Swiss Television Large Screen Projector

By T. M. C. LANCE*

This description is abstracted from a paper by the author on "Some Aspects of Large Screen Television," read before the Television Society on November 28th, 1944

MANY systems of producing large television images suitable in size and of sufficient brightness for presentation in cinema theatres have been proposed.

The Baird Company in London and the R.C.A. in New York, demonstrated before the War, pictures obtained by projecting enlargements of the images formed on the screens of high intensity cathode ray tubes. Because of the high energy concentration and the possibility of light saturation of the fluorescent materials relatively large images were required, necessitating the use of specially designed projection lenses and of spherical mirrors of large aperture.

It has long been realised that there is always the possibility of other principles being employed for the production of large images which might lead to the development of devices which, while being modulated by electronic means, do not in themselves provide the luminous images, but which act as controllers or relays of the light emanating from separate sources. These sources, being fixed, can be of sufficient intensity to meet the requirements of the cinema screen as regards brightness. J. L. Baird in his demonstrations with mirror drum projection used this principle with an apparatus in which the light beam from an arc lamp was passed through a Kerr cell into the projection lens. This was the first practical application of the direct modulation of a light source by an intermediate electronic device to produce a television image.

The Scophony system employed the Debye Sears effect in the same manner, while more recently Donal and Langmuir have demonstrated what they call a new type of light valve dependent in its action on the orientation of opaque particles in a suspension when an electric field is applied to the insulating face of a cathode ray tube.

A. H. Rosenthal has proposed a system of large screen television reception based on the development of opaque areas in microcrystalline layers of ionic crystals under the action of electronic bombardment.

Now comes the description of a very interesting piece of apparatus published by Dr. Fisher of the Swiss Federal Institute of Technology in Zurich* which follows the same general lines.

