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(54) **PROCESS AND APPARATUS FOR THE MANUFACTURE OF CATHODE RAY TUBES HAVING TENSION MASKS.**

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Description

This invention relates to color cathode ray picture tubes, and is addressed specifically to improved factory means and processes for the manufacture of tubes having a tensed foil shadow mask. Color tubes of various types that have a tension foil mask can be manufactured by the process, including those used in home entertainment television receivers. The process according to the invention is particularly valuable in the manufacture of medium-resolution, high-resultion, and ultra-high resolution tubes intended for color monitors.

The use of the foil-type flat tensed mask and flat faceplate provides many benefits in comparision to the conventional domed shadow mask and correlatively curved faceplate. Chief among these is a greater power-handling capability which makes possible as much as a three-fold increase in brightness. The conventional curved shadow mask, which is not under tension, tends to "dome" in picture areas of high brightness where the intensity of the electron beam bombardment is greatest. Color impurities result as the mask moves closer to the faceplate and as the beam-passing apertures move out of registration with their associated phosphor elements on the faceplate. The tensed mask when heated distorts in a manner quite different from the conventional mask. If the entire mask is heated uniformly, there is no doming and no distortion until tension is completely lost; just before that point, wrinkling may occur in the corners. If only portions of the mask are heated, those portions expand, and the unheated portions contract, resulting in displacements within the plane of the mask; i.e., the mask remains flat.

The tensed foil shadow mask is a part of the cathode ray tube front assembly, and is located in close adjacency to the faceplate The front assembly comprises the faceplate with its screen which consists of deposits of light-emitting phosphors, a shadow mask, and support means for the mask. As used herein, the term "shadow mask" means an apertured metallic foil which may, by way of example, be about 25 μm (0.001 inch) or less in thickness. The mask must be supported under high tension a predetermined distance from the inner surface of the cathode ray tube faceplate; this distance is known as the "Q-distance." As is well known in the art, the shadow mask acts as a color-selection electrode, or parallax barrier, which ensures that each of the three electron beams lands only on its assigned phosphor deposits.

The conventional process of depositing patterns of color phosphor elements on the screening surface of a color picture tube faceplate utilizes the well-known photoscreening process. A shadow mask, which in effect functions as a perforated optical stencil, is used in conjunction with a light source to expose in successive steps, three discrete light-sensitive photo-resist patterns on the screening surface. The shadow mask is typically "mated" to each faceplate; that is, the same mask is used in the production of a specific tube throughout the production process, and is permanently installed in the tube in final assembly. At least four engagements and four disengagements of the mask, as well as six exposures, are required in the standard screening process. In certain processes, a "master" may be used for exposing the photoresist patterns in lieu of the mated shadow mask.

There have been a number of disclosures of tensed foil masks and means for applying tension to the mask and retaining the mask under tension. Typical of these is the disclosure of Law in U.S. Patent No. 2,625,734 which addresses the construction of a taut planar foraminous mask. A foil mask blank is loosely mounted in a two-section frame, and the mask is expanded by the hot-blocking process. Machine screws peripheral to the frame provide for clamping the mask tightly in the frame when the mask is in its expanded state. The mask becomes tensed upon cooling as it is restrained from returning to its former dimensions by its captivation by the frame. The frame with the mask enclosed is mounted with the phosphor-bearing screen as a unitary assembly adjacent to the inner surface of the faceplate. Law in U.S. Patent No. 2,654,940 also discloses means for stretching and captivating by frames masks formed from wire mesh.

In U.S. Patent No. 4,591,344 to Palac, a method of making a color cathode ray tube is disclosed in which a frame on which a shadow mask is stretched has indexing means cooperable with registration-affording means on a faceplate. The assembly provides for multiple registered matings of the faceplate and mask during photoscreening operations. A photographic plate is used in a process for applying the phosphor elements to the faceplate screening surface to provide an interchangeable mask system; this in lieu of the more common method of using a shadow mask permanently mated with a faceplate, and which serves as an optical stencil during the photo-screening process. The sealing areas of the faceplate and the frame are joined in a final assembly operation such that the frame becomes an integral constituent of the cathode ray tube.

A mask registration and supporting system for a cathode ray tube having a rounded faceplate with a skirt for attachment to a funnel is disclosed by Strauss in U.S. Patent No. 4,547,696. The skirt of the faceplate provides the necessary Q-distance between the mask and the screen. A frame dimen-

sioned to enclose the screen comprises first and second spaced-apart surfaces. A tensed foil shadow mask has a peripheral portion bonded to a second surface of the frame. The frame is registered with the faceplate by ball-and-groove indexing means. The shadow mask is sandwiched between the frame and a stabilizing or stiffening member. Following final assembly, the frame is permanently fixed in place within the tube envelope between the sealing lands of the faceplate and a funnel, with a stiffening member projecting from the frame into the funnel.

In U.S. Patent No. 4,593,224 to Palac, there is disclosed a shadow mask mount in the shape of a rectangular frame for use in tensing an in-process shadow mask, and for temporarily supporting the mask while in tension. An apertured foil comprising the in-process mask is laid across the opening in the frame and is secured to the frame by brazing or welding. The coefficient of thermal expansion of the foil is preferably equal to or slightly less than that of the frame. A glass frame is also provided that consists of two identical rectangular members smaller in circumferential dimension than the metal frame. When joined into a single frame, the members are located between the tube faceplate and funnel to become an integral part of the tube envelope in final assembly. Each member of the glass frame has indexing means, one member for indent-detent registration with the faceplate, and the other for indent-detent registration with the funnel. Following the application of a layer of devitrifying cement in paste form to the facing surfaces of the two members, the mask, held in the metal frame, is sandwiched between the two members. As the assembly is heated, the expansion of the mask is taken up by screw means attached to the metal frame which press against the peripheries of the members. Upon cooling of the assembly, the coefficient of thermal expansion of the mask being greater than that of the glass, results in the mask being held permanently in tension by the glass frame through the medium of the frit cement, which has become solidified by the heat. The portion of the mask that projects beyond the periphery of the glass frame is severed to release the metal frame. The glass frame with its captivated mask is then mounted on a lighthouse for photoscreening the faceplate, with registration with the lighthouse and faceplate provided by the indent-detent means described.

In a journal article, there is described means for mounting a flat tensed mask on a frame for use in a color cathode ray tube having a circular faceplate with a curved viewing surface. In one embodiment, the mask, which is also circular, is described as being welded to a circular frame comprised of a 3.2 mm (1/8-inch) steel section. The frame with captivated mask is mounted in spaced relationship to a phosphor-dot plate, and the combination is assembled into the tube as a package located adjacent to the faceplate. ("Improvements in the RCA Three-Beam Shadow Mask Color Kinescope," by Grimes et al. The IRE, January, 1954; decimal classification R583.6).

