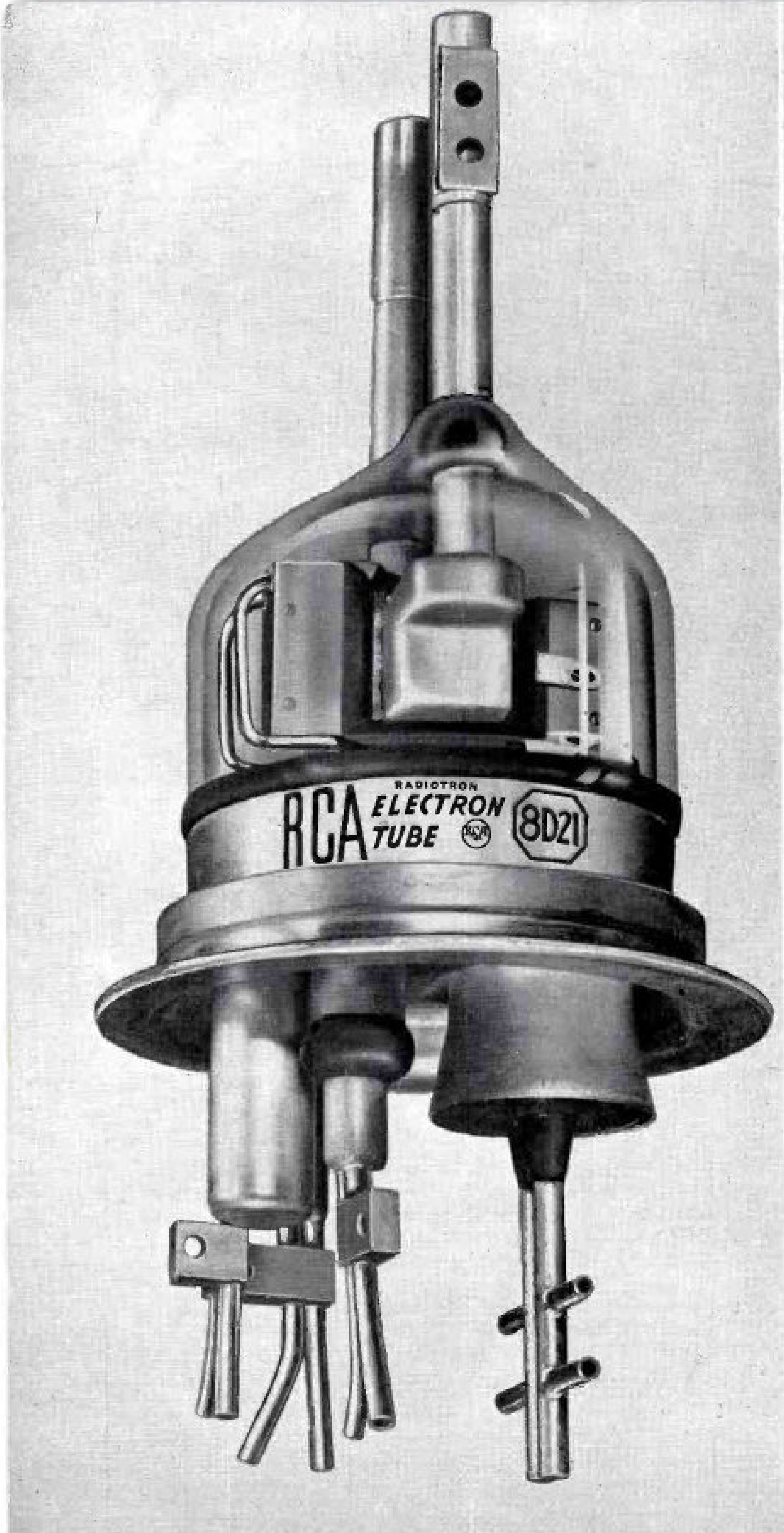
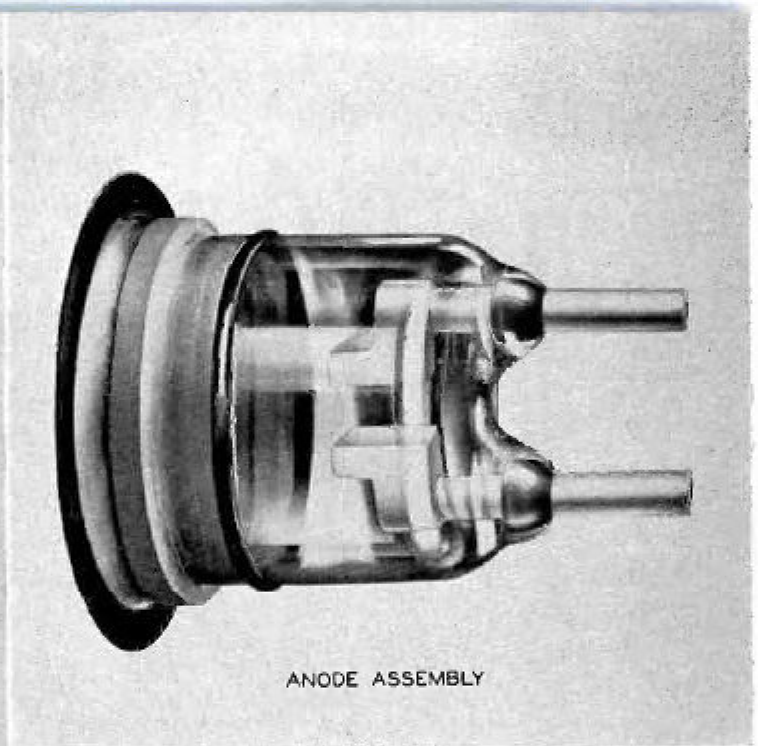


