

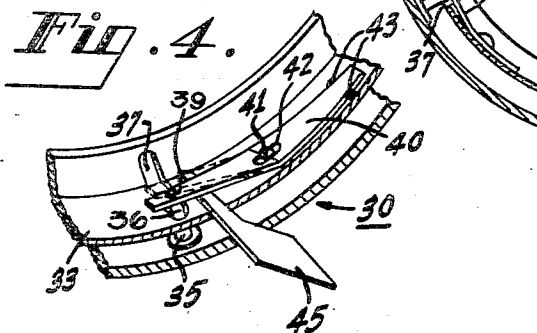
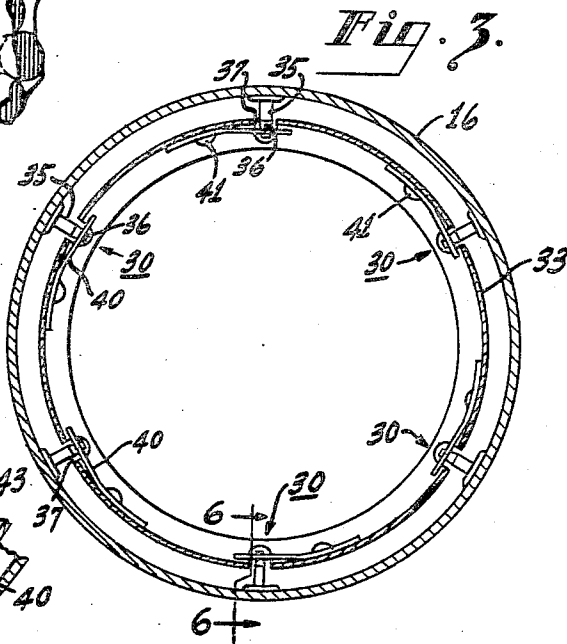
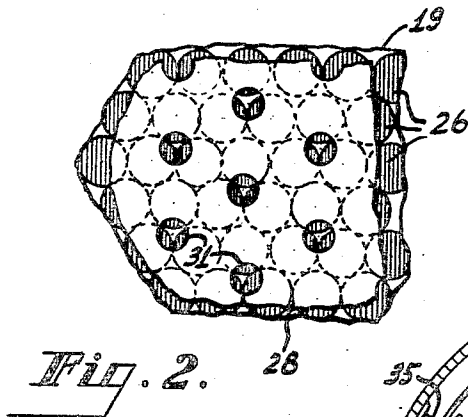
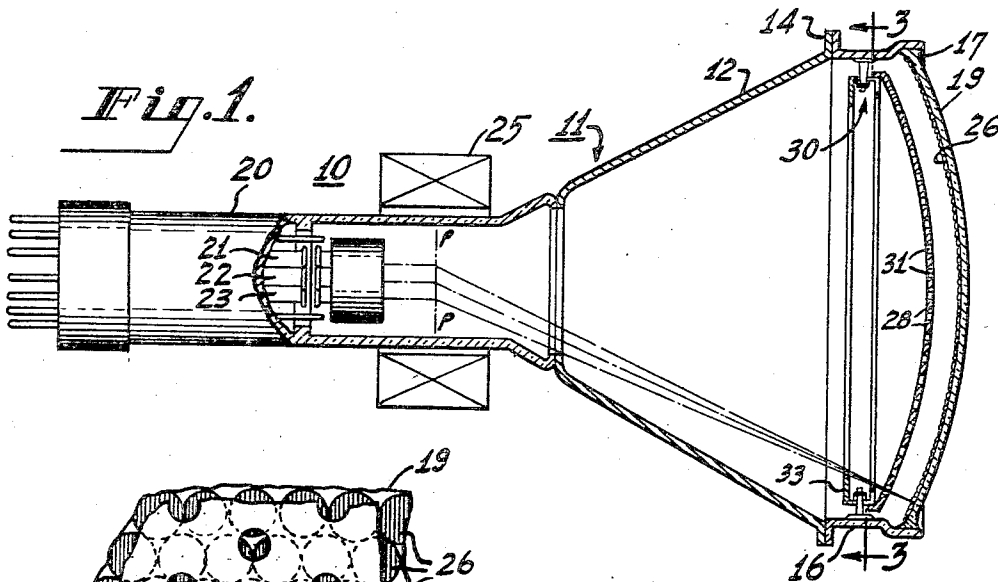
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CATHODE-RAY TUBE

2,846,608

Filed Sept. 14, 1954

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

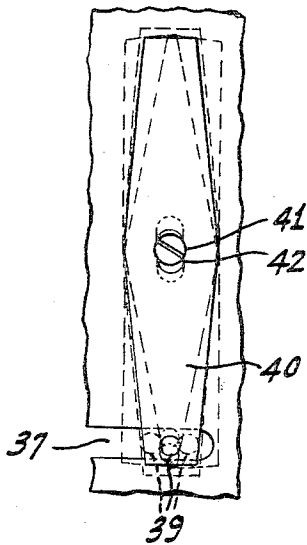


Fig. 5.