U.S. Patent No. 3,894,321 to Moore, which is more pertinent prior art is directed to a method for processing a color cathode ray tube faceplate in conjunction with a thin foil tension shadow mask. A frame screw-clamp supports a tensed mask during lighthouse exposure of an associated screen. The faceplate is registered with the mask support frame by means of three alignment posts which extend from the lighthouse, and against which the frame and the faceplate are both biased by gravity. The faceplate and frame, being both reference to the three lighthouse posts, are thereby referenced to each other.

In general this invention aims to provide means to facilitate the manufacture of color cathode ray tubes having a tensed foil shadow mask by providing improved fixturing means that will greatly facilitate this manufacture.

The present invention therefore provides a factory fixture frame for mounting an in-process shadow mask for use in the manufacture of a color cathode ray tube having a flat faceplate and a tensed foil shadow mask said shadow mask having a predetermined pattern of apertures therein and said faceplate having registration affording means externally of the tube, said frame including a generally rectangular frame means defining a central opening, indexing means associated with said frame and cooperable directly with the registration affording means of an in-process faceplate, and means for removably securing said shadow mask in tension on said frame across said frame opening whereby said frame is adapted for temporarily mounting and conveying an in-process shadow mask for processing by manufacturing machinery.

A related aim is to provide an improved process for the manufacture of color cathode ray tubes.

The present invention therefore provides a process for use in the manufacture of a color cathode ray tube having a flat faceplate and a tensed foil shadow mask, said process including the steps of providing a reusable, generally rectangular factory fixture frame having releasable mask-retaining means, temporarily and removably supporting an in-process shadow mask in tension on said frame with said releasable mask-retaining means, providing an in-process faceplate having indexing means extending from the side thereof for registration with indexing means extending internally from said factory fixture frame, providing a shadow-mask-sup-

porting structure and securing said structure to the screen-bearing surface of said faceplate on opposed sides of the screen, affixing said in-process shadow mask in tension to said supporting structure, and severing the combined mask-faceplate assembly from said frame thereby releasing said frame for reuse.

The novel feature of the present invention is that indexing means is associated with the frame and cooperated directly with the registration affording means. The registration affording means extend from the side of the in-process faceplate for registration with indexing means extending internally from the frame. Contrary to the present invention, the known frame of U.S. Patent 3,894,321 has indexing means associated with the lighthouse so that the frame and the faceplate are indexed indirectly through the lighthouse. The alignment posts functioning as registration affording means extend from the lighthouse rather than from the side of the faceplate.

Another feature of the invention is the provision of a factory fixture frame that is capable of highly precise and repeatable two-sided registration with a lighthouse and a faceplate during faceplate photoscreening, and precise registration with a mask-welding and severing machine.

Still another feature of the invention involving a factory fixture frame including tensed foil in-process shadow mask clamping means for quickly and securely clamping and retaining a shadow mask under high tension without damage to the mask.

In general the factory fixture frame of the invention is rigid in construction, reusable, and relatively light in weight for easy handling.

Further features and advantages of the present invention will best be understood by reference to the following description of preferred embodiments of the invention taken in conjunction with the accompanying drawings (not to scale), in the several figures of which like reference numerals identify like elements, and in which:

Figure 1 is a side view in perspective of a color cathode ray tube having a flat faceplate and a tensed foil shadow mask, with cut-away sections that indicate the location and relation of the faceplate and shadow mask to other major tube components;

Figure 2 is an oblique view in perspective of a factory fixture frame according to the invention with an in-process shadow mask mounted in tension therein.

Figure 3 is a view in elevation and in perspective of a mask tensing-clamping machine for receiving a factory fixture frame according to the invention;

Figure 4 is a plan view of an in-process shadow mask;

Figure 5 is a perspective view that depicts schematically the mounting of an in-process shadow mask on a platen.

Figure 6 is a plan view of a first side of a factory fixture frame according to the invention and showing details of indexing means;

Figure 7 is a view similar to the figure 6 view, but showing a second side of a factory fixture frame according to the invention, and showing additional details of indexing means;

Figure 8 is a perspective view of a photo-exposure lighthouse with the base partly cut away, and with the factory fixture frame according to the invention and an in-process faceplate indicated as being exploded therefrom;

Figure 9 is a plan view of an in-process faceplate showing the screening area, a shadow mask support, and indexing means extending from the sides thereof;

Figure 10 is a view in perspective that depicts diagrammatically the means for mounting and registering the factory fixture frame according to the invention with means for mask welding and severing;

Figures 11A and 11B are sectional views in elevation taken along lines A-A of Figure 10, and showing the sequence of precision registration of the factory fixture frame according to the invention with means for mask welding and severing.

Figure 12 is an end elevational view of one of the mask-clamping spring clips of the invention;

Figure 13 is a side elevational view taken 90° to that of Figure 12, of the spring clip;

Figure 14 is an end elevational view of a modified version of the Figure 12 clip;

Figure 15 is a plan view of the topside of a factory fixture frame according to the invention;

Figure 16 is a plan view of the bottomside of a frame disclosing a plurality of spring clips clamping an in-process shadow mask in tension on the frame;

Figure 17 is an end elevational view of an actuating mechanism employed in the machine of Figure 3 for closing and opening the spring clips shown in Figures 12-14;

Figure 18 is a side elevational view of a portion of the machine of Figure 3, illustrating a partial bank of the mechanism shown in Figure 17;

Figure 19 is an elevational view of the upper portion of the mechanism illustrated in Figure 17 in conjunction with a fragmented portion of a factory fixture frame and a shadow mask disposed between two heater platens of the machine of Figure 3;

Figure 20 is a view similar to that of Figure 19 but with the spring clip actuating mechanism, the factory fixture frame and the platens in posi-

tion with the spring clip initiating control with the edge of the shadow mask;

Figure 21 is a view operationally sequential to the views of Figures 19 and 20, showing the spring clip fully inserted, to maintain the shadow mask in tension while supported by a factory fixture frame;

Figure 22 is a fragmented and partially sectioned view, on an enlarged scale, illustrating withdrawal from a spring clip actuating mechanism and depicting the position of a spring clip shoe holding the shadow mask in tension on the factory fixture frame;

Figure 23 is a fragmented and partially sectional view illustrating initiation of the mask scrap removal process;

Figure 24 is a fragmented and partially sectioned view depicting completion of the mask scrap removal process.

Figure 25 is a plan view of a factory fixture frame provided with peripheral groove means within which an in-process shadow mask is temporarily and removably supported in tension in accordance with a further embodiment of the invention;

Figure 26 is a fragmented section through a portion of the factory fixture frame of Figure 25 illustrating the peripheral groove means with one form of mask retaining means according to the invention;

Figure 27 is a view similar to that of Figure 26 illustrating another form of the mask retaining means;

Figure 28 is a view somewhat similar to that of Figures 26 and 27, illustrating a further form of the mask retaining means;

Figures 29a-29f are views somewhat similar to Figures 26-28, illustrating the sequence of operation of still another form of the mask retaining means.

