Aug. 31, 1937. J. KESSLER 2,091,862

PHOTOELECTRIC IMAGE CONVERTER

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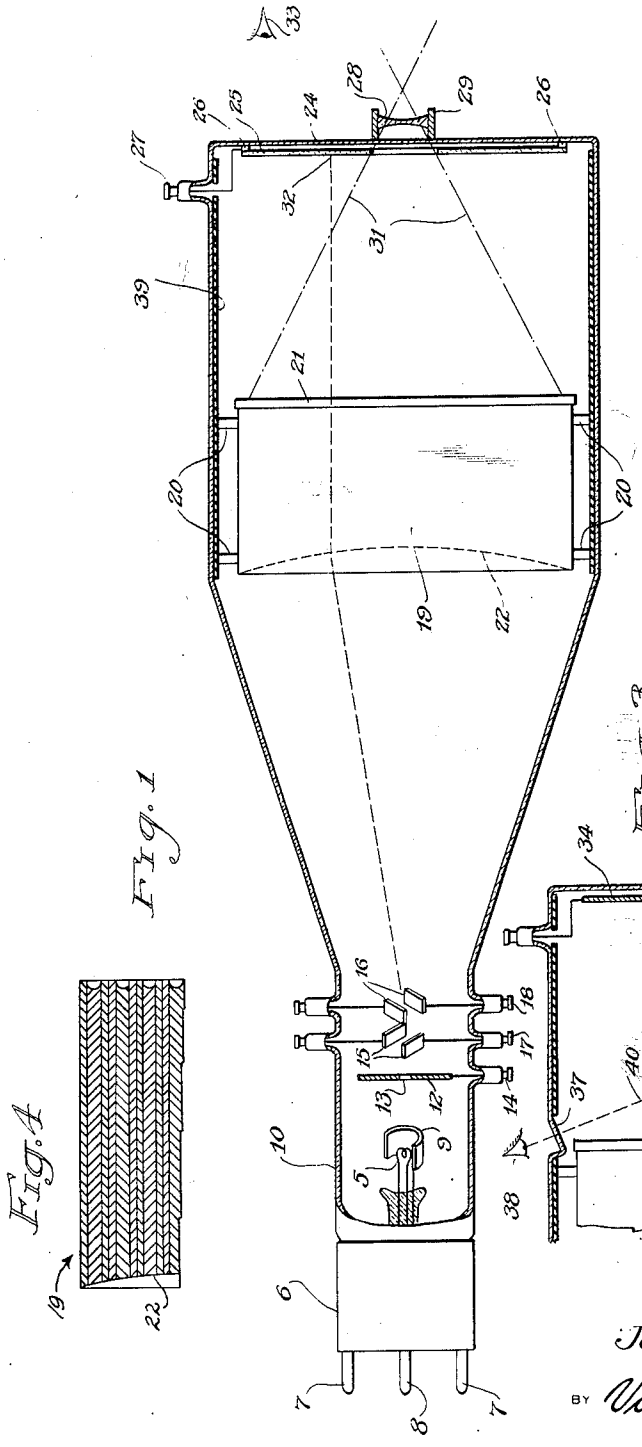


Fig. 1

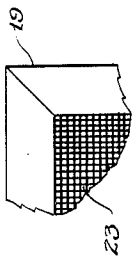


Fig. 2

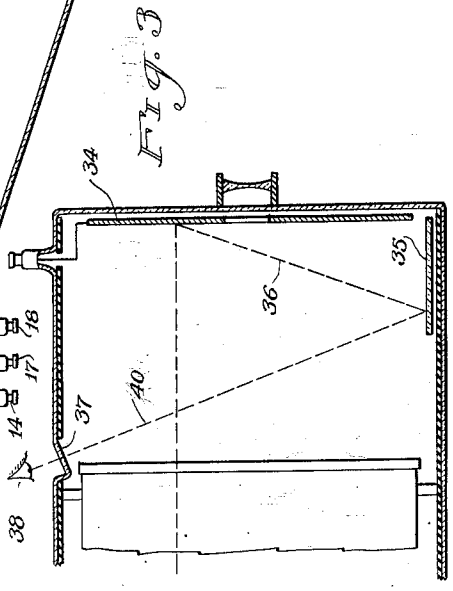


Fig. 3

Fig. 4

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PHOTOELECTRIC IMAGE CONVERTER

