THE NEW PHILIPS RECTANGULAR PICTURE TUBES *(A 1954 VIEW)*

Contributed by **Abel Santoro**

Experience gained with the older types of picture tubes (the all-glass type with a round screen and the different types with metal cones) has led to the development of rectangular all-glass picture tubes, which are now in common use. This type has proved to be the most suitable form of picture tube, especially with respect to the dimensions and pleasant appearance of the receiver cabinet.

The most important features of the tubes described are: wide-angle deflection, magnetic focusing, and a heater suitable for series or parallel supply. These features, and the fact that this series comprises three tubes of different sizes, render the series very valuable to the set-making industry, since at all times a tube can be chosen which will meet the requirements of a certain set in all respects. In addition to the features mentioned above, these tubes have a gun of special design which ensures a very good picture quality over the entire screen area.

DESCRIPTION

The MW 36-44, MW 43-64 and MW 53-20 (Fig. 1) are rectangular picture tubes with an outside screen diagonal of 36 cm (14"), 43 cm (17") and 53 cm (21") respectively. The tubes are all-glass types, and the heater voltage is 6.3 V at 300 mA, suitable for either series or parallel supply. Magnetic deflection is used with these tubes, the deflection angle for scanning the full width of the screen being 70°.

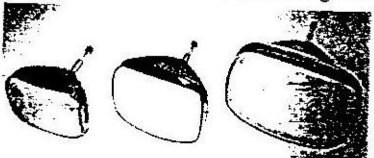

Fig. 1. The new line

THE GUN

The gun is designed for magnetic focusing. This method of focusing has proved to give the best results up till now. The gun has an electron-optical system of special design, in which the accelerating electrode g4 is preceded by an additional electrode g3, so that the entire gun comprises a heater-cathode assembly, a first grid g1 for modulating the intensity of the electron beam, a second grid g2, a third grid g3 and an accelerating electrode g4 (Fig. 2).

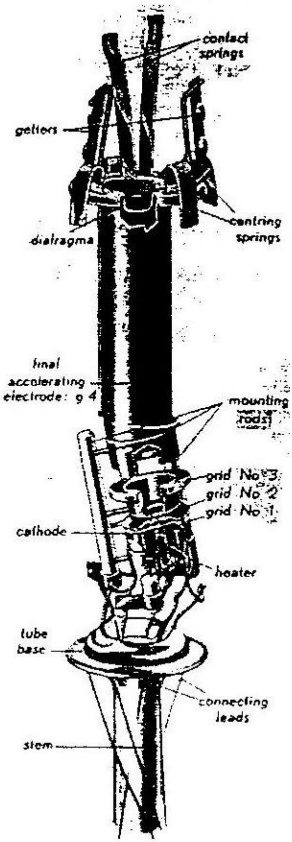

Fig. 2. The electron gun

When g3 has a positive potential of 400 volts, the beam of these tubes is 12% narrower than that of picture tubes having an electron gun of earlier construction, without g3. When g3 is connected to the cathode, the improvement is as much as 50%. A narrow beam offers the advantage that little trouble will be experienced from deflection defocusing. It may be deduced that the third grid g3 exerts a prefocusing action on the electron beam, so that, when the beam enters the main magnetic focusing field, the divergence is smaller than with earlier electron-gun constructions.

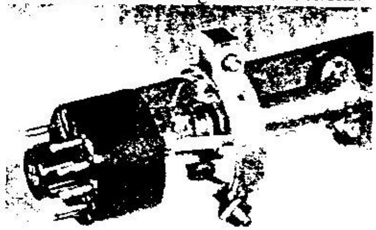

Fig. 3. Ion-trap magnet

THE ION TRAP

These tubes are provided with an ion trap which prevents the occurrence of ion burn on the screen. This ion trap is of the bent-gun type, and the external magnet (Fig. 3), has a field strength of 60 gauss. The cathode of a picture tube emits not only electrons but also a beam of negative ions. These ions have a very much greater mass than the electrons and are far less sensitive to magnetic deflection fields. The result is that, in a conventional picture tube without ion trap, the centre of the screen is continually subjected to bombardment by the heavy ions, and this eventually leads to discoloration of that part of the screen. In the tube described, both the el-ectrons and the ion beams leave the cathode at a small angle to the tube axis. Since the electron beam is very sensitive to a magnetic field, it is deflected along the axis of the tube and passes normal to the screen. The ions, however, which are far less sensitive to a magnetic field, are not deflected to any appreciable extent, and thus continue on a line at an angle to the tube axis and are finally captured by the accelerating el-ectrode. In this way the ions are prevent from reaching the screen.

THE SCREEN

The face of the MW 36-44, MW 43-64 and MW 53-20 is made of filter glass and has a neutral grey color. This results in improved picture contrast, particularly when light from the illumination of the room impinges upon the surface of the tube. The incident light is reflected at the inner side of the tube face, and since this will also be the case in the dark parts of the picture, the contrast is thereby deteriorated.

By using a grey-glass face instead a clear one, a large proportion of the light is absorbed as it passes the face of the tube. It is true that this is also the case for the light emitted by the fluorescent screen, but the incident light must pass the tinted glass twice, resulting in a much larger reduction of intensity. The filter glass, moreover, advances the contrast in another way, by reducing internal reflections in the glass front of the tube.