Figure 30 is a plan view of a further modification of a factory fixture frame according to the invention with peripheral recess means within which an in-process shadow mask is temporarily and removably supported in tension;

Figure 31 is a fragmented section through a corner of the factory fixture frame of Figure 30 illustrating one aspect of this further modification of a mask-retaining means according to the invention; and

Figure 32 is a view similar to that of Figure 31, illustrating another aspect of the mask-retaining means according to this further modification of the invention.

To facilitate understanding of the factory fixture frame and its relation to the process of manufacturing a tensed mask cathode ray tube, a brief description of a tube and its components is provided in following paragraphs.

A color cathode ray tube 20 having a tensed foil shadow masks is shown by Figure 1. The front assembly 22 of tube 20 includes a faceplate 24. On the inner surface 26 of face-plate 24--known as the "screening surface"--is indicated as being deposited a phosphor screen 28. A film of aluminum 30 is indicated as covering the screen 28. The peripheral sealing area 32 of faceplate 24 is depicted as being attached to the peripheral sealing area 33 of a funnel 34.

Front assembly 22 includes a shadow mask support structure 48 for mounting a metal foil shadow-mask 50 which is secured to support structure 48 in tension. The anterior-posterior axis of tube 20 is indicated by reference number 56. A magnetic shield 58 is shown as being enclosed within funnel 34. High voltage for tube operation is indicated as being applied to a conductive coating 60 on the inner surface of funnel 34 by way of an anode button 62 connected in turn to a high-voltage conductor 64.

The neck 66 of tube 20 is represented as enclosing an in-line electron gun 68, depicted as providing three discrete in-line electron beams 70, 72 and 74 for exciting respective red-light-emitting, green-light-emitting, and blue-light-emitting phosphor elements on screen 28. Yoke 76 receives scanning signals and provides for the scanning of beams 70, 72 and 74 across screen 28. A contact spring 78 provides an electrical path between the funnel coating 60 and mask support structure 48.

The factory fixture frame according to the invention provides for the high precision in the registration and re-registration of a foil in-process shadow mask with a faceplate during manufacture. Absent the requisite precision, an error in registration of as little as 5 μm (0.0002 inch) can result in color impurities. Mask 50 typically may have about 1,700,000 apertures, and the resulting screen 28, after photoscreening by means of the factory fixture frame according to the invention, will have three times as many discrete phosphor deposits thereon. There is an absolute minimum of tolerance in registration at any stage of the production process.

A reusable factory fixture frame 82 according to the invention is shown in Figure 2; a first side 84 of frame 82 is indicated. The frame 82 is intended for use in the manufacture of a color cathode ray tube of the type shown by Figure 1, which is noted as having a flat faceplate and a tensed foil shadow mask. Factory fixture frame 82 provides for mounting an in-process shadow mask during photoexposure of an in-process faceplate in a lighthouse, and serves as a fixture for the process of welding and severing the in-process mask, as will be described. As depicted in Figure 2, reusable factory

fixture frame 82 comprises a generally rectangular frame means and quick-release mechanical mask-retaining means for temporarily and removably supporting in-process shadow mask 86 in tension. Frame 82 is indicated as supporting shadow mask 86 in tension by means of mechanical mask-retaining means 88. Factory fixture frame 82 provides for the cementless and weldless quick-retention of in-process shadow mask 86 out of the plane of mask 86.

The factory fixture frame 82 will be noted as having handles 90A, 90B and 90C for convenience in handling during manufacture. Handles 90A and 90B provide for lifting the frame, and handle 90C provides for inserting and removing the factory fixture frame 82 from the mask tensing-clamping machine 96 depicted in Figure 3. The mask tensing-clamping machine 96 provides for receiving the factory fixture frame 82, which is loaded into the mask tensing-clamping machine 96 by an operator using the handles described; the factory fixture frame 82 is indicated in Figure 3 as being mounted in machine 96, and ready to tense and clamp an in-process shadow mask. Machine 96 is indicated as having an upper platen 100 and a lower platen 102. The platens are heated to provide for expansion of the mask blank prior to the clamping operation.

An in-process shadow mask is depicted in Figure 4. In-process mask 86 comprises a center field 104 of apertures intended for the color selection function in the completed tube. Center field 104 is indicated as being enclosed by a frame 106 of unperforated metal; this frame is trimmed off in a later operation at trim line 108, indicated by the dash line, by means that will be described. In-process mask 86 is indicated as having a round perforation 109 in frame 106, and an elongated perforation 110 opposite. As depicted in Figure 5, the perforations 109 and 110 provide for registering the in-process mask 86 with respective pins 112 and 114 that project from lower platen 102. The elongated perforation 110 provides tolerance for the expansion of the in-process mask resulting from its contact with the heated platens 100 and 102, an expansion that is on the order of 0.8 mm (0.030 inch).

When the in-process mask 86 is fully expanded by the heat of upper and lower platens 100 and 102, the mask is clamped, and the platens are withdrawn. The mask tenses as it cools, and it is held in tension by the clamping means 88 that are a component of factory fixture frame 82, as will be described.

Factory fixture frame 82 has two sides of interest: first side 84, depicted in Figures 2, 6 and 10 and a second side 118, depicted in Figures 7 and 8. With reference to Figure 8, first six-point indexing means on first side 84 provide for registration with complementary registration-affording means on an exposure lighthouse 122, and second six-point indexing means on an opposed second side 118 provide for registration with complementary registration-affording means on an in-process faceplate 120. As a result, in-process shadow mask 86 can be precisely registered and re-registered with lighthouse 122 and an in-process faceplate 120 while retaining the in-process shadow mask 86 in tension. The first six-point indexing means on the first side 84 also provide for registering the frame 82 and in-process shadow mask 86 with mask tensing and clamping means, noted as being machine 96, which has complementary six-point indexing means, as will be described.

The clamping means 88 for clamping and holding in-process mask 86 in tension is depicted in Figure 6 as being in the form of a series of discrete spring clip means which provide for mechanically clamping the mask in tension. The preferred spring clip means for clamping the in-process mask in tension will be described hereinafter in greater detail with reference to Figs. 12 to 24 of the drawings. The factory fixture frame, while clamping the tensed in-process mask, is removed from the mask tensing-clamping machine 96 in readiness for subsequent photoexposure and screening operations, as will be described.

Photoexposure lighthouse 122 is illustrated schematically in Figure 8 as comprising a base 124 within which is a light source 126 that emits ultraviolet radiation to which the various screening fluids are sensitized. The rays of the light source 126 typically pass through a correction lens and a neutral density filter (not shown) before reaching the shadow mask. A table top 128 provides for mounting a platform 130 for receiving factory fixture frame 82.

The six-point indexing means is depicted by way of example as comprising ball-and-groove means located on the parts to be registered. Although ball-and-groove indexing means are depicted for this means of indexing in this, and in subsequent depictions, it is noted that other means of indexing may as well be used.