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5 Claims. (Cl. 250—27.5)

The present invention pertains to a photo-electric image converter of the type wherein an invisible light ray is transmitted to a cathode ray commutator transmitter block so as to form a visible image that may be observed with the naked eye.

The primary object of the invention is to provide in a single cathode ray tube an improved means for converting in successive order a light image falling upon a specially constructed screen, into a free electron image and reconverting the latter image in a correspondingly successive order into a visible image that may be observed with the naked eye.

A further object of the invention is the provision of an improved cathode ray tube having a commutator transmitter block and its special adaptation to the use of invisible light as in ultra-violet photo-micrography.

A further object is to provide a means for utilizing ultra-violet light in microscopy or in magnifying an object and translating the magnified image into an image visible to the naked eye without the necessity of photographing the ultra-violet image.

A still further object of the invention is to facilitate and extend the use of ultra-violet light by providing an improved means of finding the focus in a system of lenses for ultra-violet photo-micrography by translating an image of ultra-violet light into an electron image and reconverting the latter image into a visible image so that all images of the original object are correspondingly clear and defined in relation to the sharpness of the focus.

The invention will be fully and comprehensively understood from a consideration of the following detailed description when read in connection with the accompanying drawing which forms part of the application.

In the drawing:

Fig. 1 is a view of the improved tube, partly in section, partly in elevation, and partly broken away, the tube being shown as used for converting a photo-electric image.

Fig. 2 is a fragmentary elevational view of the right end of the commutator block.

Fig. 3 is a fragmentary sectional view of a modified form of tube.

Fig. 4 is a fragmentary sectional view of the commutator block.

Referring to the drawing for a more detailed description thereof, the numeral 5 indicates an incandescible filament adapted to serve as the cathode ray source. The base 6 of the cathode ray tube has extending therefrom prongs 7 which serve as terminals for the filament 5 and a prong 8, which also projects from the base 6 is the terminal of a well-known Wehnelt control cylinder 9 which encircles the filament 5.

A sealed bulb or envelope 10 is held in the base 6 and contains the parts illustrated as being therein, said bulb being evacuated of air and filled with ionizable gas. The gas contained within the envelope 10 may be, for example, argon at a few millimeters of mercury pressure.

An electrode 12 is positioned within the tube in front of the filament 5 and has a central aperture 13 thru which the cathode rays may pass. The electrode 12 has a terminal 14 positioned outside of the envelope 10, as shown, and is to be charged with a positive potential at, for example, three or four thousand volts, in order to give a high velocity to the cathode rays. Two pairs of deflector plates 15 and 16, respectively, are contained within the bulb 10 in front of the electrode 12 and positioned at right angles to each other. Each of the deflector plates 15 and 16 are provided with terminals 17 and 18, respectively, which terminals are exterior of the envelope or bulb 10. The deflector plates 15 and 16 and their operation in the cathode ray tube are well known, and are for the purpose of deflecting a cathode ray so that it may be directed to predetermined positions when charged respectively to varying potentials, the varying potentials of each pair being out of phase with the other pair, as is well known.