FIG. 2. Finished 8D21 showing how the anode-dome assembly (with anode terminals of tetrodes No. 1 and No. 2 projecting from top) is welded to metal header which supports the internal structure of tube. Directly below metal header and to the right are the control-grid terminals of tetrodes No. 1 and No. 2. To left of center, the terminal for the No. 2 grids; and to the extreme left, the filament terminals. The tube is fitted with a special cathode and beam-confining electrodes, and, because of the cathode structure used, must be operated in a horizontal position with plane of the control grids below horizontal plane of the filament leads.



ANODE ASSEMBLY

FIG. 2. The glass-to-metal seal structure of anode assembly: The two anodes are soldered to the ends of supporting tubes which form the elements of a transmission line and also function to carry the water to and from the anodes, thereby providing cooling for the glass-to-metal seals.

THE RCA 8D21

HIGH POWER AT VERY HIGH FREQUENCIES

A significant step forward in the development of power tubes for television occurred last spring with the introduction of the RCA-8D21 by the RCA Tube Department. An internally neutralized, push-pull tetrode of advanced design, the 8D21 features high power capability at very high frequency. This is accomplished by the use of a compact, high-current-density structure in which all electrodes are water-cooled close to the active electrode areas, including the anodes, control grid, scren grids, and filament mounting blocks.

When used as a class C, grid-modulated, push-pull r-f power amplifier in television service, the 8D21 has a maximum plate-voltage rating of 6000 volts, a maximum total plate input of 10,000 watts, and a maximum total plate dissipation of 6,000 watts. The tube may be operated with maximum rated input up to 300 megacycles.

Measuring 12 inches in overall length and 5¾ inches in diameter, the 8D21 has an eight-stranded, U-shaped, thoria-coated, tantalum-ribbon filament capable of large emission densities. The tube is internally neutralized, eliminating the need for external neutralization. Additional features are low inter-electrode capacitances, internal shielding between input and output circuits, internal bypassing of screens to filament to maintain the r-f potential of the screens at ground potential, and relatively short internal leads with consequent low inductances.

Because of electron-optical principles incorporated in its design, the 8D21 has high power sensitivity resulting in low driving-power requirements.