The other way to obtain sufficient brightness with these large picture tubes, without the beam current becoming excessive, is by the application of a "Metal-Backing" process, coating the inner side of the luminescent screen with a very thin layer of aluminum of only a few hundredths of a micron thick. The electrons of the beam will still have ample energy, for an H. T. supply between 12.5 and 18 kV, which is used at the present, to excite the luminescent screen after having passed through this layer. In picture tubes not provided with this feature, a large portion of the light radiated by the screen is directed to the inner side of the tube, so that the brightness of the picture is reduced. Thus a tube having a "Metal-Backed" screen is about 70% higher than the light out put of a similar tube without the "Metal-Backing" process.

CONE

The outside of the cone of these tubes has been provided with a conductive coating. This coating shields the tube against external electrostatic fields and reduces electromagnetic radiation from the electron beam. The capacitance between this outer coating and a conductive layer connected to the anode on the inside of the cone can act as a reservoir capacitor for the H. T. supply. For this, the external conductive coating must be connected to the chassis, otherwise it may attain a high potential and become a source of danger. The H. T. supply for these tubes varies between 9 and 18 kV. Failure of the deflection circuits may result in damage to the screen, unless provision is made to reduce the beam current automatically when the scanning fields are no longer present, by an graduated arrangement of the H. T. supply, which is obtained from the line flyback, making sure that the anode voltage drops to zero when the line-output circuit ceases to function. A stationary horizontal line which would occur upon failure of the vertical deflection is far less serious than a stationary spot.

Fig. 4. Annealing furnace

MANUFACTURE

The manufacture of these tubes in a big Philips factory involves several steps. The glass component parts of the tubes having been sealed together, the tube passes to a 20-meter-long tunnel furnace to remove contingent stresses in the glass (Fig. 4). Now the glass envelopes leave the glass furnaces, traveling through the entire factory by means of a specially designed conveyor belt (Fig. 5).

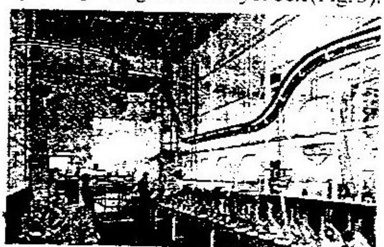

Fig. 5. conveyor system

The electrodes of the electron gun are fixed by fusing them to porcelain rods (Fig 6).

Fig. 6. Assembling the gun

Later the electrode system is carefully inspected through a magnifying glass before being sealed into the tube neck. The large box on the table contains a microscope for checking the distance between the cathode and the first grid of every electrode system (Fig. 7).

Fig. 7. Checking a gun

The screen is settled on the faceplate in a slowly rotating machine (Fig. 8).

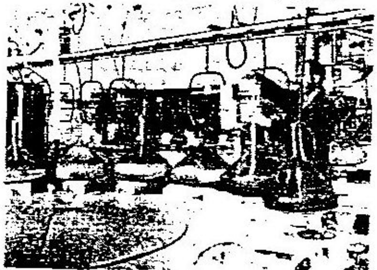

Fig. 8. Settling the screen

After the screens are settled, the tubes are dried by means of infrared lamps (Fig. 9).

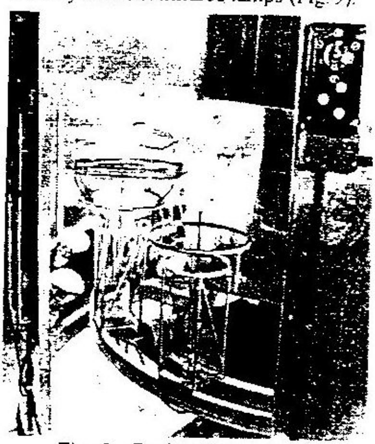

Fig. 9. Drying the screen

Fig. 10 shows the setup for aluminizing the screen of the tube. The flame in the bulb is caused by the heating element by means of which the aluminum is evaporated. The electrode system is sealed into the tube neck in a slowly rotating machine (Fig. 11).

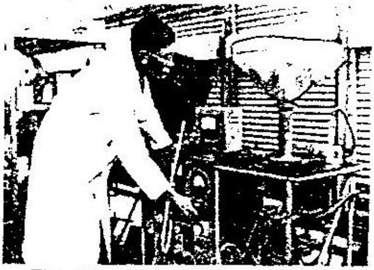

Fig. 10. Aluminizing the screen

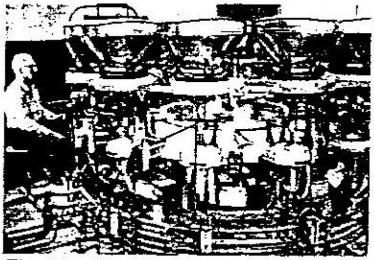

Fig. 11. Sealing the gun into the neck

The tubes are evacuated on individual pump systems. During this process the pumps travel with the tubes through a large tunnel where the tubes are heated to remove residual traces of gas (Fig. 12).

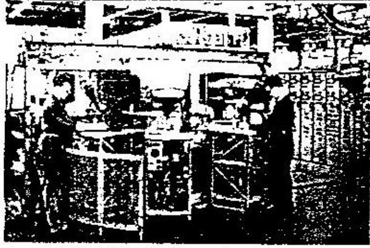

Fig. 12. Exhaust process

The finished tubes are tested for definition; the test pattern is obtained by means of the flying-spot scanner at the extreme right (Fig. 13).

Fig. 13. Quality check

These new types of picture tubes were released to the market circa 1954.

ACKNOWLEDGEMENT

To Philips Electronic Tube Division, Eindhoven, Holland.