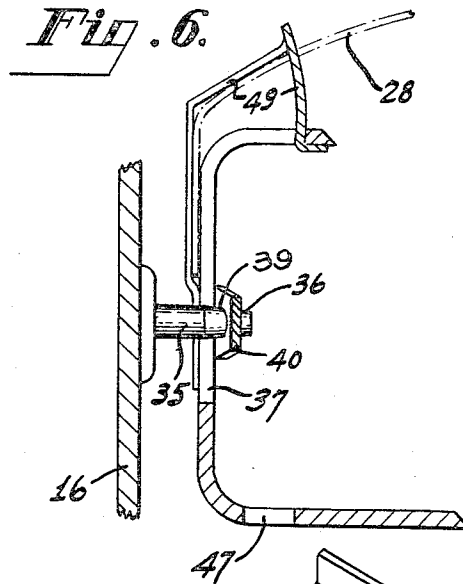


Fig. 6.

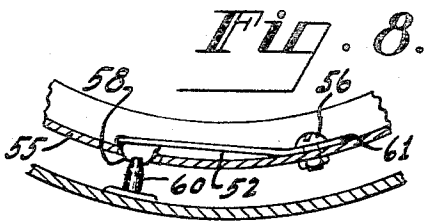


Fig. 8.

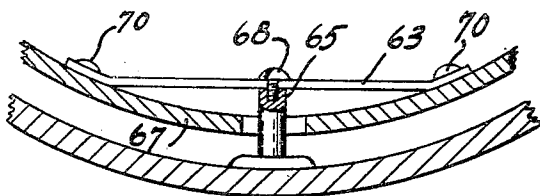


Fig. 9.

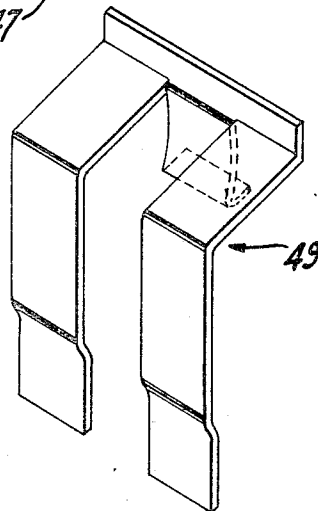


Fig. 7.

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CATHODE-RAY TUBE

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8 Claims. (Cl. 313—85)

This invention relates to improvements in color-kinescopes and other cathode-ray tubes, and like devices, and more particularly to mounting to certain large members therein. One particular form of tube adapted for use of this invention is, for example, a cathode ray tube having a plane of deflection and a target assembly comprising an electrode containing a multiplicity of systematically arranged apertures through which beam-electrons pass along different angularly related paths in their transit from said plane of deflection to selected ones of the metallized elemental color-phosphor areas on a nearby fluorescent screen. In such a color kinescope, color selection is obtained in a tri-color arrangement involving red, green and blue colors, for example, by causing electrons to pass through the apertured electrode along three convergent directions, as from three spaced electron guns, one for each color, and impinge upon red, green and blue elemental phosphor areas on the screen. The response in each color at the screen is controlled by controlling the beam current of the beam impinging on phosphor areas of that color in accordance with the color signal used.

The present invention is, in one aspect, concerned with tubes in which the glass face plate or panel of the envelope or bulb serves as the screen. The preferred methods of laying down the elemental red, green, and blue color phosphors on the panel of such tubes involve the use of the apertured electrode or mask as a stencil, or as a photographic negative, to determine the positions of the phosphor deposits.