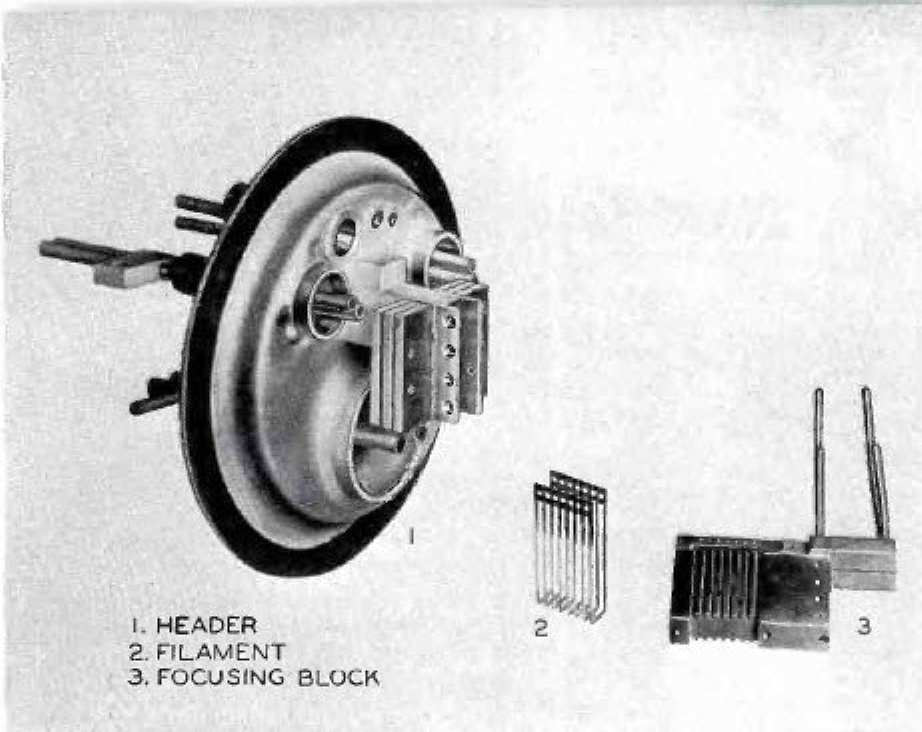


FIG. 3. 8D21 header before assembly. Identified parts are:

1. Metal header showing water-cooling connections for control grids, screens, and filament mounting and focusing block, and in the center, the supporting structure for the focusing block and the screens.

2. Filament: Each side of the 8-stranded, U-shaped, thoria-coated, tantalum-ribbon structure functions as the filament for one tetrode section.

3. Focusing Block: On this water-cooled mounting block the filament-type cathode is mounted. The ribs of the block act as focusing elements to form electron beams which pass between the aligned control grid and screen-grid to each anode.

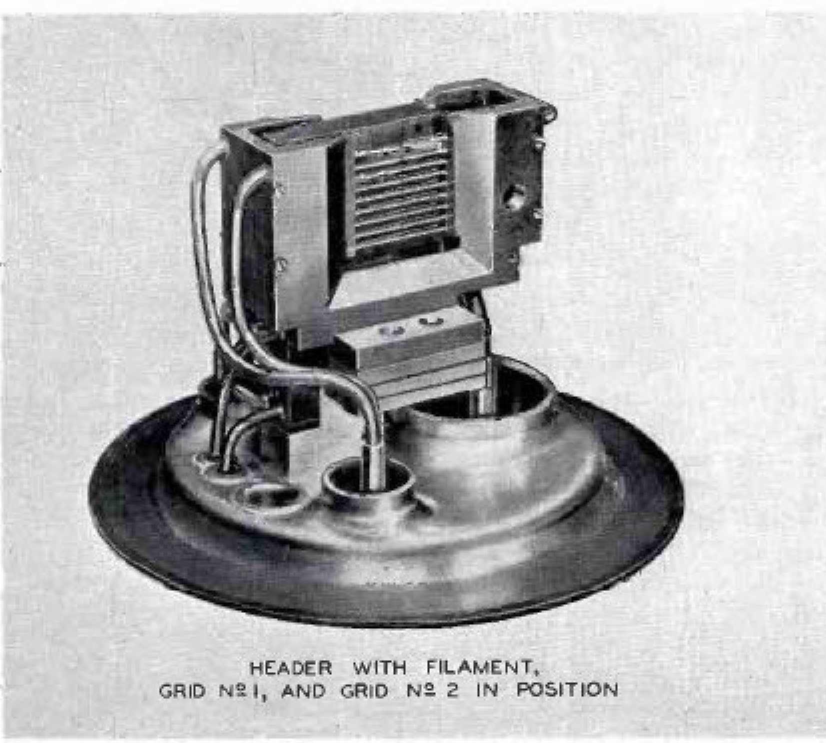
FIG. 4. Grid and anode parts of the 8D21. Identified as:

