

TO: Engineers of Project 6345

FROM: Jay W. Forrester

SUBJECT: RCA Selectron Storage Tube

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Project 6345
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Figures 1-4

The following information may be of interest on the RCA selectron storage tube. A tube consists of a cylindrical cathode surrounded by a current control grid, outside of which is a screen at +100 volts, surrounded by a rectilinear grid structure formed of vertical rods on the inner section and horizontal rods on the outer section, providing several thousand rectilinear windows as viewed from the cathode. Control of individual grid wires in both the vertical and horizontal rods is independent, except as noted later. Outside the grid structure are vertical radial fins at +300 volts, surrounded by the dielectric storage surface. The dielectric storage surface has fluorescent material on the inner surface of a mica-cylinder which is half silvered on the outside. The dielectric cylinder is divided into rectangular areas by the control grids as viewed from the cathode. Grid wires are so grouped, as shown in Figure 3, that only one opening at a time through the grid structure is bounded by positive grid wires. A single negative grid wire around the periphery of a grid opening is sufficient to prevent electron flow through the opening. The grids are arranged with 32 vertical and 32 horizontal wires brought out in two groups of eight each, such that by selecting one positive wire in each group 4,096 window openings are available. This number corresponds to $(\frac{n}{2})^2$ where n is the number of grid wires.

Two stable states exist in the condition of the inner surface of the dielectric as shown in Figure 4. Figure 4 is a plot of the ratio of secondary electrons to primary electrons versus cathode to dielectric voltage. This curve reaches unity at 40 volts. In the neighborhood of zero, existence of a positive accelerating voltage will collect electrons driving the particular rectangle of the dielectric back towards zero. If a negative cathode to dielectric potentials exists, no electrons are collected.

With a slightly less than 300 volt potential between cathode and dielectric, the excessive secondary emission to the +300 collector will raise the dielectric surface to 300 volts. If the dielectric lies slightly above 300 volts, secondaries cannot be collected and will return along with the primaries to the dielectric surface dropping surface potential to 300 volts.

A stable condition exists at zero and another at 300 volts which are self-maintaining in the presence of all positive grid wires and uniform electron emission from the cathode. A dielectric potential of 300 volts is indicated by fluorescence of the particular window area when electrons are permitted to pass through the grid rectangle in question. Fluorescence is read as a binary digit by means of a photo-multiplier tube. The dielectric potential at a particular point is changed by raising or lowering the signal plate by 300 volts, then opening the window in question and slowly (a few microseconds) returning the signal plate to original value so that cathode emission catches and maintains the dielectric spot potential at one of the stable operating positions. Potentials on the dielectric behind closed windows receive no cathode current and return to their original value along with the signal plate.

R.C.A. have thusfar made only D-C tests on this tube and have not made actual measurements or observations of operating speed. The tube still exhibits unsolved problems in electron optics, and their hope of having successful tubes by the end of this year appears rather optimistic, although evaluation of such a research program is extremely difficult.