Spaced from and positioned in front of the deflector plates 15 and 16 and in the forward position of the envelope 10 is a commutator block 19 being held in spaced relation to the wall of the tube by means of insulators 20. The commutator block 19 is preferably rectangular faced in shape and has a plain front face 21 and a concaved rear face 22, upon which latter face the cathode ray falls. The concaved face 22 presents a spherical surface so formed that the ray may be normal at all times to the portion of the face on which it falls. The block 19 includes a plurality of straight electrical conductors 23 suitably insulated from each other and formed of any desired material, such for example as clean aluminum or copper wire, each wire individually insulated from the other. It is to be understood, however, that the ends of the conductors or wires 23 are not insulated but are instead bare and exposed and the forward ends, that is, those which lie in the forward face 21, constitute minute photo-electric surfaces. In the present

invention these forward ends of the conductors 23 are devised to act as minute photo-electric surfaces sensitive only to invisible light, and in this instance the ends of these conductors are by preference of the same metal as the conductors proper, that is aluminum.

In the preferred form of the invention, the interior side of the front face 24 of the tube is suitably coated preferably with a thin layer of Willemite 25 which is a fluorescent substance and is adapted to receive the electrons emitted from the commutator block 19 which will be hereinafter described. Although a Willemite substance is used for coating the face of the tube, it is to be understood that any fluorescent substance that is electrically conductive and partially or completely transparent may also be applied. A thin, flat and narrow conductor ring 26 is interposed between the front face 24 and the coating 25 of the Willemite or other suitable fluorescent substance and said conductor ring is provided with a terminal 27 adapted to be charged to a high positive potential of, for example, one thousand volts, from any suitable source, such as a rectifier.

A lens or system of lenses 28 may be suitably secured to the exterior end of the tube 10, and through the lens 28 a light image may be thrown on the face 21 of the block 19. It is to be understood that an optically transparent substance such as quartz is to be employed in the lens 28 with the use of ultra-violet light or some other substance sufficiently transparent to the ultra-violet light.

It is desired to herein point out that the more economical the space between the fluorescent screen 25 and the front face of the block 19, the clearer will be the fluorescent image. The coating of the inner surface of the end 24 of the envelope 10 partially accomplishes this purpose. In order to economize upon this space an expedient method which yields the added advantage of viewing the fluorescent image directly and more squarely is indicated in the drawing. The Willemite coating serves both as the highly positively charged plate and also as the fluorescent substance. The fluorescent image produced in this case is visible from the exterior wall of the envelope 10 and may be seen with the naked eye without the aid of any lens system.

In the use of the herein described tube a microscope or the like from which an image is to be converted is positioned in close proximity to the end 24 of the tube. With the use of ultra-violet light which is projected from the object on the slide of the microscope to the tube an action is obtained, similar to the action of a photo-electric emissive tube, wherein, as long as light is incident upon the cathode and the cathode is in contact with a source of supply of electrons, photo-electrons will be caused to leave the cathode surface and travel to the anode of the photo-electric tube. In the tube herein described, the Willemite surface 25 is the common anode to all the ends of the conductors or wires 23 in the forward end of the block 19. Each end of the conductors or wires is a photo-electric cathode surface upon which an elemental area of the light constituting the image falls. The conductors are connecting wires of these cathode ends and the cathode beam, striking any one of these wires is by the charge the beam carries, a source of electron supply with which the corresponding cathode end is in contact thru the body of its wire, it being understood that the ends of the conductors are not insulated to contact with the cathode beam as well as to the incident light. The numeral 31 indicates the range of rays from the ultra-violet system which impinge upon the front face of the commutator block 19, and the point at which the photo-electrons emitted from the commutator block strike the Willemite screen, thereby producing a fluorescent image at that point, is indicated by the numeral 32. Since the screen 25 is readily fluorescent the image produced at any point thereon will be readily visible to the naked eye, 33.

It is also to be understood that the cathode beam falls on the conductors 23 successively, that is, on one conductor at a time, and never contacting two conductors at one time, moving then to an adjacent conductor as controlled by the charged deflector plates 15 and 16, respectively, the electrons from the corresponding photo-electric ends being thereby successively released and caused under high positive potential to travel at increased velocity to the fluorescent screen 25.

