United States Patent

[11] 3,564,195

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[21] Appl. No. **773,434**
[22] Filed **Nov. 5, 1968**
[45] Patented **Feb. 16, 1971**

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[54] **MASK-TO-FRAME WELDING INDICATOR**
10 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **219/109,**
313/85, 29/25.15
[51] **Int. Cl.** **B23k 9/10**
[50] **Field of Search** 219/109;
29/25.15, 25.13, 471.1; 340/282, 471

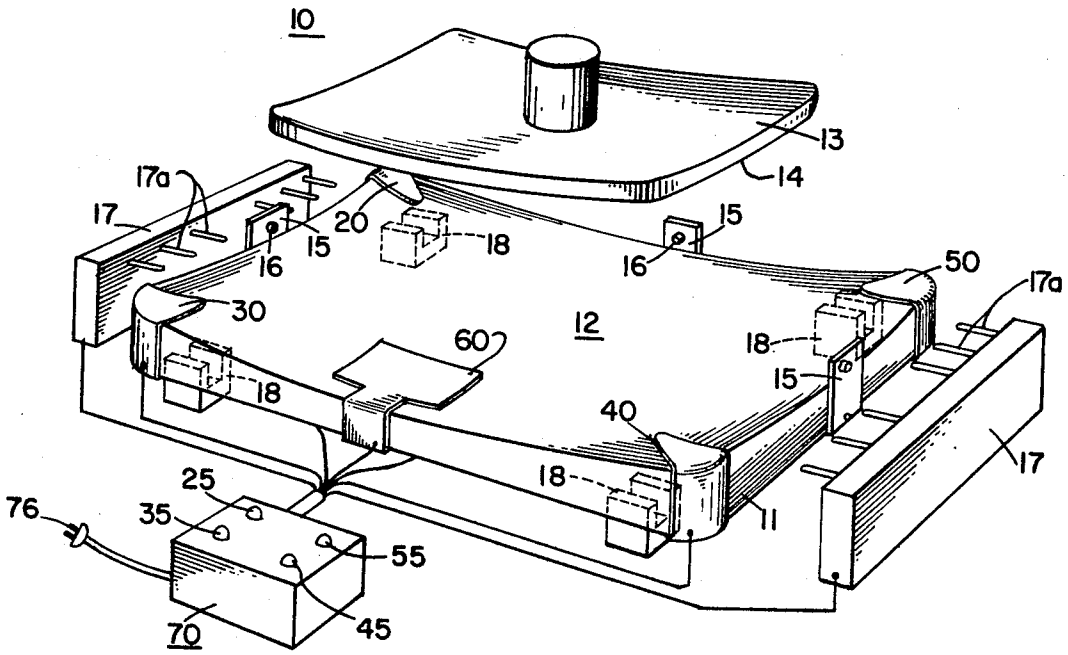
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ABSTRACT: A mask-to-frame assembly apparatus for use in the manufacture of color television picture tubes, includes a curvilinear surface, having a plurality of electrical contacts disposed thereabout. A corresponding plurality of lamps coupled, respectively, between the shadow mask and the electrical contacts, are illuminated when the mask is properly engaged with the surface. The assembly apparatus further includes an electrical interlock, coupled to the lamps which permits energization of the mask-to-frame welding apparatus when the shadow mask is properly engaged.