When the apertured electrode is used as a stencil, the different kinds of phosphor materials are projected there-through in successive steps and the apertured electrode is removed after each step for cleaning. When the apertured electrode is used as a photographic negative, the panel is first coated with a photographic emulsion mixed with one of the phosphor materials, the electrode is mounted in place in front of the panel and light is projected from a suitably located source through the apertures to expose, and thereby harden the emulsion in a pattern corresponding to the pattern of the apertures. Then the apertured electrode is removed to permit the removal of the unexposed material and the application of a second emulsion-phosphor mixture and replaced for a second exposure. In either of the two methods outlined, the apertured electrode must be mounted in the envelope cap adjacent the glass panel in the selected position it will occupy in the finished tube and in such manner that it can be readily removed and replaced substantially exactly in the same position when each of the color phosphor patterns is successively formed on the panel. Therefore, the electrode mounting means should be initially adjustable, and should also positively hold the electrode at the desired distance from the screen and be self-orienting, so that when replaced after removal the electrode will automatically resume its original angular and lateral orientation relative to the screen and the apertures and phosphor areas will then be in proper registration. To facilitate rapid manufacture the mounting means should be quick-

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detachable. Preferably, in order to keep the picture area of the screen-plate clear of obstructions, the mounting means should be carried by, or form parts of, the side wall of the envelope cap, rather than the glass panel serving as the screen-plate.

Since the apertured electrode is usually relatively thin it is preferable to support the same at its periphery, as for example by a reinforcing frame. However, it has been found that such a frame, and also the walls of the envelope, may expand and contract during the bake-out and exhaust cycles of the manufacturing process. Therefore, the supporting means for the frame should permit frame and envelope to move with respect to each other without deleterious deformation, and after such movement the apertured mask to return to substantially exactly the same position relative to the phosphor screen. Also, during operation of the tube the rigid frame must be movably supported so that the frame can expand when heated by electron bombardment without deleterious deformation. Further, it is desirable that such supporting means be free from moving parts which are in frictional engagement in order to ensure optimum reversible action under conditions of both expansion and contraction.

Accordingly, it is an object of this invention to provide an improved means for mounting an apertured electrode with adjustable spacing and orientation relatively to the phosphor screen in a cathode-ray tube.

Another object of this invention is to provide a novel means for supporting an apertured electrode within a cathode-ray tube which is characterized by its freedom from friction.

A further object of this invention is to provide an improved support means for an apertured electrode which is quick-detachable and self-orienting.

These and other objects have been accomplished in accordance with this invention by providing a novel support means for supporting a member in a cathode ray tube. For example, such a member may be an apertured electrode containing a rigid peripheral frame. In accordance with an embodiment of this invention, there is affixed to the envelope wall a plurality of protuberances, or pins, each of which is preferably tapered. Affixed to the frame is a plurality of semi-flexible members each of which is provided with a seat adapted to receive the end of one of the pins. In this embodiment the semi-flexible members take the form of flat leaf springs. The position of the semi-flexible members may be initially adjusted so as to properly locate the apertured electrode. Once these adjustments are made the members are permanently affixed in the desired position. The members and pins are so supported that if any relative movement between the frame and wall occurs the members bend or flex and permit movement of the electrode apertured member and frame without friction.

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself will best be understood by reference to the following description when read in connection with the accompanying two sheets of drawings wherein:

Fig. 1 is a longitudinal sectional view of a tri-color cathode-ray tube in accordance with this invention;

Fig. 2 is a greatly enlarged detail view of a portion of the apertured electrode and screen shown in Fig. 1;

Fig. 3 is an enlarged sectional view of the tube shown in Fig. 1 taken on the line 3—3;

Fig. 4 is an enlarged perspective sectional view of one of the support means shown in Figs. 1 and 3;

Fig. 5 is a plan view of the support means shown in Fig. 4 showing the location adjustments which may be made;

Fig. 6 is an enlarged sectional view of the supporting

means taken on line 6—6 of Fig. 3, and includes an apertured electrode guard member;

Fig. 7 is a perspective view of the guard member shown in Fig. 6; and,

Figs. 8 and 9 are enlarged sectional views of two modifications of this invention.

Although the invention is applicable to other types of tubes wherein an initially adjustable self-orienting, quick-detachable and non-frictional means is utilized for floatably supporting an electrode in substantially one position, it will be explained with reference to a color kinescope and particularly to an apertured electrode through which beam electrons travel in their transit to a phosphor screen in the color kinescope.

