

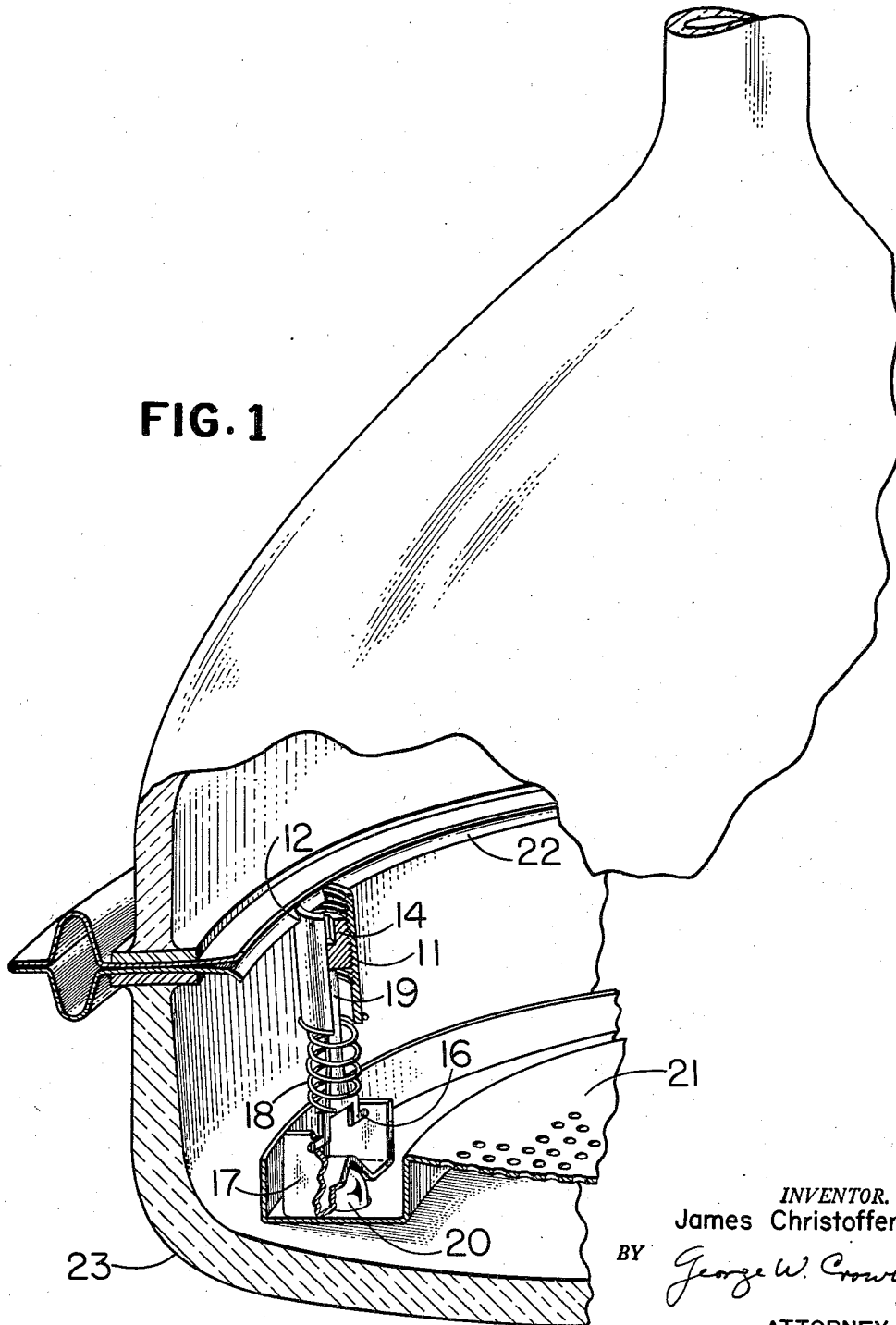
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COLOR TUBE MASK POSITIONER

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FIG. 1



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COLOR TUBE MASK POSITIONER

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This device relates to positioning devices in general and to mask positioning devices for cathode ray tubes in particular.

The only satisfactory tri-color cathode ray tube now being manufactured is the three gun type. In the present three gun type, the three guns are equally spaced around the longitudinal axis of the tube. The intensity of each gun is modulated independently; one with red, the second with green, and the third with blue information. All three electron streams emanating from the guns may be deflected and focused by common systems to converge at closely spaced points on the face of the tube. The screen on which the electron streams impinge is composed of symmetrically arranged arrays of three dots of luminescent materials or phosphors deposited directly on the face of the tube. One phosphor emits a red light when struck by an electron stream; the second, green; and the third, blue. A filtering device, called a shadow mask, is placed between the guns and the screen. This mask is a thin conducting sheet in which holes are symmetrically disposed to allow only the electron stream from the corresponding gun to fall on phosphors of a given color-producing type.