With reference to the first side 84 of factory fixture frame 82, three groove means 132A, 132B and 132C are shown; these groove means provide for registration with three ball means 134A, 134B and 134C located on platform 130 of lighthouse 122. As indicated by Figure 8, the factory fixture frame 82 according to the invention is lowered into registration with the lighthouse 122 for exposing the screening surface of in-process faceplate 120 to radiation from light source 126.

Groove means 132A, 132B and 132C also provide for the registration of factory fixture frame 82

with the mask tensing-clamping machine 96 in conjunction with six-point indexing means 135A, 135B and 135C depicted in Figure 3 as being in the form of ball means projecting from the lower platform 137 of machine 96. (Ball means 135C is not visible in Figure 3.) Factory fixture frame 82 according to the invention is noted as having on its second side 118, second six-point indexing means for registering with complementary registration-affording means on the in-process faceplate 120. The indexing means are indicated as comprising ball-and-groove means located on the parts to be registered. With reference to the second side 118 depicted in Figure 7 three groove means 136A, 136B and 136C are depicted; these groove means provide for registration with three balls means 138A, 138B and 138C extending from the sides of faceplate 120, as depicted in Figure 9. The ball means 138A, 138B and 138C comprise temporary indexing means. The cement used for attachment of the temporary indexing means is of the type that becomes non-adherent at the frit cycle temperature of 435 degrees C. As a result, the ball means fall away from the faceplate at the time of final assembly. It will he observed that at least one of the sides of the factory fixture frame according to the invention has at least first and second six-point indexing means azimuthally rotated with respect to each other for indexed mating with complementary six-point indexing means on manufacturing machinery, with the manufacturing machinery noted as being a lighthouse in this phase of the process.

Plastic guides 140, indicated as being eight in number, provide for guiding in-process faceplate 120 into recess 141 of factory fixture frame 82, with the final, precision registration being provided by grooves 136A, 136B and 136C in registery with ball means 138A, 138B and 138C that extend from in-process faceplate 120.

In-process faceplate 120 has on its inner surface 142 a screening area 144 for receiving discrete deposits of phosphors. A shadow mask support structure 146 has surface 148 for receiving and securing in-process shadow mask 86 in tension by means to be described. The photoscreening process then follows. The inner surface 142 of the in-process faceplate 120, noted as being the screening surface, is first coated with a light-sensitive material. With reference to Figure 8, the factory fixture frame 82 according to the invention , with the in-process shadow mask mounted in tension therein, is installed on the platform 130 of lighthouse 122, with precise registration of the first side 84 of frame 82 being provided by groove means 132A-C in conjunction with ball means 134A-C, which are located on lighthouse platform 130. The in-process faceplate 120 is in turn mounted on the factory fixture frame in precise registration with the captivated mask using groove means 136A-C on the second side 118 of frame 82 in conjunction with ball means 138A-C that extend from the sides of faceplate 120.

The screening surface 142 of faceplate 120 is exposed to light actinic to the coating through each of the apertures in the in-process mask 86. Faceplate 120 is then removed from lighthouse 122 to "develop" the coating. As a result of the preceding steps, a "grille" is formed on the screening surface 142 which has three open areas in correlation to each aperture of the shadow mask. The opening provide for receiving sequential deposits of red-light-emitting, green-light-emitting and blue-light-emitting phosphors. The faceplate is coated with a slurry containing phosphor which may comprise, by way of example, a phosphor that emits red light when excited by an electron beam. The faceplate is replaced in the lighthouse in precise registration with the in-process shadow mask, and the coating is exposed to light projected through the apertures of the mask from a light source located at a position that corresponds to the emission point of the particular electron beam that is intended to excite the red-light-emitting phosphor. The light, in effect, "hardens" the phosphor so that it will remain in place during a subsequent washing process.

The foregoing steps are repeated in turn to deposit the green-light-emitting phosphor and the blue-light-emitting phosphor in the respective openings in the grille. At least four such engagements and disengagements of the mask are required in the screening process. The final product is a faceplate having on its screening area 144 a pattern of groups of dots or lines capable of emitting upon excitation by electron beams red, green or blue light; this area comprises the screen 145. It is to be noted that, in this process, an in-process shadow mask is typically "mated" with an in-process faceplate; that is, the same mask is used in the photoscreening of a particular faceplate, and is permanently installed in conjunction with the faceplate in final assembly.

Upon completion of the photoscreening process, the in-process shadow mask 86 is affixed to the mask-receiving surface 148 of the shadow mask support structure 146, and the mask 86 is removed from the factory fixture frame 82. The apparatus and process however, is described in the following paragraphs in some detail in connection with Figures 7, 10 and 11 to facilitate a fuller understanding of the form and function of the factory fixture frame according to the invention.

With reference to Figure 7, the second side 118 of factory fixture frame 82 is depicted as having third six-point indexing means 152A, 152B and 152C, depicted as being in the form of radially

oriented grooves. Second side 118 is also depicted as having fourth six-point indexing means 154A, 154B and 154C, depicted as being in the form of ball means projecting from frame 82. Third and fourth six-point indexing means provide for gross and fine registration, respectively, of factory fixture frame according to the invention and an in-process mask with assembly means for affixing the mask to mask-support means extending from and secured to the faceplate, as will be shown and described.

With reference now to Figure 10, there is indicated diagrammatically a receiving fixture 156 which is a part of a mask welding and severing machine (not shown). The machine includes a carousel which rotates to four stations in the process of welding an in-process shadow mask held in tension in the factory fixture frame to a mask support structure, and severing the resulting mask-faceplate assembly from the frame. In consequence of this process, the factory fixture frame is released for the temporary installation of a new in-process mask, and the faceplate assembly is released for attachment to a funnel.

Receiving fixture 156 is indicated as having three indexing means 158A, 158B and 158C represented as being in the form of ball means extending upwardly from fixture 156. Indexing means 158A, 158B and 158C provide for indexing with complementary six-point third indexing means 152A, 152B and 152C located on the second side 118 of factory fixture frame 82 (see Figure 7); indexing means 152A, 152B and 152C are indicated as being in the form of radially oriented grooves. These indexing means provide for the gross registration of the factory fixture frame 82 and the enclosed in-process shadow mask 86 with the mask welding and tensing machine. Installation of the frame 82 on receiving fixture 156 is accomplished manually by means of the handles 90A, 90B and 90C.

The precise configuration of the shadow mask receiving surface 148 in relation to the ball means 138A-C of the in-process faceplate 120 is mapped by optical means in the second station (not shown) of the mask welding and severing machine. The receiving fixture 156, with thee factory fixture frame 82 mounted thereon, is then rotated to a third station of the mask welding and severing machine along with the in-process face-plate 120. At this third station, fine registration means are brought into play to ensure exact and precise registration of the clamped-in mask with in-process faceplate 120, and to present the mask receiving surface 148 in a precise relative relationship in order to utilize the above-described mapping information to effectively drive the welding head at the masks welding and severing machine.