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FIG. 1

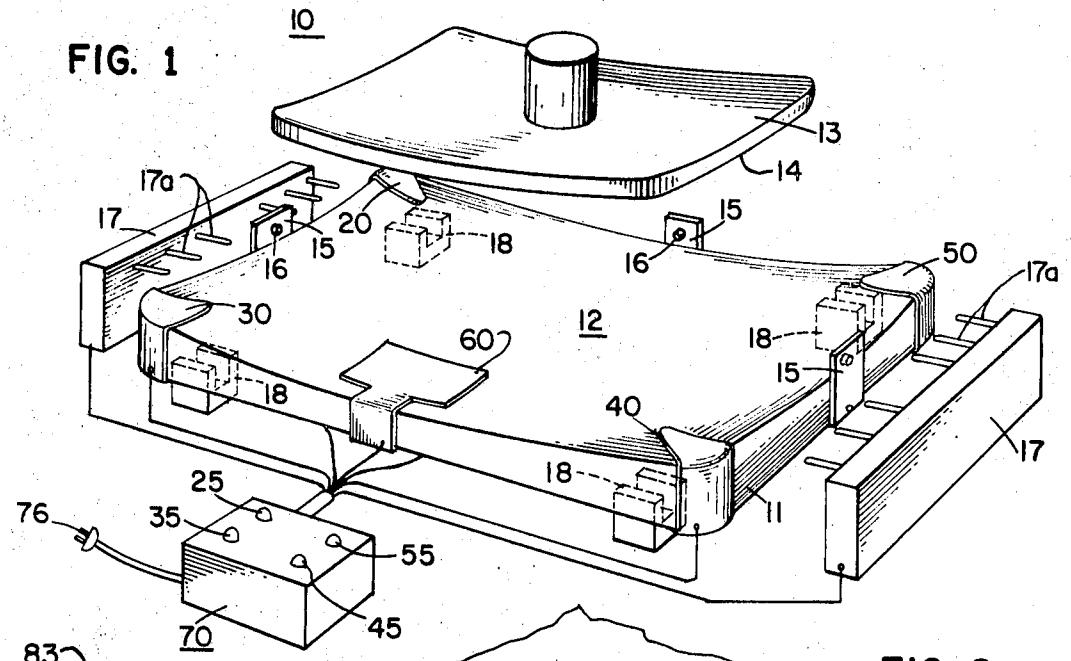
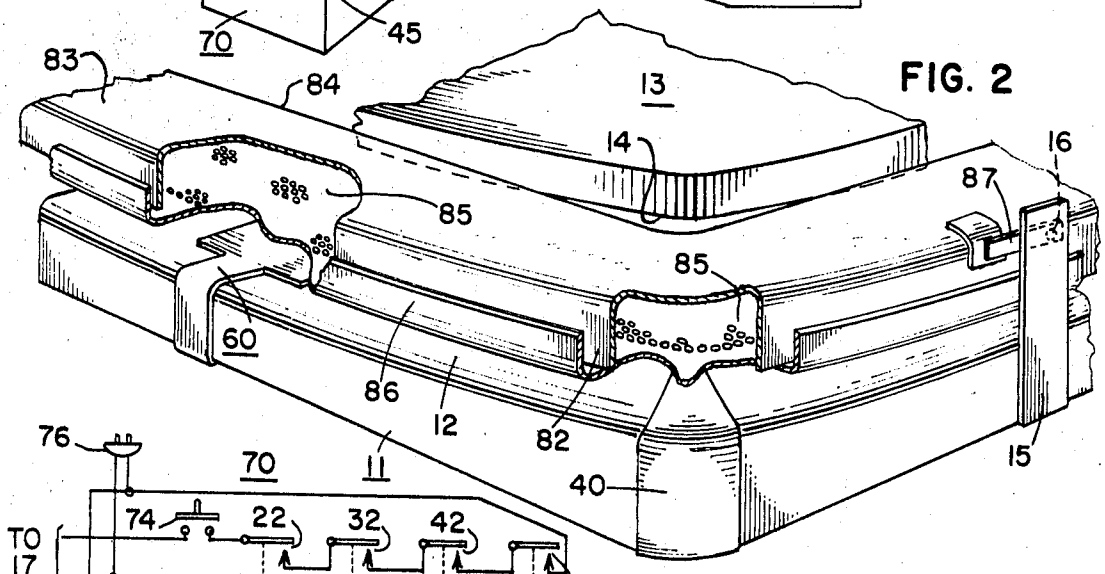