Limitations in present manufacturing techniques make it mandatory that each array of dots of a given phosphor be formed consecutively using the same shadow mask as a photographic negative. One of the color phosphors is first settled on the screen and the dots are formed by exposure of the phosphor through the shadow mask by a light placed at the same position as will be occupied by the corresponding gun in the tube. The dots are then fixed by wet photographic techniques. The same process is repeated to obtain the last two arrays of dots. The shadow mask must be removed to allow development of each array of dots and accurately positioned each time a color phosphor is formed on the screen. Ease of handling to reduce manufacturing costs dictates a removable yet positive positioning means for these steps. Standard practice has been to use a spring type hold-down device which can be removed and reinserted when necessary in processing the screen.

After some intermediate steps, not material here, the shadow mask is again assembled to the screen and the assembly is subjected to elevated temperatures to remove all volatile impurities. The shadow mask must maintain its correct position during and after this treatment. The positioning means must not be affected by relatively high temperatures. Ordinary spring materials sometimes lose a substantial amount of their resiliency during this operation. Therefore, a simple spring type hold-down device, although adequate to hold the mask in position and reasonably suitable for screen processing, may be improved upon considerably.

Of course, any positioning means used must prevent any substantial movement of the shadow mask when it is subjected to accelerating forces or mechanical shock during shipment and use. A substantial permanent dislodg-

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ment of the mask will cause mis-registration of the electron beams, causing false colors to appear to the viewer of the screen. Again, a simple spring type hold-down device sometimes fails to positively hold the mask in position.

A further important consideration making it desirable to maintain a firm mechanical contact between the shadow mask and the screen base is the necessity of bonding the two parts electrically. If the shadow mask is at a different potential than the screen, the electron streams are affected adversely. A spring type hold-down device does not ensure a firm electrical contact between the mask and screen.

Unfortunately, the degree of resiliency of the positioning means desired for preliminary manufacturing stages is detrimental after assembly. At the same time, absolutely rigid positioning means can not answer the problem after assembly since some resiliency must be present to compensate for differential expansion and shock.

The necessity of maintaining a small amount of resiliency in the positioning means may be seen more clearly if the operating temperature of the shadow mask and tube assembly is considered. Power in the order of twenty to fifty watts is dissipated in presently manufactured tubes with shadow masks. The temperature rise of the parts being considered is approximately 1° C. per watt dissipated. It is evident that, if the dissimilar materials of which the parts are made are rigidly bonded together, large internal strains will result. The strains, unless relieved, will quickly exceed the elastic limits of the various materials. The problem will, in all probability, become more acute with the introduction of tubes of higher power dissipation.

The amount of residual resiliency necessary to prevent excessive strains may be substantially reduced by a judicious selection of materials. At present, glass is used as the material on which the screen is deposited. A high copper alloy is the preferred material from which the shadow mask is fabricated. Since support and orientation for the mask are best obtained from the glass wall of the tube, it would be most logical to hold the mask in place with a support made from glass. This glass would be the same material as the glass of the tube wall to which the copper is being positioned. There are, however, many metallic materials which have coefficients of expansion matching those of particular types of glass. An example of a material having a suitable coefficient is that with the trade name "Kovar." Since metallic materials are generally more easily fabricated than glass, a metallic device having such properties is preferred in the present invention.

No positioning device exists in the field of electron tubes which completely answers the problems. Any device which will adequately solve the foregoing problems would constitute a considerable advance in the color television art.

Therefore, it is an object of this invention to provide positive positioning means in a color picture tube which are easily removable during preliminary manufacturing stages.

It is a further object of this invention to provide means incorporating an adjustable amount of resiliency to allow differential expansion without loss of registration of the various materials making up the shadow mask and screen of a completed color picture tube.

Still a further object of this invention is to provide substantially firm positioning means in a color picture tube to prevent permanent misalignment between the shadow mask and screen when the assembly is subject to mechanical shock.

Another object of this invention is to minimize the amount of resiliency required in a positioning means for

the shadow mask in a color picture tube by selection of the proper materials from which the positioning means is fabricated.

Another object of this invention is to provide a low resistance electrical contact between the shadow mask and screen of a color picture tube regardless of the conditions of use of the assembly.

In general, the objects of this invention are attained by means of a number of identical elongated adjustable spacers positioned around the periphery of the shadow mask. Each spacer is composed basically of a fixed member, a sliding member, telescopically mounted on the fixed member, a spring between the sliding and fixed members and an adjustable stop attached to the sliding member.