With reference again to Figure 7, the fourth "fine" registration means comprise six-point indexing means 154A, 154B and 154C, depicted as comprising three ball means extending from the second side 118 factory fixture frame 82. Complementary to six-point indexing ball means 154A, 154B and 154C are the associated six-point indexing means 160A, 160B and 160C, indicated in Figure 10 as comprising groove means located atop respective ram heads 161A, 161B and 161C all three of which are mounted on a platform and raised and lowered in synchronism by a pneumatic piston (the platform and piston are not shown). As indicated by the associated arrows, ram heads 161A, 161B and 161C are caused to rise up to cause groove means 160A, 160B and 160C to engage respective the six-point indexing ball means 154A, 154B and 154C, located on second side 118 of the frame 82, and lift factory fixture frame 82 in precise, alignment with the drive reference of the laser beam that is used to weld the in-process mask 86 to mask support structure 146. In effect, factory fixture frame 82 has two related sets of six-point indexing means: the first of the sets provides for transporting frame 82 into a gross position relative to an operation utilizing the in-process mask, noted as being a laser mask welding and severing operation. The second of the sets provides for positioning of the factory fixture frame 82 in the welding and severing operation such that when the in-process faceplate 120 is brought into registry with the frame through the conjunction of ball means 138A-C on the faceplate with the groove means 136A-C on the frame, the faceplate is so located that the welding head can "find" the mask mounting surface 148 according to the stored mapping information obtained in the mapping station. In addition, as in lighthouse exposure processing, mating of the faceplate ball means 138A-C with the groove means 136A-C on the factory fixture frame assures precise registry at the screen 145 with the center field of apertures 104 of the clamped mask during the welding and severing operation.

With reference again to Figure 7, ball means 154A, 154B and 154C also provide for precise registration of the factory fixture frame 82 with a frame carrier and hence precise positioning and mounting of the in-process shadow mask in the factory fixture frame according to the invention.

The function of the second of the sets of six-point indexing means for assuring absolute accuracy is depicted highly schematically in Figures 11A and 11B. Ram heads 161A and 161B (in conjunction with ram head 161C which is not shown) are indicated as having lifted factory fixture frame 82 from the gross position wherein the frame 82 was resting on ball means 158A, 158B and

158C of receiving fixture 156 by the conjunction of the ball means with groove means 152A, 152B and 152C. The clamping of mask 86 in frame 82 is indicated schematically by arrow 88A. Faceplate 120 is depicted as resting on carriage 162, indicated symbolically as being made of a plastic. A plastic softer than the glass of the faceplate is preferred as a carrier as it will not scratch or otherwise abrade the polished surface of the faceplate.

As indicated by the associated arrow, carriage 162 can be raised and lowered by the pneumatic piston 163, depicted in Figure 11A as being in the lowered position.

Figure 11B depicts in-process faceplate 120 as having been lifted by piston 163 into exact registration with factory fixture frame 82 and with the in-process shadow mask 86 contained therein. The means of registration of the in-process faceplate with the factory fixture frame are indicated as comprising the conjunction of ball means 138a, 138b (and 138C, not shown) that extend from faceplate 120 with groove means 136A, 136B, (and 136C not shown) that extend inwardly from factory fixture frame 82. The mask-receiving surface 148 of shadow mask support structure 146 is indicated in Figure 11B as being in intimate, uniform contact with the shadow mask 86. The mask 86 could as well be in a negative interference relationship with the mask-receiving surface 148 mask support structure 146.

The in-process mask 86, still clamped in tension in the factory fixture frame 82, is welded to mask receiving surface 148 of the shadow mask support structure 146; the weld line 164 is indicated in Figures 4 and 10. Welding is preferably accomplished with the beam of a carbon dioxide laser. The welding process is indicated schematically in Figure 11B by arrow 166 which represents the laser beam. Upon completion of the welding, the power of the beam is reduced and the frame 106 of unperforated metal of in-process shadow mask 86 is severed at trim line 108, indicated by the arrow; the trim line 108 is, also indicated in Figures 4 and 10.

Upon completion of the severing operation, the in-process shadow mask, now secured to mask support structure 146, is free of the factory fixture frame 82, and the assembly has become a viable faceplate assembly complete with a phosphor-bearing screen 145, and ready for attachment to a funnel. The attachment of a faceplate assembly to a funnel is depicted in Figure 1.

The factory fixture frame 82 is reinstalled in the mask tensing-clamping machine 96, and the remainder of the mask 86 that is still clamped in the frame 82, that is, the frame 106 of unperforated metal, is removed from the frame, and a new in-process mask is tensed and clamped in the frame. The cycle of faceplate photoscreening, and mask welding and severing, is then repeated.

In summary, the process according to a preferred aspect of the invention for use in the manufacture of a color cathode ray tube having a flat faceplate and a tensed foil shadow mask comprises the following--

providing a reusable, generally rectangular factory fixture frame having quick-release mechanical mask-retaining means;

temporarily and removably supporting an in-process shadow mask in tension on the frame by the mechanical mask-retaining means;

providing on a first side of the frame six-point indexing means and, using the indexing means, registering the frame and the mask with a photoexposure lighthouse having complementary six-point indexing means;

providing on a second, opposed side of the frame six-point indexing means, and registering the frame and the mask with means for affixing the mask to a mask-supporting structure on the faceplate;

affixing the mask to the mask-supporting structure; and

severing the combined mask and faceplate assembly from the frame thereby releasing the frame for reuse.

Additionally and further in accord with a preferred aspect of the inventive process, third and fourth six-point indexing means are provided on the second side 118 of factory fixture frame 82 for gross and fine registration, respectively, of the frame 82 according to the invention, and the in-process mask 86, with complementary six-point indexing means on the mask welding and severing machine. It is essential that the material of which the factory fixture frame is made provide a structure that is reusable, rigid in construction, and yet relatively light in weight for easy handling. A preferred material is cast stainless steel which provides the necessary rigidity and corrosion resistance. The lightness of the factory fixture frame according to the invention is due to its construction, in that it is cast in the form of thin main members supported by numerous gussets. The factory fixture frame is made reusable by virtue of the fact that the frame 106 of unperforated metal of the in-process shadow mask is not permanently secured to the factory fixture frame by means such as welding, but instead, by quick-release mechanical means according to the invention. Components of the six-point indexing means such as groove means and ball means are necessarily hardened to limit the effects of physical wear and the trauma of physical shock and impact inherent in the positioning and retrieving of the frame by hand during

production.

Figures 12-24 disclose further aspects of the invention including the preferred form of quick-release mechanical mask-retaining means for use on the reusable factory fixture frame to temporarily and removably support the in-process shadow mask in tension.

Figures 12-14 show the details of the clamping means in the form of spring clips 218, 218' embodying the concepts of the invention.

