Super-Emitron Camera

NEW TELEVISION EQUIPMENT FIRST USED FOR THE LORD MAYOR'S SHOW AND CENOTAPH BROADCASTS

THE principles of operation of the Emitron camera used in present-day television by the London Television Station have been previously described,[1] and its performance over a considerable period has been proved excellent as all viewers can testify. The camera is, in fact, highly sensitive, as is evidenced by the good outdoor broadcasts which have occurred from time to time. The attainment of this high sensitivity, however, necessitates the use of a large aperture lens with a correspondingly low depth of focus. This means that objects at different distances from the camera cannot be sharply focused simultaneously, and even small movements of the object are sufficient to throw out the focus. This can often be observed in a close-up of a singer, at one moment he is sharply focused, at the next he moves towards the camera and is blurred until the operator refocuses.

A new Emitron of higher sensitivity and much wider scope has now been developed by E.M.I. This camera, which has been named the "Super-Emitron," operates on different lines from the older type of Emitron. In the old type camera the picture is focused upon a mosaic of photo-cells which become charged due to the liberation of photo-electrons, the stored up charges being then discharged by the scanning electron beam. The Super-Emitron also has a mosaic which is scanned by an electron beam, but the mosaic need not be photo-electric, since an entirely separate photo-surface is provided. This separation of the photo-surface from the mosaic is fundamental to the operation of the tube and brings very important advantages.

There are several forms which the construction of the new Emitron can take, and one of the simplest is shown in Fig. 1, which is taken from British Patent Specification No. 442,666. An evacuated glass container has a photo-electric screen mounted at one end and a mosaic screen at the other, while an electron gun is mounted in a tube which is let into the side of the main body at an angle, so that the cathode-ray beam can scan the mosaic screen. Between the two screens is a metallic cylinder of large diameter which is maintained at a positive potential with respect to the photo-electric screen, and which is known as the accelerator. A coil is mounted outside the tube for producing a magnetic field which focuses the electron image on to the mosaic.

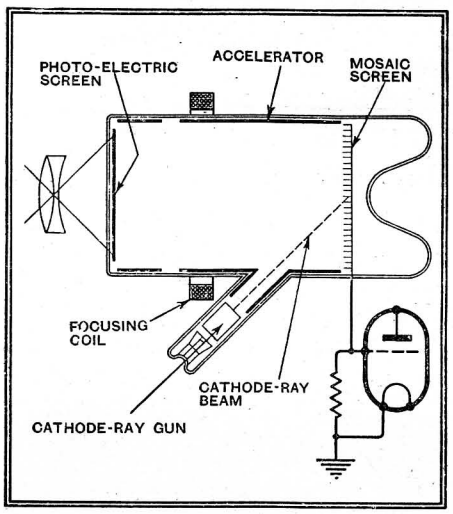


Fig. 1. The main details in the construction of the Super-Emitron camera are shown in this drawing.

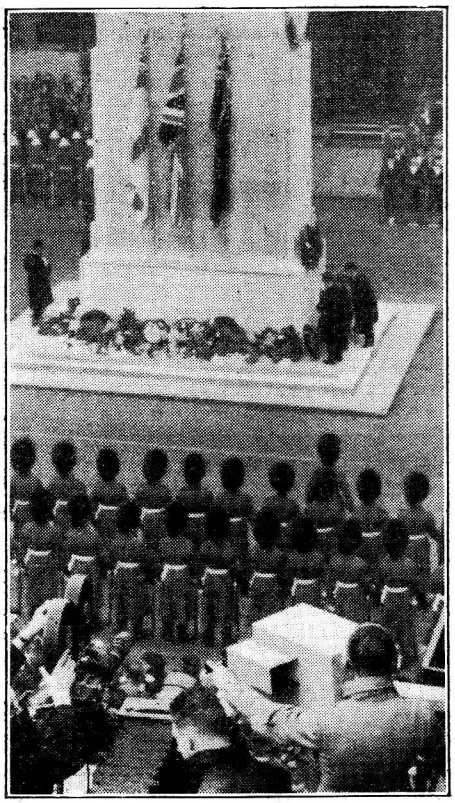
The elements of the electron gun are conventional and, consequently, need not be explained here. The usual deflecting coils for the scanning process are mounted around the narrow neck of the tube.

The photo-electric screen can be deposited on a transparent plate mounted internally, or it can be deposited on the inside surface of the glass end-wall of the tube. In either case it can consist of a layer of silver with a silver-oxide surface upon which is deposited a layer of caesium, the whole coating being so thin that it is semi-transparent. The mosaic is made of a secondary emissive material which is deposited upon a sheet of mica, the mica forming the di-electric between the elements of the mosaic and a continuous metal backing plate. Each element of the mosaic thus has a given capacity to the backing plate. (In some cases it is found that the mica sheet can itself serve as a mosaic, no additional secondary emissive material being necessary.)

