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ELECTRON DISCHARGE DEVICE

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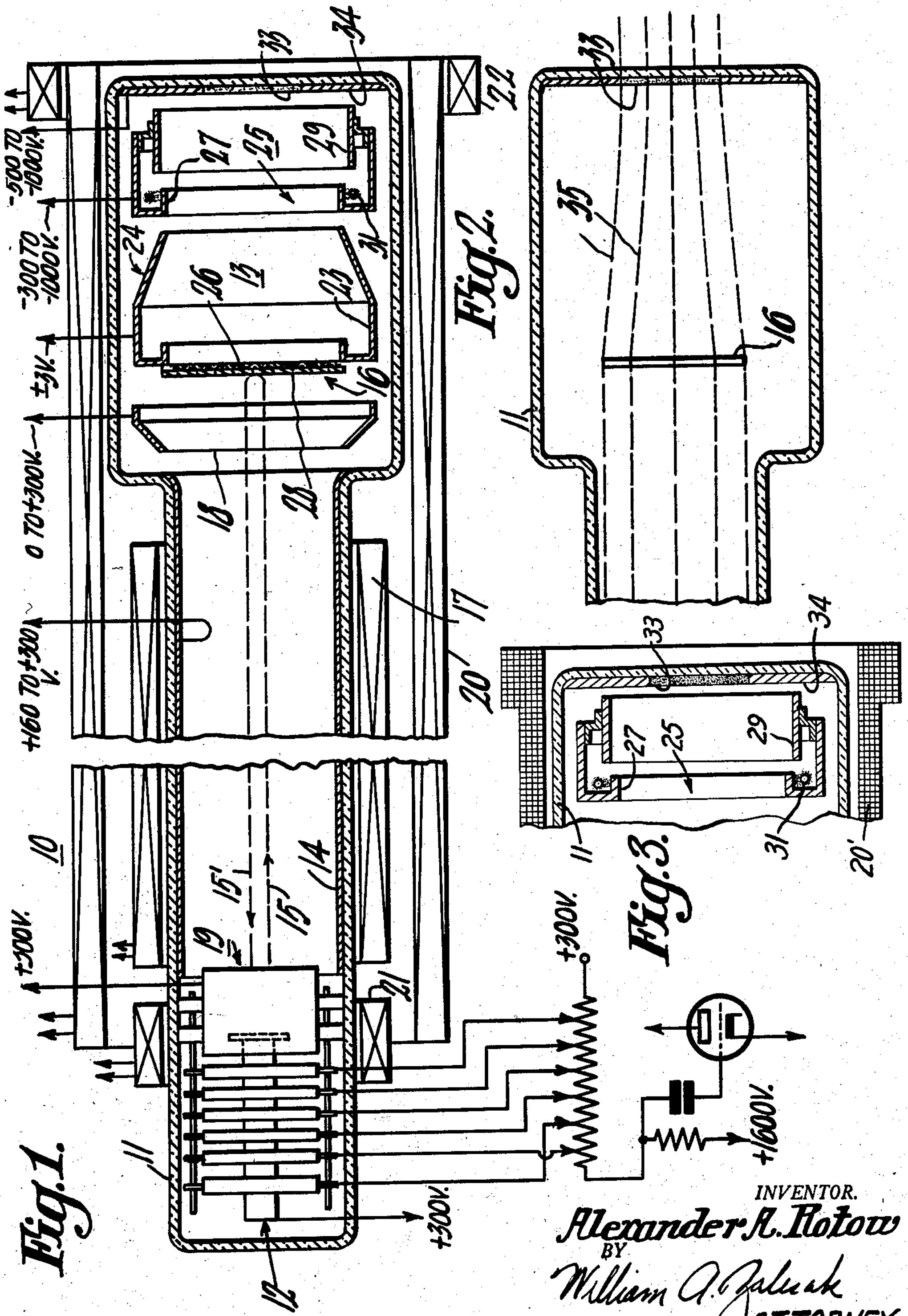

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ELECTRON DISCHARGE DEVICE

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This invention relates to television pickup, or camera tubes. In particular this invention relates to an improved image orthicon type of television camera tube.