Figures 15 and 16 show a factory fixture frame 220 which functions like frame 82 of Figures 6 and 7 for precisely registering and re-registering a foil in-process shadow mask with a faceplate during manufacture. As is visible in Figure 16, a plurality of spring clips 218 are employed in rows along each side of frame 220 for clamping the mask foil.

As previously described factory fixture frame 220 like frame 82 provides for mounting an in-process shadow mask 222 during photoexposure of an in-process faceplate in a lighthouse, and serves as a fixture for the process of welding and trimming the in-process mask. The factory fixture frame is reusable and comprises a generally rectangular frame means and a quick-release mechanism comprising mask-retaining means (i.e. spring clips 218) for temporarily and removably supporting an in-process shadow mask 222 in tension by means of the spring clips 218. The factory fixture frame provides for a cementless and weldless quick-retention of an in-process shadow mask 222. Without going into great detail, suffice it to say that factory fixture frame 220 includes receptacle means in the form of grooves 224 (Fig. 16) for receiving an edge 226 of shadow mask 222, with spring clips 218 captivating the shadow mask in the grooves. In essence, the spring clips comprise a quick-release mechanical mask-retaining means for securing the shadow mask in tension in the receptacle means formed by grooves 224.

The mask tensing-clamping machine 96 (Fig. 3) receives the factory fixture frame 220 which is loaded into the machine by an operator in a manner similar to the loading of frame 82 . The machine also provides for receiving a shadow mask 222 in a free state between the upper and lower platens 100 and 102, respectively. As noted earlier, the platens are heated to elevate the temperature of shadow mask 222 as the platens sandwich the mask therebetween, which sandwiching serves principally to flatten the mask and render it wrinkle-free. Edges 226 of the shadow mask are clamped into grooves 224 by spring clips 218 of the factory fixture frame while the shadow mask is heated. The edge-clamped shadow mask then is allowed to cool and shrink into tension while being temporarily and removably supported in this state, on frame 220 by spring clips 218. The frame, with its tensed shadow mask, then is ready to be transported through other processing steps, such as the aforesaid photoexposure of an in-process faceplate in a lighthouse.

Referring back to Figures 12 and 13, each spring clip 218 includes a relatively strong, generally U-shaped outer spring 228 and a generally U-shaped inner spring 230 of lesser strength. A pair of shoes 232 of inverted, generally L-shapes are positioned over the distal ends of U-shaped Spring 228, as shown in Figures 12 and 14. Locating pins, generally designated 240, extend freely through concentrically disposed apertures in shoes 232 and the legs of spring 228, see Figures 12 or 14. Specifically, each pin 240 has a reduced end 240a which extends through the respective shoe 232 and an enlarged end 240b which abuts the outwardly directed face of its assigned shoe and extends through aperture 242 in the adjacent leg of spring 228. The distal ends of U-shaped inner spring 230 are bifurcated and located on ends 240a of pins 240 while, at the same time, apply a biasing force against the inside surfaces of shoes 232 in opposing directions, as indicated by arrows "B" (Fig. 12). The combination of the biasing spring 230, and the cooperative structure of shoes 232 combine to provide a "floating" or "lost-motion" action for shoes 232 to enable the shoes to yield and wipe the edge of the shadow mask as a spring clip 18 is inserted into groove 224 in the factory fixture frame, all in a manner to be described.

At this juncture it should be noted that spring clip 218' of Figure 14 differs from clip 218 of Figures 12 and 13 only in that the pin 240 assigned to the leg of left shoe 252 (as viewed in Figure 14) is welded, or otherwise fixed to the left leg of U-spring 228. This weld is identified by reference numeral 241. This effectively immobilizes the left shoe 232, for a purpose to be explained below.

Referring to Figures 17 and 18 in conjunction with Figure 3, machine 96 is seen to include rows of actuating mechanisms, generally designated 244, about the periphery of the four sides of lower heater platen 102. At least portions of these mechanisms are shown in Figures 17-24 and are provided to effect closing and opening of spring clips 218. As shown in Figures 17 and 18, one such actuating mechanism 244, is provided for closing and opening an adjacent pair of spring clips 218. The actuating mechanisms are operated by pneumatic piston and cylinder devices 246 which respond to the control center that governs the cyclic operation of machine 96.

Each actuating mechanism 244 includes a scissors-type spring clip closing device, or grippers, generally designated 248, a cam wedge 250, and a pneumatic piston and cylinder device 246.

Scissors device 248 includes a pair of arms 248a pivoted intermediate their ends, as at 252, to define opposed jaws 254, at one end of the scissors device, and actuating arms 256 at the opposite end. A removable rub pad 255 is fastened atop each of jaws 254 to engage the underside of the associated shoe 232, see Figure 19. This arrangement serves to prevent bight of U-spring 228 from bottoming against jaws 254 and being removable they can be replaced when worn, rather than replace an entire scissor arm 248a. In addition, each gripper jaw 254 contains a pair of cavities 275 to generally locate each spring clip assembly 218 along the four rows of scissors assemblies 248. A tension spring 258 is disposed between actuating arms 256 to bias the arms inwardly and, thereby, jaws 254 to an open position. A pair of follower rollers 260 are journalled within the bottom of actuator arms 256 for engaging either of two dwell surfaces 250a, 250b, on a cam wedge 250, as described hereinafter.

Cam wedge 250 is coupled to a plunger or extension 262 of the piston portion of the piston and cylinder device 246. A biasing coil spring 264 surrounds plunger 262. From the foregoing it can be seen that movement of cam wedge 250 by the pneumatic piston and cylinder device 246 in the direction of arrow "B" (Fig. 17) will cause the cam wedge to enage follower rollers 260 journalled on the lower ends of actuator arms 256. An upward displacement of cam wedge 250 from an initial position (Figure 17), in which cam dwell surface 250a is in engagement with roller 260, to an elevated position (Figure 19), in which dwell surface 250b engages roller 260, spreads actuator arms 248a outwardly in the direction of arrows "C" to cause a pivotal displacement of jaws 254 about point 252 inwardly in the direction of arrows "D". Since jaws 254 are in engagement with spring clip 218, an inward movement of the jaws is effective to drive the legs of U-shaped spring 228 inwardly to close the spring clip and effect inward movement of shoes 232 in the direction indicated by arrows "E", see Figure 19.

The above described function of actuating mechanism 244 is depicted in Figure 19 and this action, in conjunction with the mask clamping function of the upper and lower heater platens 100 and 102 of machine 96 serve to clamp the edges 226 of mask 222 in the receptacle grooves 224 of the factory fixture frame 282.

To particularize, Figure 17 shows the aforesaid components in a condition wherein cam wedge 250 is lowered, gripper jaws 254 are open, as is spring clip 218 and actuating mechanism 244 is in its deenergized condition.

Turning now to Figure 19, a factory fixture frame 220 has been inserted in the central opening in the Figure 3 machine 96 and is supported by loading rollers 266 (only one shown).