1. Control grid with water-cooled supporting tube attached.

2. Screen grids of the two tetrode sections are combined in a box-like assembly (with water-cooled tubes attached) which surrounds and shields the control grids and filament block.

3. Neutralizing Tab: Neutralization is provided by the capacitance between a tab and an anode, the tabs being directly supported by elements soldered to the control grids.

4. Anode Face: Fits into anode support assembly and has an exposed area of approximately one square inch.



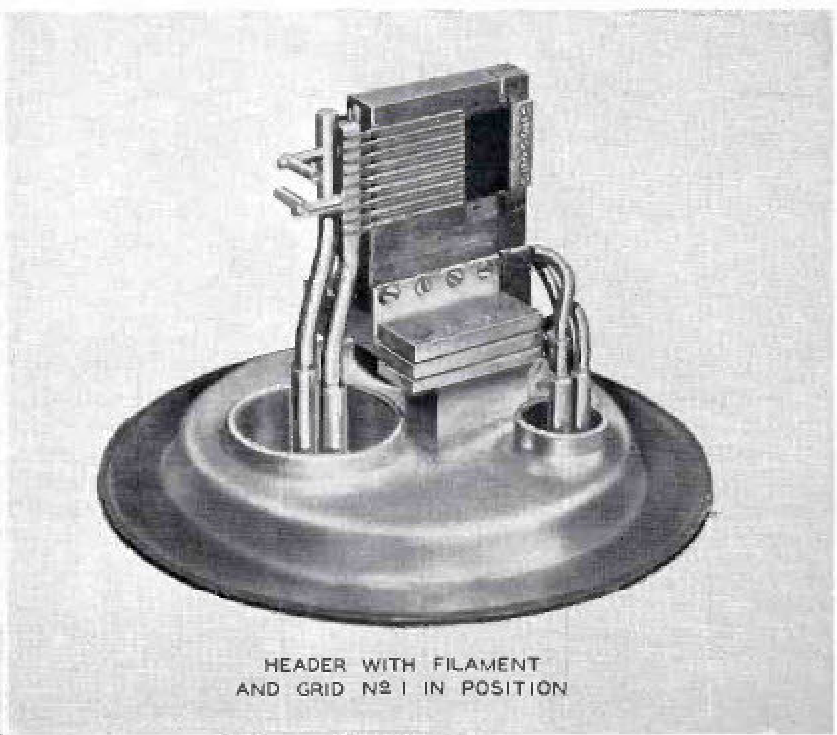


FIG. 5. The screen-grid assembly is mechanically clamped to the filament structure and insulated from it by mica, the clamping structure forming a bypass capacitor between screen grid and filament structure. This method of assembly permits inspection and accurate alignment and spacing of the filaments, control grids, and screen grids before the anode dome is attached to the metal header.

FIG. 6. Molybdenum control-grid bars are soldered to water-cooled supporting tubes, which in turn, are supported by the glass seal. The supporting arms for the neutralizer tabs are mounted directly on the grid water-cooled tubes as shown, and project through the screen-grid assembly which surrounds the cathode and the control grids.