An image orthicon tube normally includes, within an evacuated envelope, an electron gun for producing an electron beam. The electron beam is directed upon one side of a storage target. Within the other end of the envelope is a photocathode the photoemission from which is directed onto the other side of the target to produce charge patterns on the target that are discharged by the electron beam to provide output signals from the tube.

When utilizing an image orthicon type of camera tube, there are instances when it is desirable to obtain greater resolution of the scene being televised than has been possible heretofore. It is known that the resolution of the image orthicon type of tube is limited primarily by the size of the target rather than the size of the photocathode. One solution to this resolution problem has been to utilize an image orthicon having a target and photocathode of greater diameter. However, when utilizing photocathodes of larger diameter it is necessary to utilize a camera lens system, which includes expensive lenses such as the telephoto and zoomer lenses, of a size to match the larger photocathode. This increased size of lens system is considerably more expensive than the equivalents in the smaller universally used size of lens systems.

It is therefore an object of this invention to provide an improved image orthicon type of tube having improved resolution.

It is another object of this invention to provide a new and improved image orthicon type of tube which can be used with relatively inexpensive lens systems and one which has improved resolution.

These and other objects are accomplished in accordance with this invention by providing an image orthicon type of pickup tube comprising an evacuated envelope. In one end of the envelope is an electron gun and an electron multiplier section having a conventional dynode structure. In the central portion of the envelope there is provided a scanning section which may comprise deflection and focus coils adjacent to the tube as is well known. Within the other end of the envelope there is provided an image section including a target and photocathode. The size of the target is large as compared to the size of the photocathode. In order to magnify the electron picture between the small photocathode and the relatively large target, a magnetic field is provided which has an intensity that is greater at the photocathode than at the target. The lines of force of the magnetic field are substantially without bends so that a smooth transition from the smaller photocathode to the larger target is provided. Also, a tube in accordance with this invention includes a conical shield and a cylindrical shield both of which are provided to produce a smooth transition of electric fields between the small photocathode and the larger target.

The novel features of this invention are pointed out in the appended claims. The invention itself will now be

described in greater detail in connection with the accompanying single sheet of drawings, wherein:

Figure 1 is a partial sectional view of an image orthicon type of tube in accordance with this invention,

Figure 2 is a fragmentary schematic view showing of the magnetic fields produced in the tube shown in Figure 1 and;

Figure 3 is a fragmentary sectional view of an embodiment of the invention.

Referring specifically now to Figure 1 there is shown a partial sectional view of an image orthicon type of tube **10** in accordance with this invention. Generally, the image orthicon tube **10** comprises an evacuated envelope **11** having an electron gun assembly **12** in one end of the envelope. The electron gun assembly **12** includes a conventional heater, cathode, control grid and accelerating electrode structures (not shown) for producing an electron beam **15**. Surrounding the gun **12** is an electron multiplier structure **19**. An additional accelerating electrode **14** is formed as a wall coating on the inner surface of the envelope. The accelerating electrode **14** is utilized for accelerating the electron beam **15** toward a target electrode **16** enclosed within an image section **13**.

Pairs of horizontal and vertical deflection coils are formed into a yoke structure **17** surrounding the tube envelope **11**. The deflection coils provide fields perpendicular to each other and to the axis of the envelope **11** and are connected to appropriate sources of potential (not shown) for providing frame and line scanning of the electron beam **15** over the surface of target **16**. Such deflection systems are well known and further description thereof is not deemed necessary.