FIG. 2



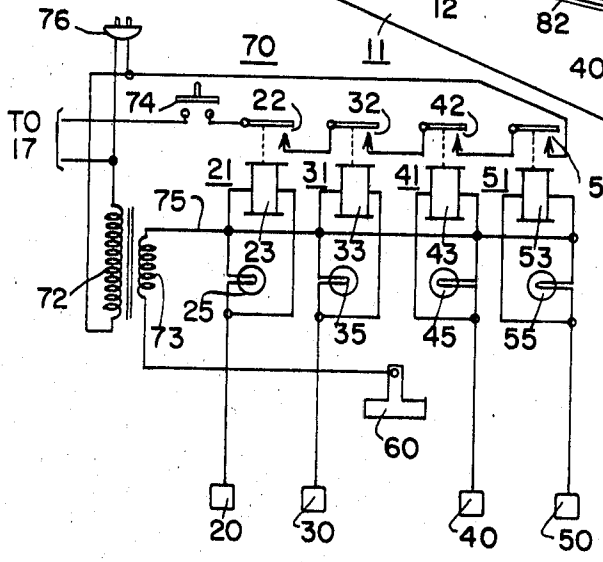


FIG. 3

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MASK-TO-FRAME WELDING INDICATOR

This invention relates to an improvement in the mask-to-frame assembly apparatus used in the manufacture of color television picture tubes. The improvement provides means for indicating when the curvilinear shadow mask is properly positioned with respect to the frame in the assembly apparatus. A modification includes means for fastening the mask to the frame when the shadow mask is in proper position.

During tri-gun picture tube operation an electron source, secured inside the neck of the picture tube, generates three electron beams, each corresponding to one of three primary colors. Portions of these beams pass through the shadow mask, impinging corresponding color phosphors deposited on the interior surface of the picture tube faceplate. It is well known that in order to assure proper electron impingement, and thereby chromatic purity, the distance between the shadow mask and the faceplate must be held within very strict tolerances. This critical distance, known in the art as Q-spacing, is generally achieved by accurately positioning the frame and the shadow mask in conventional assembly apparatus, welding the mask to the frame, and ultimately securing the mask-frame combination to a plurality of mounting studs accurately disposed about the periphery of the faceplate.

The assembly apparatus comprises a fixture having a curvilinear surface, similar to the contour of the shadow mask, and a plurality of supporting pegs accurately placed around and above the surface. The spatial relationship between the supporting pegs and the curvilinear surface in the assembly apparatus simulates the configuration of the mounting studs and the shadow mask in a properly Q-spaced picture tube.

During manufacture, the shadow mask is frictionally fastened to a forwardly extending rim portion of the frame, which is subsequently secured to the supporting pegs in the assembly apparatus. Engagement means, comprising a plunger and magnets mounted under the curvilinear surface, substantially seat the mask with the surface. When so seated, the shadow mask is secured to the frame by welding. The mask-frame combination is then removed from the assembly apparatus and used as a negative for depositing the different color phosphors on the faceplate and is ultimately sealed within the picture tube in its mounted position.

For purposes of rigidity, the frame generally includes a relatively wide border which precludes complete cooperation between the plunger surface and the shadow mask. As a result, the peripheral portions of the shadow mask may not always be pressed into intimate contact with the curvilinear surface. In particular, the corners of the shadow mask may not seat with the surface, and this condition is seldom detectable before the mask is welded to the frame. When such a mask-frame assembly is supported on the mounting studs in the picture tube, the spatial relationship between the mask and the glass panel, i.e., the Q-spacing, is incorrect, and the defect may remain unnoticed until after the expensive slurrying process, in which the color phosphors are deposited on the panel, is completed.

The apparatus of the invention provides means for detecting improper engagement between the mask and the curvilinear surface prior to welding, whereupon the mask may be adjusted while the defect is still correctable. Specifically, the invention includes a plurality of lamps coupled between the shadow mask and a corresponding number of electrical contacts fastened to the areas on the curvilinear surface underlying those portions of the shadow mask which have a tendency to remain unmated with the surface. When the shadow mask is properly seated, the lamps are illuminated and the mask is welded to the frame in a conventional manner. In the event any corner areas of the shadow mask remain disengaged, however, one or more of the lamps will not light, depending upon the number of disengaged areas, indicating the need for adjustment.