FIG. 1. *The 8D21 tubes in the TT-5A transmitter are mounted on "tube plates" which can be easily removed whenever it is necessary to make a quick tube change.*

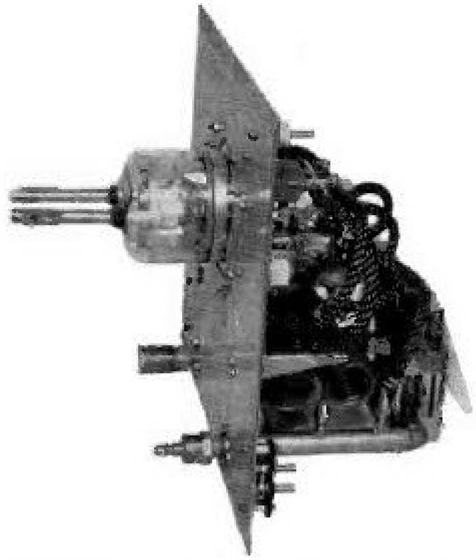


FIG. 2. *A spare tube, mounted on a tube plate, and with most of the water connections made, is kept ready for quick insertion.*

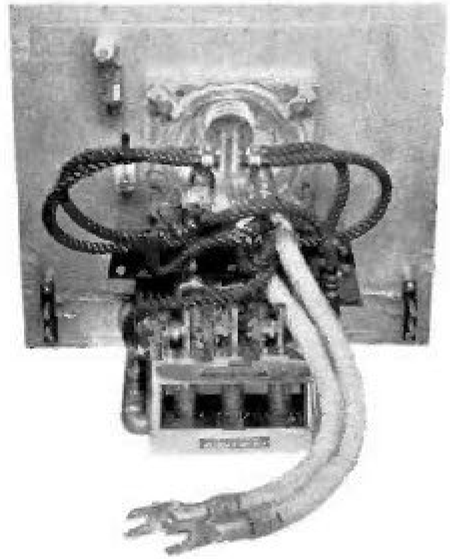


FIG. 3. *This "header-end" view of the 8D21 tube plate shows how the filament, grid and screen grid water connections are made.*

QUICK CHANGING OF 8D21 TUBE

by E. H. POTTER

Television Transmitter Section
Engineering Products Department

An ingenious method provides for rapid changing of the 8D21 tubes used in the final stages of the sound and picture amplifiers of the TT-5A transmitters. The 8D21 tube, as pointed out on previous pages, introduces a new principle of construction which results in a very high power handling capability (approximately ten times that of other tubes of comparable size). This is made possible by a highly-efficient cooling system in which all of the tube elements—filaments, plates, grids and common screen grid—are cooled by a constant stream of water which flows *through* them.

For uhf operation, the small-sized elements which internal cooling makes possible are of great advantage because of the much lower inter-electrode capacities which result. Such great advantage, however, is seldom gained without some drawback—which, in this case, is the multiplicity of water connections. There are actually fourteen water connections; i.e., input and return for each of the seven elements in the dual-tetrode. If all of these connections had to be made each time a tube was changed, it would indeed be a time-consuming and clumsy operation.

In order to overcome this difficulty, and provide a quick and easy means of changing tubes in case of failure during programs, the 8D21's in the TT-5A are mounted on removal plates (Figure 2). By this simple device the ten water connections to the header end of the tube can be made in advance on a spare tube mounting plate (Figure 2). The original 8D21's had three-sixteenths diameter tubes for all connections to which rubber hoses were clamped. To change the four anode hoses would have taken considerable time, so a water connector block was developed which clamped to the outside of each anode lead (Figure 6), leaving the ends of the anodes free for r-f connections.