Jay W. Forrester

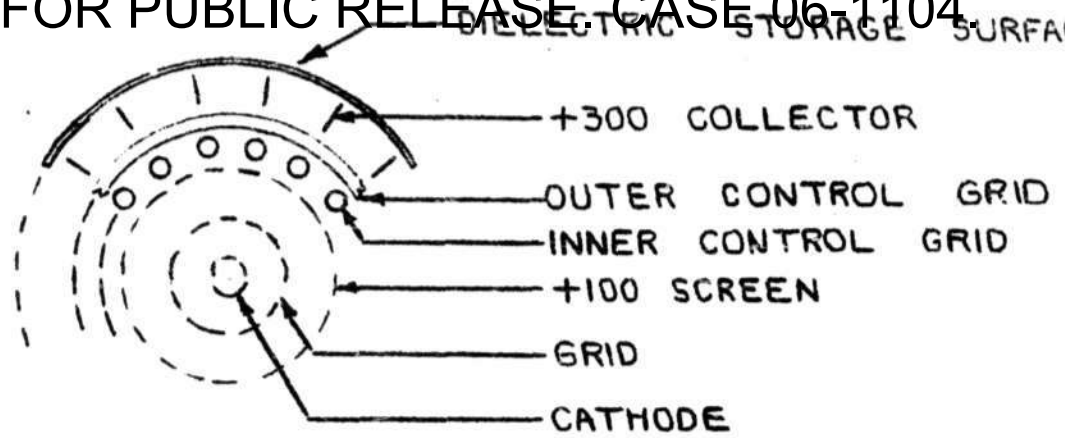


FIGURE 1

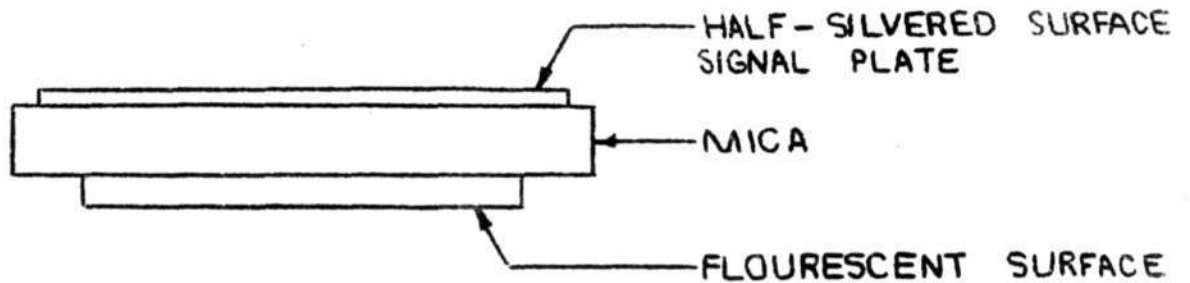


FIGURE 2

CROSS SECTION OF DIELECTRIC STORAGE SURFACE

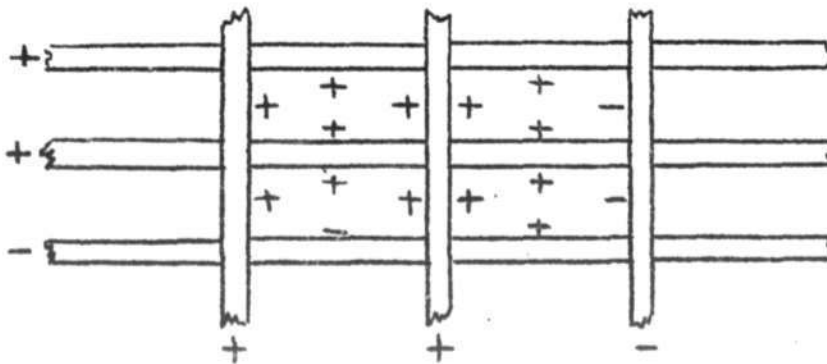


FIGURE 3

VIEW OF CONTROL GRID WINDOWS FROM CATHODE

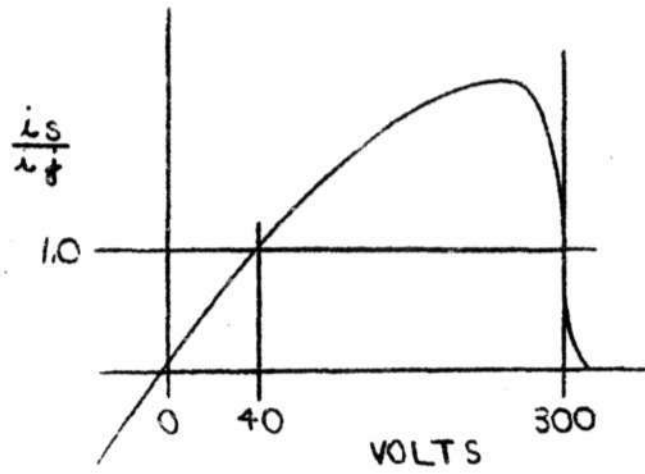


FIGURE 4
CATHODE TO DIELECTRIC