An electrical interlock coupled between the indicator circuit and the welder, is provided in a modified form of the invention. The interlock permits energization of the welder only when the mask is properly engaged with the curvilinear surface.

Accordingly, the primary object of this invention is to provide improved mask-to-frame assembly apparatus for use in manufacturing color television picture tubes.

Another object of this invention is to provide, for use with color television picture tube mask-to-frame assembly apparatus, indicating means for signalling when the shadow mask is properly positioned in the assembly apparatus.

A further object of this invention is to provide, for use with color television picture tube mask-to-frame assembly apparatus, a plurality of lamps which are illuminated when the mask is properly positioned in the assembly apparatus.

A feature of this invention resides in an electrical interlock between the indicating means and the mask-to-frame welding means which permits operation of the welding means only when the shadow mask is properly positioned in the assembly apparatus.

Another feature of this invention resides in the arrangement of the lamps in the indicating means in a pattern for clearly indicating which shadow mask corners are properly seated.

Other objects, features and advantages of this invention will become apparent upon reading the following description in conjunction with the accompanying drawing in which:

FIG. 1 is a perspective view of color television picture tube mask-to-frame assembly apparatus incorporating the invention.

FIG. 2 is an enlarged perspective view of a portion of the assembly apparatus of FIG. 1, including portions of a mask and frame, partially cutaway.

FIG. 3 is a circuit diagram of the indicating device and electrical interlock mechanism shown in FIG. 1.

Referring now to FIG. 1, a mask-to-frame assembly apparatus **10** comprises a metallic base **11**, having a concave curvilinear surface **12**. Surface **12** is very smooth, has a substantially rectangular shape, and is preferably coated with a thin electrically insulating film (not shown). A plunger **13** is movably secured above base **11** and has a surface **14** which is similar in shape, but smaller in size, to curvilinear surface **12**. A plurality of electromagnets **18** are appropriately secured beneath surface **12**. When energized, the electromagnets tend to attract and hold the corners of the permeable shadow mask (not shown) into engagement with the curvilinear surface.

Four electrical conductors **20**, **30**, **40**, and **50**, comprising thin pieces of metallic foil are respectively secured to surface **12** near the four corners thereof. Another foil conductor **60** is secured to a central portion of surface **12**, preferably into an area beneath surface **14** of plunger **13**. A number of wires connect these conductors to indicating means **70**, housing four lamps **25**, **35**, **45**, and **55**, the purpose of which will be explained below.

Three upright standards **15** are accurately disposed about surface **12** and three supporting pegs **16**, simulating the mounting studs in a color picture tube, are respectively attached to standards **15**. Supporting pegs **16** cooperate with mounting springs secured to the shadow-mask frame (not shown) for holding the frame in place above surface **12**. A detailed description of the spatial arrangement of the frame, springs and mounting studs, may be found in the copending application of Richard Cowles, et al. Ser. No. 742,651, filed Jul. 5, 1968.

A welding apparatus **17**, having a plurality of sequentially operable electrodes **17*a***, is accurately positioned with respect to base **11** and, as explained below, may be energized through indicating means **70**. When energized, welding apparatus **17** causes electrodes **17*a*** to tack weld the shadow mask to the frame in a well-known manner.

In FIG. 2, a typical shadow-mask frame has an L-shaped cross section including a forwardly extending rim **82** and a border **83**, defining a window **84**. A multiapertured metallic shadow mask **85**, having a rearwardly extending lip **86** is adjustably held on rim **82** of the frame by frictional forces therebetween.