Surrounding the envelope **11** is a focus coil **20** for providing a magnetic field having lines of force substantially parallel to the axis of the tube **10** and extending from the end of the electron gun structure **12** to the opposite end of the image section of envelope **11** as shown. During tube operation, the field produced by focus coil **20** provides a focusing action on the electrons of beam **15** to bring these electrons to a well defined point of focus on the target **16**. Also surrounding the envelope, and adjacent to the gun **12**, is a compensating coil **21** having a field perpendicular to the axis of tube **10**. By adjusting coil **21** around the axis of tube **10**, any slight miscentering of the beam **15**, due to mechanical imperfections, can be eliminated. Surrounding the other end of envelope **11** is a divergence coil **22**, in accordance with this invention, the purpose of which will be explained hereinafter.

A decelerator electrode **18**, which is formed as a ring, is mounted immediately in front of target **16** and adjacent the scanned surface thereof.

In the other end of the envelope **11** there is provided an insulating target **16**. The target **16** comprises a sheet **28** of insulating material, such as glass, and a fine mesh screen **26**. Extending from the outer periphery of the target **16** and inwardly toward the other end of the envelope **11** is a target cup **23** that is tubular and has a conically shaped end that decreases in diameter as it extends toward the other end of the envelope **11**. Adjacent to the smaller end of the conical target cup, or electron shield **24**, is supported an accelerator electrode **25** which includes a pair of hollow tubular shaped members **27** and **29**. As can be seen from Figure 1, the hollow tubular shaped members **27** and **29** are spaced apart and electrostatically screen an evaporator filament **31** from the end of envelope **11**. Due to the fact that the tubular members **27** and **29** are spaced apart there is provided a slot between these members through which an alloy material is evaporated from the filament **31** to form a photocathode **33** on the end wall of tube **10**.

Photocathode **33** is a semi-transparent coating of light sensitive, electron emissive material supported on the inner surface of the end of envelope **11** and in contact with a conductive electrode border **34**. One example of a photocathode material is a cesiated layer of silver bismuth alloy.

During operation of tube **10**, photoelectrons are emitted from the photocathode **33**, in response to an image, and are directed toward target **16**. These photoelectrons travel at a high velocity along the magnetic lines of force provided by focusing coil **20** onto the unscanned side of the glass target **16**. These photoelectrons form a positive charge pattern on the unscanned surface of target **16** corresponding to the light density of the original scene projected onto the photocathode **33**.

Assuming a condition when no light is directed onto photocathode **33**, low energy electrons from the primary electron beam **15** land on the surface of target **16** which is exposed to the electron beam, and drive this surface of target **16** substantially to ground, or cathode potential. At this time, the remaining electrons in beam **15** are reflected back, as a return election beam **15'**, toward gun **12**. When a light pattern is directed onto photocathode **33**, the photoelectrons are emitted from each elemental portion of photocathode **33** in an amount proportional to the light and shade of the original scene. The photoelectrons strike the surface of target **16** and initiate secondary emission therefrom. Due to the velocity of the photoelectrons this secondary emission has an emission ratio greater than unity from the bombarded areas, which drives these areas in a positive direction. Due to the thinness of target **16**, with the resulting high capacity between the two sides, the same potential pattern is established on the scanned, or electron gun, side of target **16**. Accordingly, the potential of the scanned surface of target **16** will vary from point to point, from substantially zero volts to several volts positive potential.

When the electron beam **15** approaches target **16**, at a very low velocity immediately in front of target **16**, the beam is reflected back, as return beam **15'**, toward electron gun **12** in the areas which are at zero potential. However, the more positive areas of target **16** cause the electrons from the primary beam **15** to land in sufficient numbers to neutralize the positive potential charge at these areas and thus discharge these areas of target **16** to the potential of the cathode of gun **12**. The remaining electrons of beam **15** are then reflected back toward the gun **12**. In this manner, as the electron beam is scanned over the surface of target **16**, it is reflected toward the gun **12** as a modulated return beam **15'**. The modulated return beam **15'** follows substantially the same path as the incident beam **15** and strikes the end of gun **12** which is formed as a dynode electrode and is the first stage of the electron multiplier section **19**. The multiplier section may be any conventional type where the modulated return beam **15'** is converted into output signal voltages from a collector electrode in the multiplier electrode.