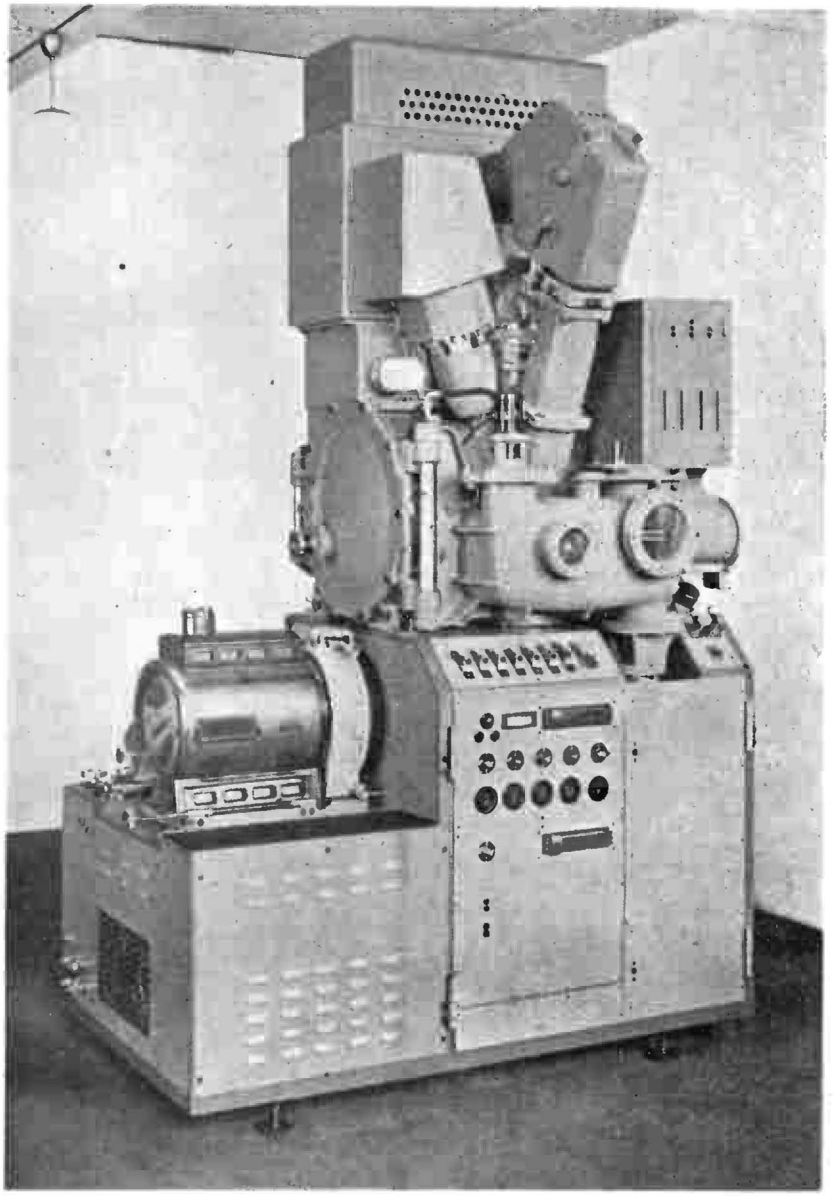


Fig. 1. The large-screen Television Projector developed by the Institute of Applied Physics, Zurich. Total height 8 feet (*from Swiss Technics*).

The principle followed is based on the point to point deformation of the surface of a thin film of liquid by means of electrostatic forces. The light from an arc lamp passing through the liquid film is deflected by the deformation, and by means of an optical system a pencil of light rays proportional in intensity to the degree of deformation and corresponding to each deformed

* Cinema-Television, Ltd.

* Published in "Swiss Technics," February, 1944.

point of the surface is made visible by projection.

A modulated cathode ray beam charges the surface of the liquid with electricity which gives rise to the forces needed to effect the deformation. Fig. 2, taken from the *Swiss Technics*, serves to illustrate the optical system. The liquid film (1) which in the absence of electrostatic forces has a smooth surface, is about 0.1 mm. thick. The film is spread on a glass plate (2) underneath which is a system of lenses (3) which serves to focus the light passing through the slits between the lower bars (4) exactly on to the upper bars (5). All the light rays, a few of which are represented by dotted lines on the right-hand side of the drawing, are consequently intercepted by the upper bars as long as the surface is smooth and undistorted, and hence no light appears on the screen.

The conditions are, however, considerably altered as soon as the surface of the liquid is deformed as is represented on the left-hand group of rays in the diagram by a minute indentation of the surface. All the rays of light which pass through the oblique sides of this indentation are deflected in proportion to the depths of this indentation and are able to pass between the upper bars and thus form a bright point in the television image. This figure also shows the complete schematic arrangement of the projector. It will also be seen that there is an electron gun (6) with magnetic focusing and deflecting fields (7) and (9) which scan a very finely focused electron beam over the surface of the liquid.

Fig. 2. Schematic diagram of the large-screen Projector.