Apertured mounting springs **87** which may be attached to frame **83** through a bimetallic hinge as clearly described in the

above-mentioned copending application, cooperate with supporting pegs **16** to rigidly secure the frame in a fixed position relative to curvilinear surface **12**. When plunger **13** is lowered, curvilinear surface **14** passes through window **84** and presses shadow mask **85** into engagement with curvilinear surface **12**. In so doing, contact is made between conductor **60** (and ideally between each of the other foil conductors **20—50**) and the metal shadow mask. As the mask is pressed into engagement with surface **12**, its lip **86** moves with respect to rim **82** of the frame which is firmly supported on pegs **16**. The mask is designed with a large enough lip **86** to insure substantial overlying of rim **82** when properly positioned.

Referring now to FIG. **3**, indicating means **70** are connected to a plug **76** which is adapted for connection to any conventional AC voltage source. A transformer has a primary winding **72** connected across plug **76**, and low-voltage secondary winding **73** connected between conductor **60** and a common lead **75**. Lamp **25** is connected between conductor **20** and common lead **75**. Similarly, lamps **35**, **45** and **55** are connected between common lead **75** and electrical conductors **30**, **40** and **50**, respectively.

When the frame with the mask frictionally secured thereto is secured to the supporting pegs in the assembly apparatus, plunger **13** is lowered to move the mask forward into engagement with conductor **60**, which it will be recalled is under surface **14** of the plunger. If properly seated with curvilinear surface **12**, the mask is also pressed into engagement with conductors **20—50**.

Thus, mask **85** completes a plurality of electrical circuits, including secondary winding **73**, conductor **60**, conductors **20—50**, and lamps **25—55**. The circuit for lamp **25**, for example, is typical and extends over winding **73**, conductors **60** and **20**, the portion of shadow mask bridging these conductors, and lamp **25**. Illumination of lamps **25—55** indicates the mask is firmly seated with surface **12** and hence, accurately positioned with respect to the frame. The mask is welded to the frame in that position, and when ultimately secured to the mounting studs in the picture tube, proper Q-spacing will result.

In the event the shadow mask is improperly seated with curvilinear surface **12**, i.e., the mask is not pressed into engagement with all of conductors **20—50**, one or more of the circuits to lamps **25—55** will be incomplete, thereby preventing illumination of corresponding lamps. Nonillumination of any lamp indicates that an area of the mask is not properly seated with surface **12** and the mask should be adjusted prior to welding. For example, if one corner of the shadow mask overlying a foil conductor is not pressed into engagement therewith, no electrical contact with the mask is made and the lamp connected to that conductor will not light. Nonillumination of a lamp indicates that a mask adjustment is necessary which simply involves manually pushing the appropriate area of the shadow mask into proper engagement with surface **12**. Further, after welding and upon retraction of the plunger, the lamps provide "quality control" information, whereby nonillumination of one or more of said lamps indicate the mask-frame combination may be defective.

In accordance with a further aspect of the invention, lamps **25—55** are arranged in a pattern corresponding to the physical locations of conductors **20—50**. Thus, lamp **25** corresponds to the left rear corner of the mask, lamp **35** to the left front, and so forth. Consequently, the machine operator can readily determine which area or areas of the mask are not properly seated by simple observation of the lamp configuration. Adjustment of the appropriate area or areas of the mask is thereby greatly simplified.

The preferred embodiment of the invention includes an electrical interlock for prohibiting energization of the welding apparatus until the indicating means indicate proper mask seating. The interlock comprises four relays **21**, **31**, **41** and **51**. Relay **21** includes a normally open switch **22** and an electromagnet **23** connected in parallel with lamp **25**. Similarly, relays **31**, **41** and **51** include normally open switches **32**, **42** and **52** and electromagnets **33**, **43** and **53** connected in parallel with lamps **35**, **45** and **55**, respectively. Switches **22—52** are serially connected with welding apparatus **17** and a manually operated start switch **74**. Consequently, all must be closed before the welding apparatus may be energized. Energization of the indicating lamps results in energization of the parallely connected electromagnets and consequent closure of their associated switches **21—51**. Upon closure of manually operated start switch **74**, power from the AC source to which plug **76** is connected flows to welding apparatus **17**, causing electrodes **17***a* to sequentially operate and tack weld the shadow mask to the frame. If any of the switches remain open, indicating a mispositioned mask, the welding apparatus cannot be energized.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