Referring now to the drawings in detail, there is shown a color kinescope tube 10 comprising an evacuated envelope 11 including a main chamber in the form of a conical frustum 12. The large end of the frustum 12 includes a lip 14 which is sealed to a cap member 16. The cap 16 includes a lip 17 which is sealed to a transparent face plate or panel 19. The small end of the frustum 12 terminates in a neck portion 20 which is made of glass. The seal between the frustum 12 and a flange on the cap 16 may be any of the conventional metal-to-metal seals, while the seal between cap 16 and face plate 19, as well as the seal between frustum 12 and neck 20, may be any of the conventional glass-to-metal seals. Enclosed within the neck portion 20 of envelope 11 there is provided a battery of three electron guns 21, 22 and 23 which may be arranged 120° apart, and parallel to the longitudinal axis to the tube 10. Surrounding the neck portion 20 is a conventional deflection yoke 25 which produces a plane of deflection P—P for the three electron beams. As shown, the envelope 11 is composed primarily of metal. However, it should be understood that the envelope 11 could be made of glass. Also, the envelope 11 could be substantially rectangular in cross section. Furthermore, this invention is applicable to color kinescopes utilizing only one electron gun.

In the cap 16 there is provided a screen 26 which includes red, blue and green phosphor dots which are systematically arranged in a hexagonal mosaic pattern on the inner, or target surface, of the glass face plate 19 to form the color screen, see Fig. 2. In the instant case, the glass face plate 19 is in the form of a circular section of a spherical shell. Adjacent to the color screen 26 is an apertured electrode, or mask, 28 which may be formed of a thin metal or other conducting material, such as a nickel alloy of 95 percent copper and the balance nickel.

When, as in the instant case, the screen 26 is laid down directly on the curved face plate 19 of the envelope 11, the mask 28 is appropriately curved in the same direction as the curved inner, or target surface, of face plate 19. As is well-known, apertures 31 in the mask 28 are arranged in the same hexagonal pattern as the phosphor dots which are laid down on the face plate 19. In the present case, the red, blue and green screening beams pass through the plane of deflection P—P of the tube with the beam centers equally spaced apart and from the tube axis and converge through the apertures 31. The apertured electrode, or mask, 28 is affixed to a rigid frame 33 by any well-known means such as welding. The frame 33 is substantially C-shaped in cross section and is supported within the envelope 11 by a plurality, in this case six, support means 30. As shown more clearly in Fig. 3 the support means 30 are spaced around the axis of envelope 11 so as to be substantially removed from the useful area of the screen 26, i. e. out of the line of view.

Referring now to Figs. 3 through 6, each of the support means 30 includes a pin 35 having a tapered end portion 36. The tapered pins 35 are attached to an inner surface of cap 16 at spaced apart intervals around the axis of the envelope 11 and each is directed toward the

axis of envelope 11. Each of the pin members 35 extends through a clearance aperture 37 in the frame 33 and each pin is preferably spaced from the walls of its aperture 37. Bonded to the inner surface of the frame 33, to receive each of the pins 35, is an elongated semi-flexible strip in the form of a leaf spring 40 which includes a pin receiving aperture or seat 39. As shown more clearly in Fig. 4 each of the leaf springs 40 extends along the frame and substantially in the plane of the side of the C-shaped frame 33. Each of the springs 40 is affixed to the frame 33 by a screw 41 extending through an elongated aperture 42 in the spring 40 and into the frame 33. Also, each of the leaf springs 40 is welded, or otherwise permanently secured, to the frame 33, such as by welds 43. It should be noted that each of the springs 40 is substantially straight between the point of bending, i. e. aperture 42, and the pin receiving means or seat, i. e. aperture 39, to provide a support for the mask-frame 33 at each pin 35 which is extremely rigid in the plane of each strip or spring 40.

When each of the pins 35 has been affixed to the inner surface of cap 16 at the desired position, and when the mask 28 is secured to the frame 33, each of the leaf springs 40 may be loosely connected to the frame 33 by means of a screw 41 with each of the apertures 39 engaging one of the pins 35. At this stage of the manufacturing, adjustments may be made in the spacing of the apertured electrode 28 and the screen 26 by pivoting the leaf springs 40 around the screw 41. Also, adjustments may be made circumferentially around the axis of the envelope 11 by sliding each of the leaf springs 40; this later movement is permitted by the elongated aperture 42 in each spring 40. The adjustments which are permitted by this type of leaf spring 40 are necessary due to the fact that the phosphor screen support plate 19 varies from one tube to another, and the spacing between mask 28 and screen 26 should be corrected to take into account these variations in the face plate 19. The spacing between the face plate 19 and the mask 28 may be determined by any well-known means (not shown) such as an adjustable spacing member, or microscopic measurements. An example of a spacing which has been successfully used in a twenty-one inch version the mask 28 is spaced .588 inch from the face plate 19 at a point eight and one-half inches from the center of the face plate 19. Due to manufacturing tolerances pins 35 may not be located in exactly the same position in each and every tube. Therefore the sliding adjustments permitted by elongated aperture, or clearance aperture, 37 permits adjusting the position of frame 33 to compensate for any misalignment of pins 35. The amount and type of adjustments permitted by the leaf springs 40 is shown more clearly in Fig. 5. Once these adjustments are completed each of the leaf springs 40 is permanently bonded by means such as welds 43.