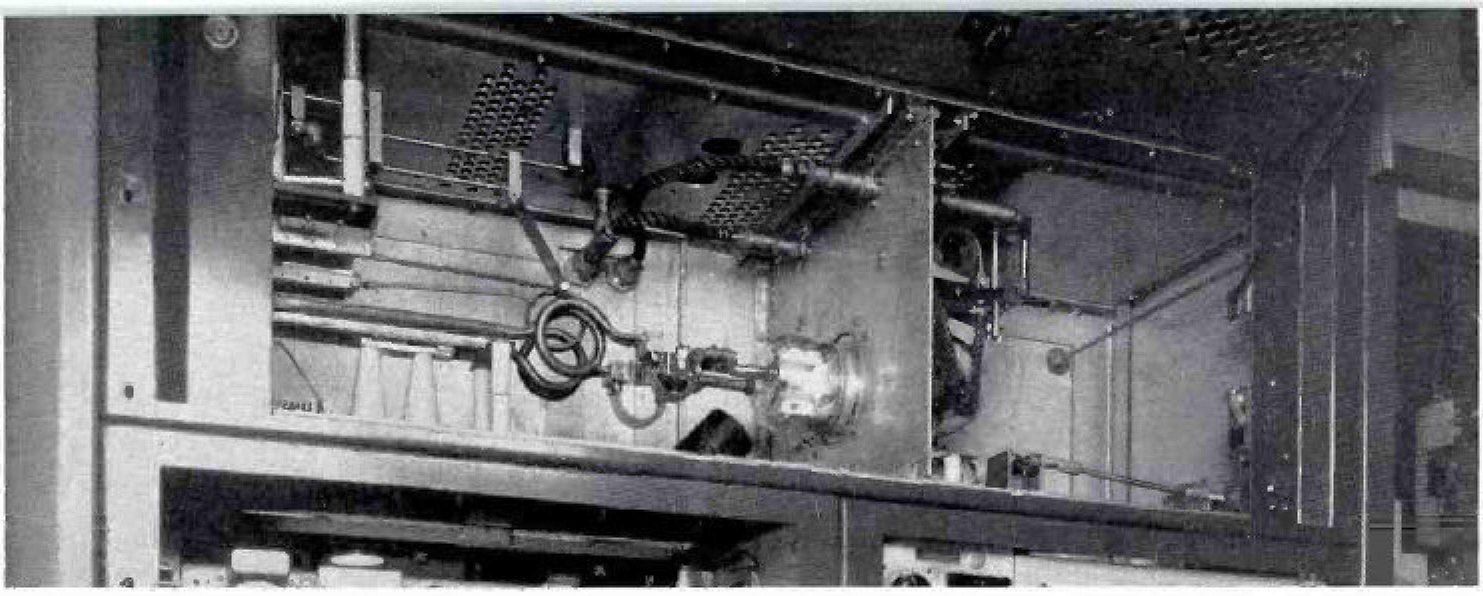


FIG. 4. *The sound power amplifier section of the TT-5A with 8D21 tube plate in place and all connections made. Only water connections which must be opened in order to remove the tube plate are the quick-disconnect fasteners on the two flexible leads at the top and the clamp-type connectors on the anodes. All four can be removed in a matter of seconds.*

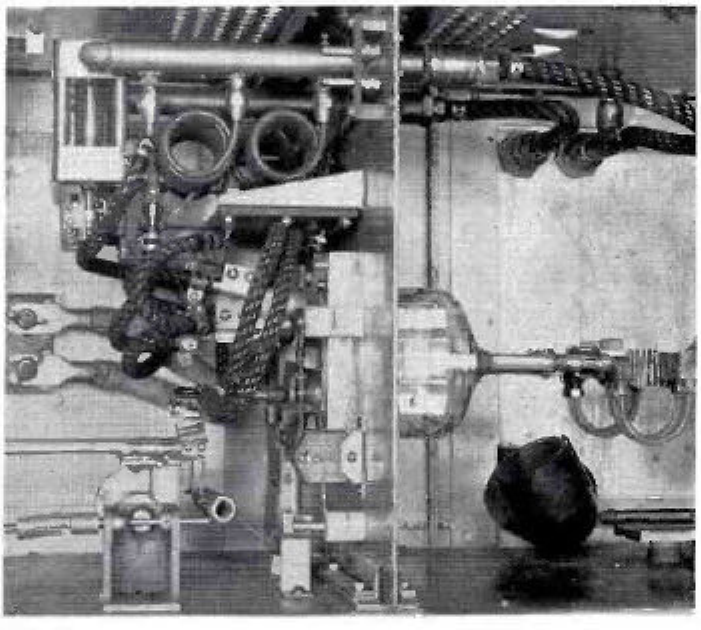


FIG. 5. *The 8D21 tube plate in the picture power amplifier section. The Saran insulating coils and water flow interlocks at the top left are permanently mounted on the tube plate.*