I claim:

1. In combination: color television picture tube mask assembly apparatus having a first curvilinear surface; rigid frame means; a multiapertured metallic shadow mask, having a contour similar to said first curvilinear surface, adjustably retained on said rigid frame means; mounting means, accurately positioned with respect to said first curvilinear surface, supporting said frame means in predetermined alignment therewith; engagement means seating said shadow mask with said first curvilinear surface; and means, completing an electrical circuit indicating said mask being in substantially complete engagement with said first curvilinear surface.

2. The combination as set forth in claim **1**, wherein said first curvilinear surface includes an array of electrically conductive regions; a first voltage source having one terminal coupled to one of said regions; and a plurality of lamps individually coupled between the other terminal of said first voltage source and different ones of the rest of said regions, whereby said metallic shadow mask contacts said regions and completes electric circuits from said voltage source to said lamps when said shadow mask is properly seated with said first curvilinear surface.

3. The combination as set forth in claim **2**, wherein said first curvilinear surface comprises a metallic base having a nonconductive covering, and wherein each of said conductive regions comprises thin metallic foil, overlying said covering.

4. The combination as set forth in claim **3**, wherein said frame means have a relatively wide border defining a window, and wherein said engagement means comprise a plunger having a second curvilinear surface smaller in size but similar in shape to said first curvilinear surface; said second surface being movable through said window for pressing said shadow mask into intimate contact with said first surface; peripheral areas of said shadow mask being untouched by said second surface and often assuming a nonmating relationship with said first surface and hence, being improperly seated therewith; said one conductive region secured in an area on said first surface engageable with said second surface to insure good electrical contact with said shadow mask; said rest of said conductive regions being located under said peripheral areas of said shadow mask.

5. The combination as set forth in claim **4**, wherein said assembly apparatus further includes fastening means operable for attaching said shadow mask to said frame means.

6. The combination as set forth in claim **5**, wherein said fastening means includes means for welding said shadow mask to said rigid frame means when energized, and normally open switch means for energizing said welding means when said shadow mask is properly seated with said first curvilinear surface.

7. The combination as set forth in claim **6**, wherein said normally open switch means include a plurality of electromechanical relays each having a normally open contact set, each of said plurality of electromechanical relays being coupled in parallel with a respective one of said lamps, whereby each contact set is closed upon energization of its respective relay and consequent energization of its associated lamp.

8. In combination: color television picture tube assembly apparatus comprising a curvilinear surface having a plurality of conductive regions; a common lead; a plurality of lamps, electrically coupled between respective ones of said conductive regions and said common lead; a plurality of supporting pegs accurately positioned with respect to said curvilinear surface; a frame, having a forwardly extending rim, releasably secured to said supporting pegs; and electrically conductive shadow mask, having a lip portion overslipping said rim and being frictionally maintained thereon; engagement means, moving said shadow mask into seating engagement with said curvilinear surface, said lip portion thereby sliding along said rim; voltage means, coupled between said shadow mask and said common lead, whereby electric current flows through said mask into said conductive regions illuminating all of said lamps when said mask is properly seated with said curvilinear surface; and welding means operable to tack weld said lip to said rim.

9. The combination as set forth in claim 8, wherein said assembly apparatus further includes a plurality of relays for controlling operation of said welding means; said plurality of relays being individually coupled across said lamps each of said relays including a normally open switch serially connected in circuit with said welding means and said voltage means.

10. The combination as set forth in claim 9, wherein said conductive regions comprise thin pieces of metallic foil arranged in a pattern about said curvilinear surface; said lamps being arranged in a similar pattern, such that each lamp corresponds to an area on said surface underlying a corresponding piece of metallic foil, whereby said lamps indicate the particular areas of nonengagement between said shadow mask and said curvilinear surface.