The viewing end of the bulb is shaped somewhat like a bowl with a flat bottom. The screen is deposited on the inside surface of the viewing end. Spherical bosses are molded in the bulb adjacent the edge of the screen. An annular flange is fixed adjacent the viewing end projecting into the bulb. The shadow mask is indexed to the spherical bosses. The adjustable spacers are inserted over the shadow mask at each spherical boss. The free end of the spacer is pressed to shorten the spacer and allow the free end of the spacer to be slipped under the flange. The spring tension holds the ends of each spacer in position regardless of the variations in distance between each spherical boss and the edge of the flange. After the operations between which removal of the mask is necessary, the adjustable stop is moved to limit the amount the fixed and sliding element may telescope. The adjustment of the stop may be done very accurately with the spacer in its final position to obtain any desired amount of resiliency to the whole assembly.

For further objects of this invention, reference should be made to the following drawing, the single figure of which represents a practical embodiment of the principles of the invention. There is actually illustrated in the drawing a partial cross-section of a tube assembly showing the manner in which the various parts are arranged to obtain substantially rigid spacing but an adjustable amount of resiliency. For convenience and ease of understanding, only one positioner is shown. In practice, several similar positioners are disposed around the periphery.

Referring to the drawing, an elongated spacing bar 19 is shown with a hollow tubular element 11 slidably mounted thereon. A flange 16 on one end of the spacing bar 19 may be formed as an integral part thereof. The spacing bar is preferably made from a material which has a coefficient of expansion substantially the same as the glass of the bulb, such as that with the trade name "Kovar." The ends of the flange 16 fit into upwardly extending wings of a "V-block" 17. The "V-block" 17 matches one of the several spherical bosses 20 on the periphery of the glass panel 23 of the tube as shown through holes in the periphery of the shadow mask 21. A helical spring 18 is mounted coaxially around the spacing bar 19. One end of the spring 18 bears against the inner side of the flange 16. The other end of the spring 18 bears against the slidably mounted tubular element 11. So long as the spring 18 is in compression, it exerts a force tending to move the slidably mounted element 11 away from the flange 16 and consequently away from the indentation 17. A diagonal cut which may be of the shape shown at 12 is made in the top surface of the slidably mounted element 11. A flange 22 is rigidly attached to the viewing end 23. The edge of the flange 22 fits into the cut 12. It is obvious that even if the distance between the two indices on the tube varies, the force of the spring 18 will accommodate the length of the hold-down device to any such variations. An adjustable stop 14 which may be threaded into the slidably mounted element 11 is moved into contact with

the end of the spacing bar 19 after assembly of the hold-down device for the final time in the tube.

The foregoing explanation is a detailed description of a proven embodiment of the invention. In the actual tube, several similar positioning devices are inserted around the periphery of the shadow mask 21 to match the remaining number of spherical bosses 20. The length of each positioning device is automatically adjusted to equal the distance between each spherical boss 20 and the nearest point on flange 22. The end of the elongated spacing bar 19 is affixed to the shadow mask 21. The shadow mask 21 is set in place on the spherical bosses 20. The slidably mounted tubular element 11 is pressed toward the shadow mask 21 against the pressure of the helical spring 18 until the cut 12 fits against the flange 22. The slidably mounted tubular element 11 is then released and the spring 18 holds the positioning device in position.

Until the stop 14 is adjusted to bear against the end of the spacing bar 19, only the force of the spring 18 holds the positioning device in position and the device may be disengaged simply by reversing the assembly procedure.

After the stop 14 has been adjusted, the maximum length of the positioning device is fixed. This adjustment is made so that the maximum length is slightly less than the distance between each spherical boss 20 and the closest point of the flange 22. Therefore, the helical spring 18 remains active, but limited in the amount it may change the overall length of the positioning device, thus making the assembly adjustably resilient.

During the preliminary manufacturing stages, the shadow mask 21 is positioned and removed three times, once each time an array of dots of luminescent materials is formed on the glass panel 23. Preferably, three positioners as hereinbefore described are hinged at the flange 16 to the "V-block" 17. Each time an array of dots is to be formed, the shadow mask 21 is positioned on the hemispherical bosses 20. Each hollow tubular element 11 is pressed to shorten the overall length of each positioner. The positioners are then rotated until the cuts 12 may be mated with the edge of the flange 22. The hollow tubular elements are then released. The helical springs 18 force the hollow tubular elements 11 into frictional engagement with the flange 22 at the cuts 12. The stops 14 are retracted with a screwdriver or other suitable tool so that they do not coact with the spacings bars 19 during these operations. Removal of the shadow mask 21 is accomplished by pressing and rotating the hollow tubular elements 11 until the flange 22 is disengaged from the cuts 12. The shadow mask 21 is then free to be lifted off the hemispherical bosses 20.

After the luminescent screen has been completed on the glass panel 23 the shadow mask 21 is again positioned as described and the adjustable stop 14 is screwed into the hollow tubular element 11 until it bears against the end of the spacing bar 19. The stop 14 is then backed off a turn or two to allow the spring 18 to exert a slight amount of resiliency between tubular element 11 and spacing bar 19.