Referring to Fig. 1, the scene to be televised is focused on the photo-electric screen by means of a suitable optical lens system. Each point on the screen then emits electrons in proportion to the amount of light falling on that point. These electrons are accelerated towards the mosaic screen by the positive accelerating electrode and are focused to produce a sharp electron image thereon by the magnetic field set up by the external focusing coil, through which a suitable direct current is passed.

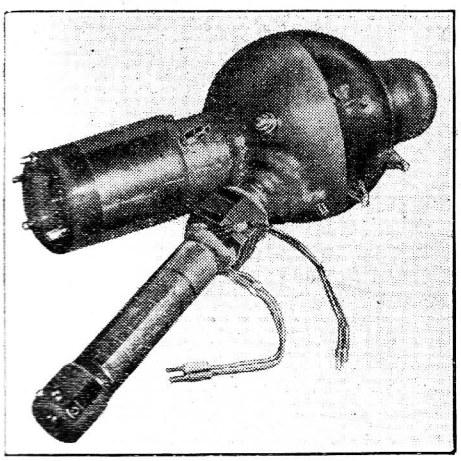
Secondary Emission

Owing to the secondary emissive properties of the mosaic screen material, each photo electron which strikes this screen liberates on an average several secondary electrons. These secondary electrons are attracted to the positive accelerator. The net loss of electrons causes each element of the mosaic to become more positive relative to the backing plate, so that each minute condenser formed by the capacity of each element to the backing plate becomes charged. This charge is proportional to the difference between the number



Occupying a position of advantage, shared with the news-reel teams, practically opposite the Cenotaph, the new television camera is seen in action during the transmission.

[1] *Wireless World*, Nov. 4th, 1937.



A view of the tube used in the Super-Emitron camera. The deflecting coils can be seen around the neck of the lower cylinder containing the cathode-ray gun.

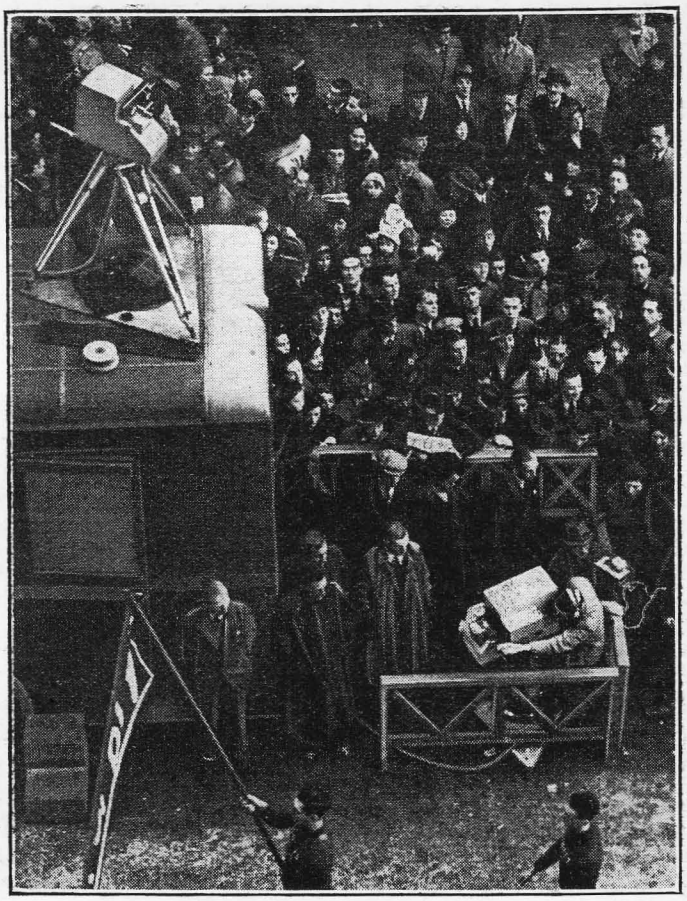
Super-Emitron Camera—

of secondary electrons leaving each element, and the number of primary electrons reaching it from the corresponding point on the photo-electric screen during one frame period. In turn, the number of primary electrons is proportional to the amount of light falling upon that part of the screen. The charge of each minute condenser is thus proportional to the light on the corresponding part of the picture.

