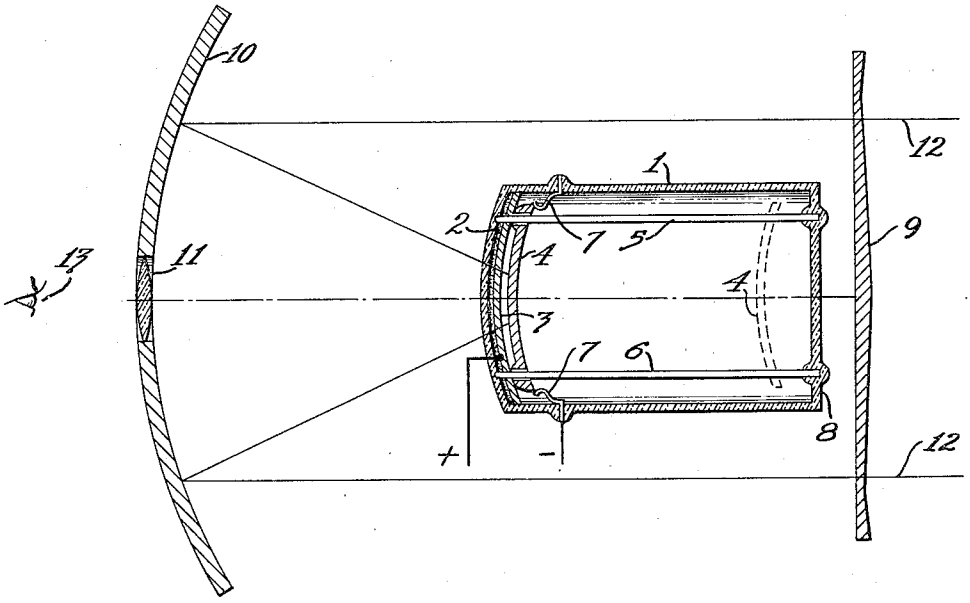
Dec. 6, 1949 F. H. NICOLL 2,490,740

IMAGE TUBE

Filed Sept. 6, 1946



Inventor
Frederick H. Nicoll

By
William A. Zalesak
Attorney

Patented Dec. 6, 1949 2,490,740

UNITED STATES PATENT OFFICE

2,490,740

IMAGE TUBE

Frederick H. Nicoll, Princeton, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application September 6, 1946, Serial No. 695,151

3 Claims. (Cl. 250—165)

1

This invention relates to tubes having fluorescing screens and adapted to reproduce images of objects where there is insufficient light for the eye to satisfactorily see the objects. The tubes embodying the invention are particularly useful for observing objects by means of infra red, or near infra red energy reflected into the tube by the objects. The invention is also useful for seeing through fog and smoke screens.

In tubes heretofore used for producing images in twilight or darkness the photocathode has either been made transparent to the incident energy so that photoelectrons from the sensitized surface may be free to move to the fluorescent screen as disclosed in Patent 2,131,185 to Knoll, September 27, 1938, or else the photocathode has been made of sufficiently reduced size to permit the image to be observed by the light passing to the observer's eye around and outside the photocathode as disclosed in Patent 2,153,614 to Coeterier et al.

A transparent photocathode reduces the photoelectron emission and therefore the intensity of the luminescent energy of the screen, and providing a space outside the photocathode for passage of the light from the screen either unduly reduces the size of the photocathode or else increases the size of the tube to an unwanted degree.

It is an object of this invention to provide an adequately thick photocathode in a receiving tube and to use a thin enough fluorescent screen to permit the incident radiant energy to pass therethrough to reach the photocathode.

Other objects of the invention will appear in the following description reference being had to the drawing in which the single figure of the drawing is a section of a tube illustrating the application of the invention.

Referring to the drawing, the tube comprises an evacuated glass envelope 1 on the inside end surface of which is a transparent anode film 2 and adjacent this film is a thin transparent film of fluorescent material 3. Various ways may be employed to apply the film 2 and fluorescent material 3 but a satisfactory way is to sputter a very thin metal film on the inside surface of the tube end and then a thin transparent film of zinc fluoride with manganese activator is evaporated and condensed on the glass end and film 2.

A photocathode 4 is formed on a foundation of metal or other material of adequate thickness to provide a copious emission of photoelectrons with this thickness the photocathode would be opaque, but this is satisfactory because in my

2

improvement the light does not pass therethrough. This photocathode should be very close to the anode film 2 so that the electrons emitted from the photocathode will not be dispersed but will land on the fluorescent screen in focus without use of a focusing field. Since the photocathode as usually constructed of silver oxide has to be activated by caesium vapor a space must either be provided between the screen 3 and photocathode, or else the photocathode must be movable into position after activation has been accomplished. The drawing illustrates a movable photocathode which is movably supported on, say, four rods, two of which, namely, 5 and 6, appear in the figure. During activation the photocathode 4 is in the position at the right of the figure as shown in dotted lines. After activation the photocathode may be slid axially of the tube into the position shown in full lines where it will be held by wire clips such as 7 sealed in the envelope. The rods may be sealed in the envelope end 8 and in the other end also if desired.

The tube may be used in the well known Schmidt optical system containing the corrector plate 9 and reflector 10 which may be associated with an optical unit typified by the lens 11 at its center.

The anode film 2 may be connected to a sealed-in-wire for connection to a positive terminal of voltage supply and the photocathode may be connected to the negative terminal as by one of the clips 7. Other than this no electrical connections are required as neither electromagnetic nor electrostatic focusing is necessary.

In explanation of the operation, the incident energy, say infra red, as at 12 passes through the corrector plate 9 to the mirror 10 and is brought to a focus on the photocathode through the transparent anode film 2 and fluorescent screen 3. Photoelectrons are emitted by the photo-cathode in proportion to the incident energy of the image and these are accelerated to the adjacent fluorescent screen by the conducting film 2 and the luminous image produced thereby may be observed by the eye of the observer as at 13 through lens 11.

By use of a transparent fluorescent screen the image tube may be made of minimum size with no electrical connections except between the accelerating anode film 2 and the photocathode 4. The image tube thus is particularly adapted for field use with a small compact battery power supply.

Various modifications of the improvement may

be made without departing from the spirit of the invention.

What I claim as new is:

1. An electron image tube comprising an evacuated envelope having a transparent end, a transparent accelerating anode on the inner surface of said end, a transparent fluorescent screen on said anode and an opaque photo-cathode closely adjacent said fluorescent screen adapted to receive radiant energy through said anode and screen.

2. An electron image tube comprising an avacuated transparent envelope, a transparent accelerating film anode on the inner surface of one end, a transparent fluorescent screen on said anode film and an opaque photo-cathode adapted to receive radiant energy through said film anode and said screen, said photo-cathode being sufficiently close to said screen to focus thereon the photo-electrons emitted by the photo-cathode.

3. An electron image tube comprising an evacuated envelope having a transparent end, a transparent accelerating anode on the inner surface of said end, a transparent fluorescent screen on said anode and an opaque photo-cathode for receiving light energy through said fluorescent screen, and means holding the photo-cathode closely adjacent the fluorescent screen.

FREDERICK H. NICOLL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,724,298	Miller	Aug. 13, 1929
2,039,134	Waldschmidt	Apr. 28, 1936
2,060,977	De Boer et al.	Nov. 17, 1936
2,177,360	Busse	Oct. 24, 1939
2,258,436	Von Ardenne	Oct. 7, 1941

FOREIGN PATENTS

Number	Country	Date
366,883	Great Britain	Feb. 11, 1932