When the temperature of the mask 21 and panel 23 changes during operation, the distance between the hemispherical bosses 20 and the flange 22 changes primarily because of expansion of panel 23. The positioner accommodates itself to the changed distance due to the resiliency of the spring 18. The amount of change required of the spring 18 is minimized by fabricating the spacing bar 19 from a material having substantially the same coefficient of linear expansion as the glass panel 23. Even if the spring 18 loses a substantial amount of its resiliency, it is impossible for the flange 22 to become disengaged from the cut 12 because the minimum length of the positioner is fixed by the stop 14.

The low resistance contact between the shadow mask 21 and the panel 23 is a secondary result of using a spacing bar 19 fabricated from a material having substantially the same coefficient of linear expansion as the

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panel 23. Since the flange 22 is intimately joined to the panel 23 and the flange 22 cannot disengage from the cut 12, a complete electrical path is maintained from the mask 21 through the positioner and flange 22.

While the foregoing description outlines a preferred embodiment of the invention, modifications will suggest themselves to those skilled in the art. The invention should not be restricted to the embodiment shown, but only by the spirit and scope of the claims appended hereto.

What is claimed is:

1. A color television picture tube having a shadow mask secured therein with a plurality of adjustably resilient retaining members within said tube each said retaining member being independently adjustable.

2. A color television picture tube having a shadow mask therein, means for resiliently mounting said shadow mask within said tube, and means for adjusting the degree of resiliency of said mounting means.

3. A color television picture tube having a shadow mask therein, means for resiliently mounting said shadow mask within said tube, and means for adjusting the degree of resiliency of said mounting means, the material from which said mounting means are fabricated having substantially the same coefficient of linear expansion as the material from which the said tube is made.

4. In a cathode ray tube having a shadow mask, apparatus for positioning said shadow mask at predetermined points therein comprising, a plurality of similar retaining members, each of said retaining members having first and second telescoping portions, each of said first portions being mounted on said shadow mask at one of said predetermined points, means springily attaching one each of said second portions to one each of said first portions, an adjustable stop mounted on each of said second portions, each said adjustable stop coacting with one each of said first portions to vary the maximum telescoping of the first and second portions with which it is associated, and means in said tube for holding each of said second portions.

5. In a color television picture tube, apparatus for circumferentially supporting a shadow mask substantially against the periphery of the viewing screen comprising, a plurality of hold-down devices, each including first and second telescopically engaging members, the first member coacting with the said shadow mask, said second member coacting with a predetermined point on the inner wall of said tube, means springily joining said first and second members, and an adjustable stop whereby the telescoping of the said first and second members may be adjusted.

6. A hold-down device for the shadow mask in a color picture tube comprising, a retaining member having one portion thereof resiliently movable relative to a second portion thereof whereby the length of said retaining member is adjustable, said retaining member being formed of material having a coefficient of expansion matching that of the material of said tube, and disposed to resiliently retain said mask in a predetermined position relative to said tube.

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7. In a tri-color cathode ray tube in which a shadow mask is mounted between a source of electrons and a luminescent screen, an adjustable resilient positioner comprising, an elongated spacing bar attached to said shadow mask, a hollow element slidably mounted on said spacing bar, a helical spring coaxially mounted on said elongated spacing bar whereby said hollow element is urged away from said spacing bar, means indexing said hollow adjustable element to a predetermined point on the wall of said cathode ray tube, and an adjustable stop mounted on said hollow member coacting with said elongated spacing bar whereby the overall length of said spacing bar and hollow adjustable member may be substantially fixed.

8. In a glass color television picture tube, apparatus for circumferentially supporting a shadow mask comprising, a plurality of similar retaining members and a plurality of hemispherical bosses molded into said tube adjacent the viewing screen thereof, each of said similar retaining members including, a V-block having outwardly flaring portions, means attaching said outwardly flaring portions of said V-block substantially on the periphery of said shadow mask, an opening being formed in the periphery of said shadow mask adjacent the point of attachment of said V-block to accommodate a hemispherical boss, said V-block bearing on said spherical boss, an elongated spacing bar, the material from which said spacing bar is fabricated having substantially the same coefficient of linear expansion as the material from which the said tube is fabricated, means for hinging the first end of said spacing bar to said V-block, a hollow tubular member telescopically mounted over the second end of said spacing bar, a helical spring coaxially mounted on said spacing bar, one end of said spring being attached to said spacing bar, the other end of said spring being attached to said tubular member, means for securing said tubular member to a predetermined point on the inner wall of said tube, a screw thread impressed on the inner surface of said tubular element, and a set screw mating with said screw thread and coacting with said spacing bar to limit the amount of telescoping of said spacing bar and said tubular element.

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