The mosaic screen is scanned by the cathode-ray beam, and as each element has a positive charge, owing to its net loss of electrons, it receives electrons from the beam in sufficient quantity to neutralise its charge. As the beam sweeps over the elements composing the mosaic it delivers electrons to the elements in varying quantities which depend upon the magnitudes of their charges, and this varying loss of electrons constitutes a varying current which produces a varying voltage across a resistance in the external circuit. This voltage is applied to a valve and amplified in the usual way.

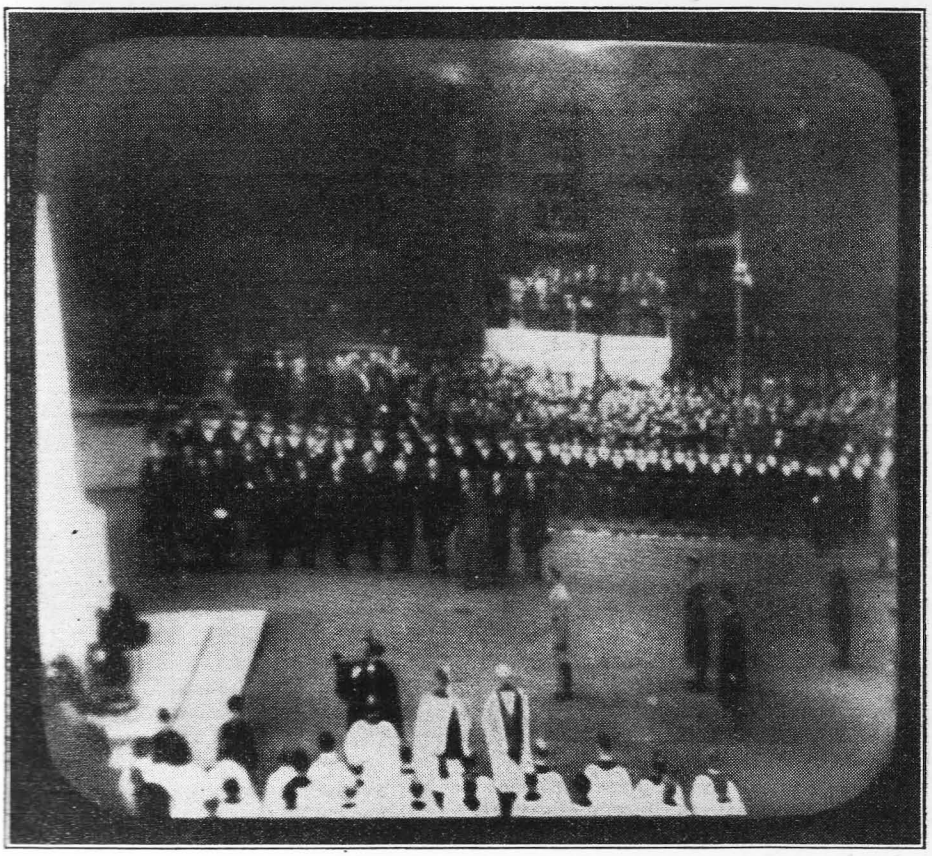
In the ordinary Emitron the picture is focused on the mosaic screen, which is made of photo-electric material, and the charging of the minute capacities takes place because the photo-electric material loses electrons under the influence of light. In the Super-Emitron the photo-electric and mosaic screens are separate and the electrons lost by the former under the influence of light are made to eject a greater number of electrons from the latter by means of secondary emission.

It is easy to see that the separation of the photo-surface from the mosaic brings advantages. The photo-surface may be made transparent so that the limitations placed upon the optical projection system by the geometry of the present Emitron are removed, and lenses of shorter focal length and wider angle of view or telephoto lenses may be used. Further, by making the mosaic from substances having high secondary emission considerable electron multiplication is obtained, thus giving additional sensitivity. Again, the sacrifice of photo sensitivity necessitated by the requirement of inter-element insulation in the case of the photo-electric mosaic used in the old Emitron no longer remains, and full photo-sensitivity can be readily obtained.



The standard television camera is seen overlooking the Super-Emitron at work on close-ups during the Lord Mayor's Show.

The result is that the Super-Emitron is considerably more sensitive than the old Emitron. Because of this, less illumination of the subject is necessary for the attainment of a good picture if the normal aperture lens system is retained. This is especially valuable in outdoor broadcasts on dull days, or when using a telephoto lens for the reproduction of distant scenes. If the normal illumination is retained, however, the aperture of the lens can be reduced, with a consequent gain in focal depth. For studio work this is the more important aspect, and should lead to a great improvement



The benefit of the new camera to viewers was most marked: a greatly improved picture resulted. The reproduction above was made from an untouched photograph of the television screen.

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