In conventional tubes of this type, the photoelectron image is converged from the photocathode to the target. In other words, the useful area of the target is smaller than the useful area of the photocathode even though physically the photocathode and target are the same size. However, in accordance with this invention the photoelectron image is diverged from the photocathode **33** to the target **16**. Thus, tubes built in accordance with this invention permit the use of a universally used lens system with the relatively small photocathode **33**, in cooperation with the higher resolution of the relatively large target **16**.

The diverging photoelectron path configuration in accordance with this invention is provided by means of a diverging coil **22**, around the image section **13**, which produces a magnetic field density that is greater adjacent to the photocathode **33** than the magnetic field density, provided by focusing coil **20**, adjacent to target **16**. Thus, the magnetic field lines, and the electron paths, diverge from the photocathode to the target. An alternative structure is shown in Figure 3 wherein the focusing coil **20** is wound with a larger number of turns per unit of area near the photocathode **33** than the number of turns around the balance of tube **10**. When this alternative structure is utilized the divergence coil **22** is omitted since its function is replaced by the larger number of turns in the focusing coil **20**.

It can be shown electron optically that, in order to minimize image distortion in a tube of this type, the diverging or spreading of the magnetic lines of force **35**, i.e. the magnetic field which determines the diverging electron paths between the photocathode **33** and the target **16**, should be a smooth flow without sharp bends or strong diversions. To satisfy this condition, and at the same time to obtain considerable image magnification, the distance from the photocathode **33** to the target **16** is greater in tubes built in accordance with this invention than in standard tubes.

Electron optical considerations also show that, in order to minimize image distortion, the electrostatic lines of force, as well as the magnetic lines of force, must be as smooth as possible and free of sharp bends. To achieve this object the conical shaped shield **24** is introduced in accordance with this invention. The conical shaped shield **24** provides a smooth transition of electrostatic lines of force from the target **16** to the accelerator electrode **25**.

An example of specific dimensions of the components involved in this invention is shown below. It should be understood that this is merely an example of a tube which has been successfully operated and the invention should not be limited to this particular example.

	Inches
Diameter of photocathode **33**	1¾
Diameter of target **16**	2¾
Spacing between target **16** and photocathode **33**	3¾
Smallest diameter of cone **24**	1⅛
Largest diameter of cone **24**	2½
Inside diameter of electrodes **27** and **29**	1⅛
Spacing between electrodes	⅛ to 1⁄16

As a result of the diverging magnetic field between photocathode **33** and target **16**, along with the electrode structures in the image section, tubes in accordance with this invention permit the use of the universally used size of lens system coupled with improved resolution.

What is claimed is:

1. A camera tube comprising an evacuated envelope, a target cup supporting a target within said envelope, a portion of said target cup extending inwardly toward the axis of said envelope, a hollow tubular electrode spaced adjacent to the end of said portion of said target cup, a photocathode spaced adjacent to the other end of said hollow tubular electrode, the electron receiving area of said target being substantially larger than the electron emissive area of said photocathode, and means around said envelope for directly focussing an electron image from said photocathode onto said target and for enlarging said electron image from said photocathode onto said target.

2. A television camera tube comprising an evacuated envelope, electron beam producing means in one end of said envelope, a target within said envelope and in the path of the electron beam, a target cup electrode said target being supported across an aperture in said target cup electrode, a portion of said target cup electrode extending outwardly from adjacent the periphery of said target to adjacent the wall of said envelope, another portion of said target cup extending from said point adjacent said wall along said wall toward an end of said envelope and then inwardly toward the axis of said envelope, a hollow tubular electrode spaced adjacent to the smaller end of said other portion of said target cup, a photo-

cathode on said end of said envelope, said target being substantially larger in electron receiving area than said photocathode is in electron emitting area, a focusing coil around said envelope and extending at least between said target and said photocathode for focussing an electron image from said photocathode directly onto said target, and a divergence coil around said focusing coil adjacent to said photocathode for enlarging said electron image from said photocathode onto said target.

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