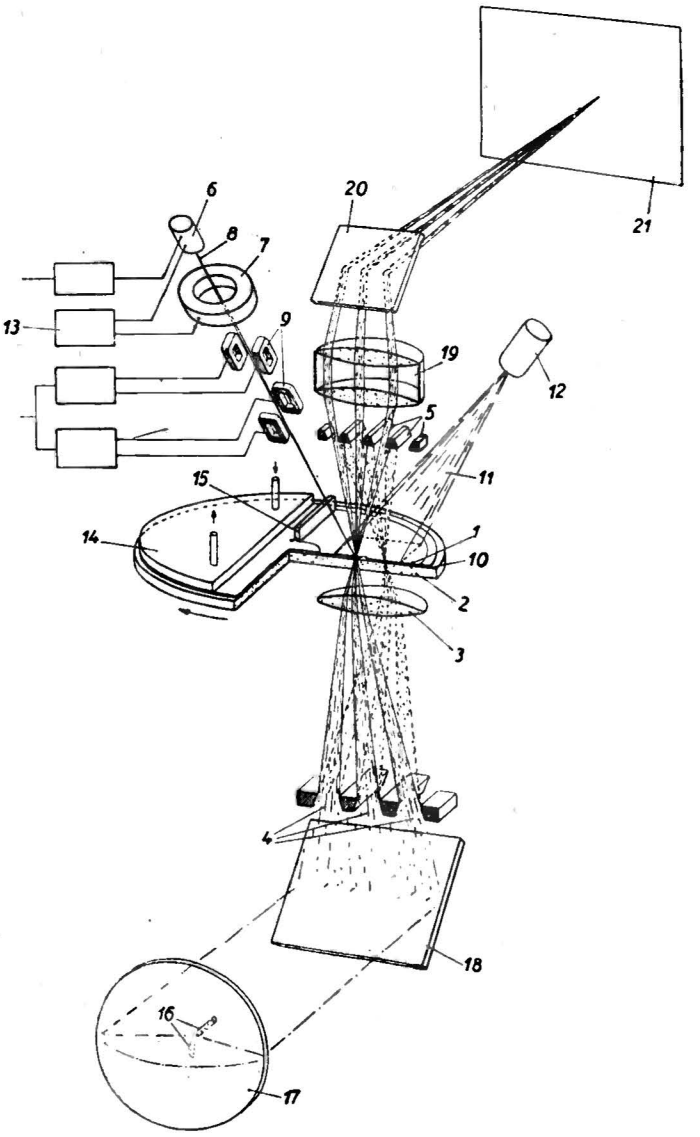


Fig. 3 (*bottom left*). Lower bars of the optical system with water cooling.

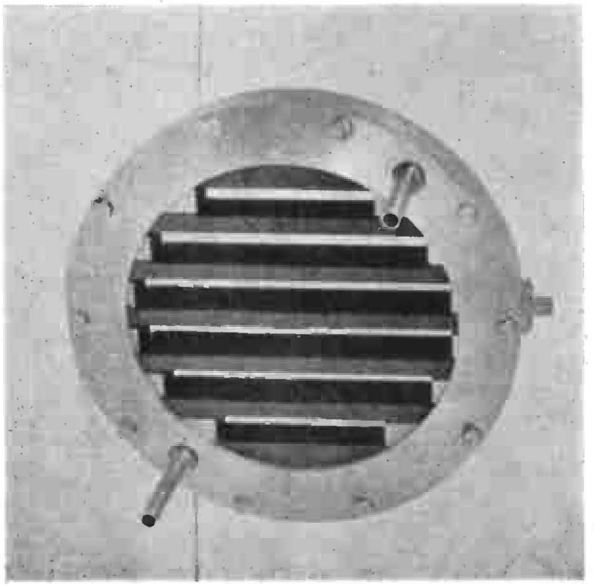
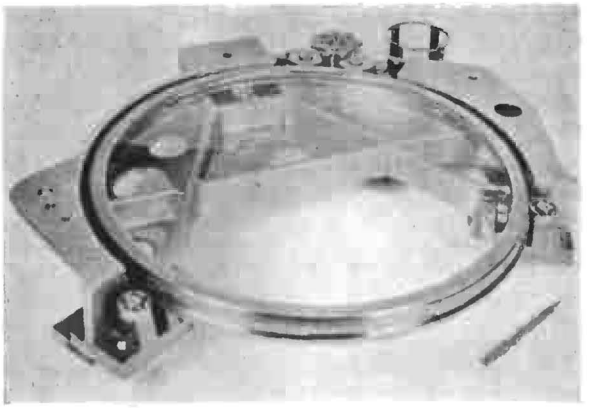


Fig. 4 (*bottom right*). Rotatable glass plate carrying the light control liquid. An idea of the size can be obtained from the propelling pencil in the foreground (*from Swiss Technics*).



During the scanning the beam is intensity modulated by the incoming signals which are applied to the tube as a modulation of a carrier frequency of 7.5. megacycles. In this way the surface of the liquid receives a charge image corresponding to the television image.

It is stated that the average beam current is only 20 microamps at 10 kV. which produces only a small charge at any point on the surface of the liquid with the result that a sufficiently deep indentation can only be obtained by adopting two further measures. Firstly, a thin transparent electron-conducting film (10) is deposited on the glass plate which acts as a counter-electrode for the charge existing on the surface of the liquid, and secondly, by supplying a uniform flood of electrons (11) from the gun (12) over the whole surface of the liquid.

In addition to all this elaboration the liquid is made semi-conducting so that the charges are dissipated within the time of picture repetition in order that the surface may be smooth again for the succeeding image, which is stated to be 1/50th second.

On studying the diagram further complications are noted. In the first place the whole of the above described processes occur in the vacuum of very high degree, so that the apparatus has to be continuously evacuated by pumps contained in the lower compartment of the instrument. The glass plate is rotated slowly and continuously in order to bring the film liquid under the cooling plates (14) where it loses the heat produced by the projection of the image of the arc crater. On leaving the cooling plate the liquid has to be scraped smooth by squeegee (15) and so made ready for further exposure.