As shown more clearly in Figs. 4 and 6, the aperture 39 in each leaf spring 40 fits onto the tapered portion 36 of its pin 35 and is interlocked therewith so that there is no movement permitted once the leaf springs 40 are permanently secured by the welds 43 (Fig. 4) to the frame 33. When the leaf springs 40 have been permanently bonded in the desired position on frame 33, the mask and frame may be inserted into, and withdrawn from, the envelope 11, for purposes of processing the screen 26, by means of a key 45 extending through each aperture 47 in the frame 33. The key 45 may be inserted between each of the leaf springs 40 and twisted to force the leaf springs 40 out of contact with the pins 35. When the springs 40 are not engaging pins 35, the mask 28 and frame 33 may be removed from cap 16. After the desired steps in the processing of screen 26 have been accomplished the mask 28 and frame 33 are reinserted into cap 16 and keys 45 are again twisted to release springs 40 which snap into engagement and are interlocked with pins 35.

Due to the fact that the mask 28 and frame 33 are inserted into, and withdrawn from, the cap member 16 of envelope 11 several times during the manufacturing process, it is desirable to provide a mask guard 49 to protect the mask 28 from being damaged by bumping one of the pins 35. Such a mask guard is shown in position in Fig. 6, and in perspective view in Fig. 7. The mask guard 49 may be made of any type of material and is preferably metallic so that the mask guard may be welded to the frame 33 around the clearance hole 37.

When the leaf springs 40 are in contact with the pins 35 it has been found that there is no sliding between these two members. However, when the frame 33 expands, such as during the exhaust cycle of the manufacturing process, each of the leaf springs 40 is bent or flexed to some extent. This permits the frame 33 to expand without deleterious deformation. When the exhaust cycle is completed and the tube cools to room temperature the frame 33 returns to its original position by flexing springs 40. Although it has been found that the mask 28 and frame 33 can expand by bending the leaf springs 40, and can thereafter contract, this complete movement results in substantially no permanent displacement of the mask 28 or frame 33 with respect to the screen 26. In other words, there is no movement along the longitudinal axis of envelope 11, nor circumferentially around the axis of envelope 11, when the expansion and contraction of the mask 28 or frame 33 occurs. Also, when the mask 28 and frame 33 are heated by electron bombardment during the normal operation of tube 10 it is believed that the frame 33 expands to some extent. Springs 40 permit this slight expansion, without warping of the frame 33 and with substantially no displacement of the mask 28 with respect to the screen 26.

It is also within the contemplation of this invention to provide a mask frame which is supported by only three support means spaced around the axis of an envelope. As an example of this feature of this invention, every other support means 30 as shown in Fig. 3 could be omitted and the desired frictionless supporting features obtained. Instead of utilizing leaf springs the members 40 could be resilient, semi-flexible members, with some means for holding the members in contact with the pins, such as shown in Fig. 9.

Referring now to Fig. 8 there is shown an embodiment of this invention wherein a leaf spring 52 is affixed to a frame 55 by means of a bolt 56. The leaf springs 52 include a pin receiving cup 58 which fits over a tapered end of a pin 60 to secure the frame 55 in position. When the adjustments have been made, similar to those described in connection with Fig. 5, the leaf springs 53 are permanently secured to the frame 55 such as by a weld 61. This embodiment of this invention permits the use of shorter pins 60 which eliminates the danger of damage to the apertured electrode from striking the pins during the manufacturing processes, and therefore the need for a mask guard such as that shown in Figs. 6 and 7 is minimized.