To initiate a mask heating, expansion, clamping, cooling and tensing process, a foil mask 222 is placed upon the lower heater platen 102 and indexed thereon by a pair of mask locating pins 268. One of these pins enters a hole 222h in the mask while the other pin is received in a mask slot 222s, see Figure 19. Upper heater platen 100 is then dropped to sandwich mask 222 between it and platen 102 to "iron" it out. The sandwiched mask is then heated by the platens to induce mask expansion.

The factory fixture frame 220 is then lowered making contact with the lower heater platen 102. As the lower platen 102 is pushed downward the upper platen follows. Referring now to Figure 20, the sandwiched mask 222 is now wiped, with consistent uniformity, into grooves 224 of fixture 220 by shoes 232, which shoes are cammed inwardly by the inwardly directed lip 224ℓ of fixture groove 224. This action serves to roll the mask intimately around lip 224ℓ as shoe 232 slides relative to the mask against the resistance posed by drag spring 230. At the same time, the undersides of the shoe shoulders slide across rub pads 255.

During the above-described procedure, i.e., as the frame 220 is lowered, each of three indexing slots 270 in its outer flange area engage one of three precision guidance spheres 272 which are pneumatically urged upwards. This arrangement assures an accurate alignment of frame 220 with respect to the array since the lateral relationship of the guidance spheres is fixed relative to the locating pins 268 on lower heater platen 102.

Note, at this stage, Figure 20, that support of frame 220 has been transferred from rollers 266 to spheres 272 and that the frame transport 276 continues to exert downward pressure upon frame 220 to drive the frame against the bank of foil wrapping shoes 232. This is occasioned by engagement of the transport contacts 278 with frame 220 as they drive the frame down against the restraint offered by the pneumatically loaded guidance spheres 272 and the subsequently additional restraint offered by the pneumatically extended lower heater platen 16.

Referring to Figure 21, downward travel of frame 220 is arrested by shoes 232 as they, upon full insertion into groove 224, sustain all frame transport loads through their reaction with the rub pads 255 on the scissors 248 which in turn are vertically grounded to the machine bed through pivot rods 252.

In the next sequence, pneumatic cylinders 246 are deenergized permitting springs 264 to retract cam wedges 250. This causes gripper jaws 254 to open and therefore freeing U-shaped springs 228 such that upon subsequent raising of frame trans-

porter 276, frame 220 together with its heat shrinking shadow mask 222 and clamp means 218 are free of all processing components of machine 96. This condition, shown in Figure 22, permits removal of the factory fixture frame 220 and shadow mask 222 for further procedures in the cathode ray tube manufacturing process.

In the prior discussion, procedures have been described for the heating of a foil shadow mask and its subsequent wiping, installation, and anchoring to an in-process factory fixture frame. This semi-automatic process however is "closed loop". A frame which has undergone all other cathode ray tube front end manufacturing procedures returns to the mask tensing-clamping machine 96 containing the periphery of the shadow mask 222, the central array portion having been severed by a laser beam after being welded to a mask support structure attached to the CRT faceplate. This periphery is securely clamped to the factory fixture frame 220 by the spring clips 218. In order to attain a stage depicted in Figure 19, the factory fixture frame with its scrap mask portion must be loaded into machine 96, the spring clips temporarily removed, and the mask scrap discarded. The machine configuration at the beginning of this process is best depicted by Figure 22 except that the frame 220 and spring clips 218 which have just been loaded into machine 96 capture only a peripheral scrap portion 226 of shadow mask 222 as shown in Figures 23 and 24. Frame 220 is lowered by frame carriage 276 such that spring clips 218 freely enter open jaws 254 of the multiplicity of scissors device 248. The downward motion of the carriage 276 and frame 220 is arrested as described before. The system configuration at this stage is depicted in Figure 23. Cylinders 246 are then energized thus elevating cam 250 to drive cam dwell 250b between rollers 260 to drive scissors arms 248a outward and scissors jaws 254 inward to compress U-spring 228. Thus, the shoes 232 are relieved of the high clamping contact with the side walls of groove 224. This contact is achieved through exertion of the heavy U-springs 228 when they are not being compressed by the gripper jaws 254. The mask scrap 226 is now no longer anchored to the factory fixture frame 220 and upon subsequent raising of the frame 220 by the carriage 276, the mask peripheral scrap 226 can be readily removed from machine 96. This condition is shown in Figure 24. It should be noted that during this "extraction" process, the shoes 232 are cammed inwards relative to the U-springs 228 by the frame lips 224ℓ in order that the nose of the shoes can clear the lips.

Accordingly, upon removal of the scrap remnant of mask 222 the apparatus 96 is now ready to receive the next mask foil 222 for the tensing-clamping procedure thus, effectively, ending and initiating the aforesaid closed loop process.

As previously noted in the Figure 14 embodiment of spring clip 218', the left shoe is retracted inward against the left leg of U-spring 228 and immobilized in this position by welding pin 240 to the left leg of spring 228. This side of the spring clip assembly is always deployed to the "outside", or non-mask wiping side of the basic spring clip orientation. This was determined in practice of the invention to be desirable for minimizing adverse frictional forces during automatic insertion of the spring clips into the factory fixture frames.

A modification of the clamping means shown in Figures 12-24 will now be described wherein the tensed mask is retained on the factory fixture frame without the use of means such as spring clips 218, 218'.

Figure 25 shows a factory fixture frame, generally designated 320, similar to the frame 2 of Figs. 12-24.

Without going into great detail, suffice it to say that factory fixture frame 320 includes receptacle means in the form of grooves 324 (Fig. 26) for receiving an edge 326 of shadow mask 322 and within which the mask edge is clamped.

Mask tensing-clamping machine 96 (Fig. 3) receives factory fixture frame 320 which is loaded into the machine by an operator in similar fashion to frame 82 of Fig. 3. The machine also provides for receiving shadow mask 322 in a free state between upper and lower platens 100 and 102, respectively. Generally, the platens are heated to provide for expansion of shadow mask 322 as the platens sandwich the mask therebetween. Edges 326 of the shadow mask are clamped into grooves 324 while the shadow mask is heated.

Referring to Figure 26, a peripheral portion of factory fixture frame 320 is shown with a peripheral groove 324. Shadow mask 322 is illustrated with an edge portion 326 thereof being clamped within a "keystone", or angled sidewall, groove 324 by elongated mechanical mask-retaining means in the form of a tube-like member 328. The tube-member is generally cylindrical and is forced into groove 324 in the direction of arrow "A" to wrap the edge of the shadow mask around the edge of the groove. In essence, the tube-like member is of metal or other hard material and is afforded a press-fit retention within groove 324 by virtue of the self-locking angle feature of the groove, thereby sandwiching the edge of the shadow mask between the tube-like member and the sides of the groove. This provides a temporary and removable support of an in-process shadow mask in tension.