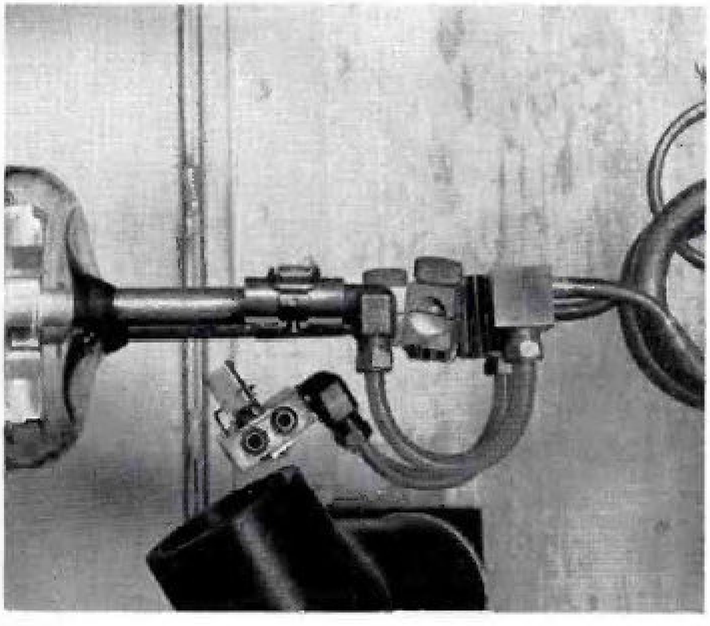


FIG. 6. *Closeup of anode leads with water-connector block of far lead removed and bent downward, while r-f connector of near lead is loosened and turned frontward.*

The anode cooling water is carried to and from each anode through the anode tank coil and then through short semi-flexible loops to the water connector blocks. These flexible loops are made of Saran tubing, and allow for expansion due to heating and for necessary tolerances. The water connector blocks have two short pieces of tubing to locate the assembly on the flat side of the anode, and suitable gaskets to seal against leakage of water, as the input water is at a pressure in excess of sixty pounds per square inch, and there is also some pressure on the return side. The block is held on, and pressure applied to seal the gaskets, by a clamp which hooks over the top and bottom edges of the flat surfaces of the anode itself. RF connections are made by block connectors which clamp to the end of the anodes, and by short flexible straps to the anode tank coil.

The tube plate has means to secure and locate the tube to place and ground the tube header. The cooling water flows through the grids and filaments in series. This means that there are three water circuits on the header end so a three element water flow indicator and flow alarm meter (Figure 3) is mounted on the tube plate to prevent application of power, or shut off the power, in case of low pressure, disconnection of a hose or stoppage of flow in any of the elements. As the grids and screen grid have high voltages to ground, a length of water column is provided by winding a piece of Saran tubing into a coil, and mounting these between the input header and connecting hoses, and between the hoses and flow meter connections. The input and return water are connected to the tube plate by quick-disconnect fittings which have internal valves that prevent water leakage when they are removed.

The screen grid and water flow interlock circuits are automatically connected when the tube is inserted. To change a tube, the operator has to: (1) loosen two wing nuts to disconnect the filament leads; (2) remove two pinch-type grid r-f connectors; (3) break the two quick-disconnect water connectors; (4) unclamp the two anode water connectors; (5) unfasten the anode r-f connections, and pull out the tube plate. A tube is inserted in the reverse manner. The whole change can be made in less than two minutes including the time to open the interlocked doors. The same tube plate will fit in either end of the transmitter, so it is necessary to have only one spare tube mounted.