The photo-electrons travel directly to the Willemite substance 25, and the density of the electrons from any one conductor end is directly proportional to the intensity of light falling upon the end cathode of each wire in the forward end of the block 19. Upon striking the substance 25, the electrons will cause the Willemite to fluoresce with an effective intensity which is directly proportional to the density of the photo-electrons at that point, since the exerted positive potential of plate 25 upon all electrons is the same. Since the densities of the electrons correspond to the elemental intensities of light coming from the object and focused upon the forward end of the block 19, a corresponding fluorescent image will be produced upon the layer of Willemite evolved in a successive order due directly to the movement of the cathode beam. The fluorescent image will be visible to the naked eye indicated at the point 33 in the drawing.

In some instances it may be desirable to insulate the forward inner wall of the envelope 10 as indicated at 39 so as to obtain the full effect of the emitted photo-electrons.

In the modified form illustrated in Fig. 3 of the drawing, the fluorescent image is focused from the Willemite substance to a mirror which may be observed from a convenient position. In the modified form a metal plate 34 is coated with Willemite and the image received from the conductors is directed downwardly to the mirror 35 as indicated at 36. The mirror is positioned at right angles to the coated plate and the image is reflected from the mirror to a lens or system of lenses 37 positioned in the surface of the envelope 10. The course of the reflected visible ray from the mirror to the eye 38 is indicated at 40.

It is to be understood that the tube herein described is applicable to the use of the ultra-violet spectrum since visible fluorescence must not effect the photo-electric ends of the wires in the forward end of the block 19 lest the visible fluoresence on the Willemite plate fog the electron image.

What I claim as new is:

1. A cathode ray tube comprising, a source from which a cathode beam may emanate, a block of electrical conductors insulated from each other, said conductors at one end being exposed to said beam, deflecting means for scanning said beam, means for directing an invisible image onto the other ends of said conductors, said last ends being photo-sensitive, and means for receiving an

electronic image produced by said photo-sensitive ends and thereby converting said electronic image into a visible image.

2. A cathode ray tube comprising, a source from which a cathode beam may emanate, a block of metallic conductors insulated from each other, said conductors at one end being exposed to said beam, deflecting means for scanning said beam, means for transmitting an image produced by ultra-violet light and directing said image on the other ends of said metallic conductors whereby an electronic image is emitted therefrom, and a fluorescent screen adjacent said ends for rendering said electronic image visible.

3. A cathode ray tube for receiving images produced by ultra-violet light comprising, a source from which a cathode beam may emanate, a block of metallic conductors insulated from each other, said conductors at one end being exposed to said beam, deflecting means for scanning said beam, means for directing an invisible image onto the other ends of said conductors whereby an electranic image is emitted therefrom, and a fluorescent screen facing the ends of said conductors for rendering said electronic image visible.

4. A cathode ray tube comprising, a source from which a cathode beam may emanate, a block of electrical conductors insulated from each other, said conductors at one end being exposed to said beam and the other ends adapted to give off electrons when ultra-violet light falls thereon, deflecting means for scanning said beam, means within said tube and facing said other ends having a coating of fluorescent substance, means for directing an invisible image onto the other ends of said conductors whereby photo-electrons emitted therefrom are received on said fluorescent substance, means for reflecting the image from said fluorescent substance, and means for viewing said reflected image.

5. A cathode ray tube for receiving images produced by ultra-violet light comprising, a source from which a cathode beam may emanate, a block of electrical conductors insulated from each other, said conductors at one end being exposed to said beam, deflecting means for scanning said beam, a metallic plate positioned within said tube and adjacent the forward end thereof and having a fluorescent substance coated thereon, means for directing an invisible image onto the other ends of said conductors, said last ends being photo-sensitive, means for directing an invisible image onto the other ends of said conductors whereby photo-electrons emitted therefrom are received on said fluorescent substance, means for reflecting the image from said fluorescent substance and means for viewing said reflected image.

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