Referring now to Fig. 9 there is shown a further embodiment of this invention wherein a leaf spring 63 abuts a pin 65 substantially in the central portion of the spring 63 and is bonded thereto by means of a screw 68. The ends of leaf spring 63 are bonded to the frame 67 such as by screws 70. This form of the invention also permits expansion and contraction of the frame 67 by means of the leaf springs 63 expanding to permit bending substantially parallel to the axis of the pins 65. It has been found that, in this embodiment, the frame 67 has expanded up to 20 mils by a spring 63 expanding only 10 mils. The adjustments of relative position for the various members which may be made, such as those which have been described heretofore, may be obtained in this embodiment by securing only one of the

screws 70 until the final adjustments have been made and then securing the other screw 70.

It should be noted that in all of the embodiments of this invention the leaf spring includes a substantially straight portion between the pin receiving means and the point where the spring is bonded to the frame. This feature of the invention provides an extremely rigid support means for the frame and mask. It is also within the contemplation of this invention to provide leaf springs bonded to the inner surface of the envelope cap with pins bonded to the frame member for the mask.

What is claimed is:

1. Means for mounting the mask of a cathode-ray tube of the masked-target variety within the cap-member of the envelope of said tube, said means comprising: a rigid frame-member for said mask; at least three rigid support pins mounted in spaced apart relationship on one of said cap-member and frame-member; at least three leaf-springs mounted on the other of said members, each of said springs having a seat engaging a respective one of said pins, said springs and pins constituting the sole mechanical connecting means between said cap member and said frame-member, whereby flexing of the leaf-springs in which said pins are seated permits said mask-frame to expand and contract substantially without frictional movement between any of the parts of said mask-supporting means.

2. The invention as set forth in claim 1 wherein said leaf-springs are mounted on said frame-member with the long axes of the springs lying substantially in the plane of said frame-member.

3. The invention as set forth in claim 1, and wherein each of said leaf-springs has a free-end portion and the seat in each spring is contained in its said free-end position.

4. The invention as set forth in claim 1 wherein said semi-flexible strips are bonded to said mask-frame by means of welds, and wherein clamping means are provided for holding said strips on said frame, prior to the formation of said welds, in a position whereat said seats and pins are in engagement.

5. The invention as set forth in claim 1 and wherein said leaf springs are mounted on the inner surface of said mask-frame and said mask-frame is provided with a clearance aperture in line with said pins and seats to permit the engagement of each pin with its seat.

6. The invention as set forth in claim 1 and wherein each of said leaf springs is secured at its opposite ends to said frame member; the seat of each spring being disposed between said opposite ends.

7. A cathode-ray tube comprising: an envelope having a longitudinal axis and including a cap member having a transparent viewing portion; a fluorescent screen on the inner surface of said viewing portion; an apertured mask spaced from said screen within said envelope; means for mounting said mask in said cap member with predetermined orientation and spacing between said mask and said screen; said means comprising a rigid frame to which said mask is attached, a plurality of rigid support pins mounted in spaced apart relationship about the inner surface of said cap member and each extending toward said longitudinal axis, a plurality of elongated leaf springs each lying in the plane of said frame and permanently attached thereto, each of said leaf springs extending substantially perpendicular to a respective one of said pins and including means interlocked with said one of said pins, said springs and pins constituting the sole mechanical connecting means between said rigid mask-frame and said rigid support-pins.

8. A color kinescope comprising an envelope containing a source of electrons and having a front-end portion terminating in a screen-plate having a dot-like mosaic pattern of color-phosphor areas on its inner surface, a mask adapted to be accommodated within said front-end portion of said envelope and containing a dot-like

mosaic pattern of apertures, and means for mounting said mask within said front-end portion of said envelope in a position to be scanned by electrons from said source and with the mosaic pattern of apertures in said mask systematically disposed with respect to the mosaic phosphor-pattern on said target surface, said mounting means comprising: a rigid-frame to which said mask is attached, a plurality of pins and a plurality of leaf-springs each containing an aperture adapted, upon the application of a flexing force to its spring, releasably to engage respective ones of said pins when said mosaic patterns are disposed in said systematic relationship, said pins and said springs being cooperatively associated with said mask-

frame and said front-end portion of said envelope and constituting the sole mechanical connection therebetween.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 23,735	Olson	Nov. 10, 1953
2,546,828	Levy	Mar. 27, 1951
2,682,620	Sanford	June 29, 1954
2,690,518	Fyler et al.	Sept. 28, 1954
2,727,172	Mark et al.	Dec. 13, 1955