No mention is made in the article in *Swiss Technics* as to any pictorial results, to the degree of contrast obtainable, or to the screen illumination realised with the apparatus.

The photographs of the completed apparatus and of the individual components, two of which are reproduced here, show the high degree of mechanical skill which has been expended in the fabrication of this instrument, and it is therefore, all the more disappointing that no indication is given of its performance.

A NOTE ON PHOTO-CELL NOMENCLATURE

By Dr. W. SOMMER

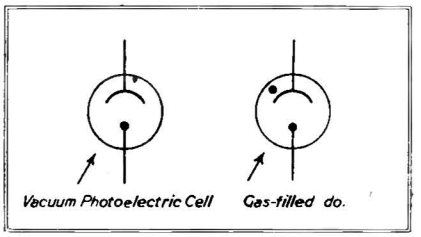
IN the writer's opinion many of the terms defined in B.S.S. 205 (part 6, Sec. 8, 1943) relating to photo-electric cells are ambiguous and misleading.

The word "photo-emissive" for example, means "light-emissive," but this type of cell does not emit light but electrons. "Photo-voltaic" does not relate to a voltaic cell, as the name might imply.

This term was rightly used by Becquerel[1], Sabine (1878), and Minchin (1893) because their particular type of light-sensitive cell was of the liquid electrolyte type, exactly as was Volta's cell.

The term "photo-voltaic" cell is, however, not confined to this group in modern practice but relates to cells described by the term "rectifier photo-electric cell."

A very good suggestion has been made for what is known in recent literature as the photo-voltaic cell. Sharp[2] suggested in 1935 making use of the term "Photo-e.m.f. cell," which is not only correct from the physical point of view but is also descriptive



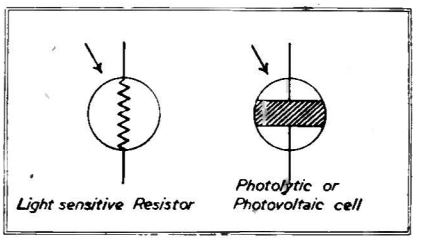
and euphonic. The photo-voltaic cell commands a greater variety of terms than any other photo-electric device; for example:—

Dry-disk cell, Rectifier cell, Blocking-layer cell, Boundary-layer cell, Insulating-layer cell, Barrier-layer cell, Sandwich cell, Photo e.m.f. cell, Self-generating cell, Sperrschicht-cell.

It is suggested that photo-emissive cells might best be defined by the terms "vacuum photo-electric cell" and "gas-filled photo-electric cell," as the case may be. Photoconductive cells should not be termed "cells" but rather, and more appropriately, "light-sensitive resistors," the word "light" replacing "photo" in order to mark the difference.

Finally, the following terms are put for criticism and discussion:—

Old Terminology	*Suggested Terminology*
Photoemissive cell	Vacuum photo-electric cell
	Gasfilled photo-electric cell



Photovoltaic cell	Photo-e.m.f. cell
Photoconductive cell	Lightsensitive resistor
Photoelectrolytic cell	Photovoltaic cell (or) Photolytic cell

In the defence and favour of the above terms it may be said that

(1) each of them is a complete and unambiguous term referring to the controlling (radiant energy) as well as to the controlled agent (electric energy) and describing unmistakably the type of cell and the type of action taking place in it;

(2) they are short terms and easily recognized as what they are intended to represent.

Symbols

Agreement, or approximation to it, has been reached on the symbol for vacuum and gasfilled photoelectric cells (Col. 2). The other types of cells are represented by symbols which vary as much as the fancy of their inventors. Although the author feels he may be guilty of the same offence when suggesting new type symbols he ventures to proffer the ones shown in the text. These are self-explanatory; the arrows indicate the general direction of the incident radiant energy and are part of the symbol. The direction of incidence is essential in the case of photo-e.m.f. cells for obvious physical reasons, and necessary in the case of light-sensitive resistors as otherwise this symbol might be mistaken to represent a barretter. In the case of vacuum or gasfilled photo-electric cells they have been inserted for uniformity.

REFERENCES.

1 Edm. Becquerel, Comp. rend., 1839; 9; 561.
2 Clayton H. Sharp, J.O.S.A., 1935; 25; 165.