A series of access holes 327 (only one shown) are arranged to communicate between the bottom of groove 324 and the outside of frame 320 to permit insertion of a comb-like tool in order to

extricate tube 328.

In operation and in conjunction with machine 96, upper and lower platens 100 and 102 are actuated to sandwich shadow mask 322 therebetween. The platens then are heated to heat the shadow mask and allow the mask to expand. While the shadow mask is still heated, the shadow mask is brought into position generally coplanar with the top of factory fixture frame 320, as seen in Figure 26. While still heated, rod-like member 328 is forced into groove 324 wrapping the edge 326 of shadow mask 322 around the corners of the groove therewith to temporarily and removably support the shadow mask in the groove. The heated platens then are separated and the shadow mask is allowed to cool and shrink in tension while still being temporarily and removably supported on frame 320 by virtue of tube-like member 328 being seated in groove 324.

Figure 27 shows a form of the invention somewhat similar to that of Figure 26, but the tube-like member 328a is fabricated of compressible material, such as nylon or like material. This enhances the wrapping and gripping of edge 326 of shadow mask 322 between the side walls of groove 324'. For this embodiment, the walls of groove 324' are not angled or keystoned. It can be seen in Figure 27 that compressible tube-like member 328a has been compressed generally in the direction of arrows "B". Otherwise, the operation is the same as that described in relation to the form of the invention shown in Figure 26 in regard to the sequence of heating the shadow mask and allowing it to cool shrink. The Figure 27 embodiment is also provided with a series of access holes 327' (only one shown) to facilitate removal of tube 328a.

Figure 28 shows another form of the invention wherein the tube-like member is identified as 328b and is split, as at 330, lengthwise of the tube to provide compressibility of the tube. This not only enhances the wrapping and clamping capability of the tube similar to that of the compressible tube 328a of Figure 27, but as will be shown, this embodiment of the invention also includes means to facilitate ready removal of the tube.

More particularly, in the embodiment of the invention shown in Figure 28, groove 324'' is undercut or enlarged at the base thereof, as at 324''a, such that the base of the groove is wider than the uncompressed diametral dimension of the tube. After the shadow mask is cooled and allowed to shrink, tube 328b is forced downwardly in the direction of arrow "C" to the position shown in phantom where it is uncompressed and thus substantially loose within undercut portion 324'' of groove 324''. The tube then can be removed simply by sliding the tube lengthwise out of the groove either before or after the edge portion of the shadow mask has been severed.

Figures 29a-29f show another form of the invention which embodies a pair of rod-like members 328c and 328d. It also should be noted that the bottom of the groove 324'''c now has a stepped configuration defining a "high" ledge portion 324'''b and a lower base portion 324'''c. Rod 328c is of relatively hard material, such as metal, and rod 328d is of relatively soft compressible material, such as nylon. It additionally should be noted that rod 28c is of a larger diameter than that of rod 328d.

In operating the embodiment of the invention shown in Figures 29a-29f, edge 326 of shadow mask 322 is brought into the position shown in Figure 29a, with the mask in heated condition and with rods 328c, 328d then being brought to overlay the mask. Figures 29b and 29c show rods 328c, 328d being brought into position to wrap mask edge 326 around the upper rounded corner of groove 324''', in the direction of arrows "D". Figure 29d shows the wrapping of the mask edge completed, with enlarged rod 328c now seated on top of ledge 324'''b. Smaller rod 328d is brought further into the groove in the direction of arrow "E" as shown in Figure 29e, so that both rods are now in a tight press-fit within the groove to temporarily and removably support the in-process shadow mask in tension. After the shadow mask is allowed to cool and shrink in tension, rods 328c, 328d are readily removed by forcing smaller rod 328d further into the groove, in the direction of arrow "F" (Fig. 29f) beyond or "overcenter" larger rod 328c. This release feature is afforded by the stepped configuration of the bottom of groove 324''' and the release action is similar to that disclosed in regard to the undercut groove portion 324''a described in connection with the embodiment of the invention shown in Figure 28.

A further modification of the quick-release clamping means of the invention is shown in Figures 30-32.

Figure 30 shows a factory fixture frame, generally designated 420 similar to the frame 2 of Figures 12-24.

Without going into great detail, suffice it to say that factory fixture frame 420 includes receptacle means in the form of groove or recess means 424 (Fig. 30) for receiving an edge 426 of shadow mask 422 and within which the mask edge is clamped.

Mask tensing-clamping machine 96 (Fig. 3) receives factory fixture frame 420 which is loaded into the machine by an operator in similar fashion to frame 82 of Fig. 3. The machine also provides for receiving shadow mask 422 in a free state between upper and lower platens 100 and 102, respectively. Generally, the platens are heated to provide for expansion of shadow mask 422 as the

platens sandwich the mask therebetween. Edges 426 of the shadow mask are clamped into a recess means 424 while the shadow mask is heated.

Figure 31 shows a fragmented section through a corner of factory fixture frame 420 illustrating one aspect of this further modification of the invention which includes a peripheral recess means in the form of a corner cutout 424a extending longitudinally along the outside of the fixture frame. A spring-loaded elongate means, generally designated 430, is positionable within cutout 424a to clamp edge 426 of shadow mask 422.

More particularly, spring-loaded elongate means 430 include a rigid rod-like member 432 which is generally cylindrically shaped, which may be in the form of a tube and which complementarily mates within cutout 424a. A leaf spring 434 is secured to the outer periphery of fixture frame 420, as by fastening means 436, whereby the leaf spring is biased against the outside of rod 430, as at 438, in the direction of arrow "A". To this end, rod 432 preferably is of a greater diameter than the width of cutout 424a so that the leaf spring is cocked away from the side of the fixture frame when rod 432 is in position for clamping and temporarily and removably supporting an in-process shadow mask in tension. Leaf spring 434 may be elongated along cutout 424a, or a plurality of leaf springs may be spaced along the cutout for engaging rod 432.

In operation, after shadow mask 422 is heated when sandwiched between upper and lower heated platens 100 and 102, respectively, the shadow mask is brought into generally coplanar position with the top of factory fixture frame 420, as seen in Figure 31, with edges 426 overlying cutout 424a. Rod 432 then is moved in the direction of arrow "B" to wrap mask edge 426 around the corner of cutout 424a through a 180° wrap angle. Leaf spring 434 is effective to bias rod 432 against the mask edge to clamp the mask edge for temporarily and removably supporting the in-process shadow mask in tension after the shadow mask is allowed to cool and shrink in tension.

Figure 32 shows another embodiment of the invention wherein the peripheral recess means 424 is in the form of a groove 424b disposed in an outer peripheral side 440 of factory fixture frame 420. It can be seen that edge 426 of shadow mask 422 is wrapped around the fixture frame through a wrap angle of 360° and is seated in groove 424b. The mask retaining means comprises a unitary retainer member, generally designated 442, for clamping mask edge 426 in groove 424b to temporarily and removably support the in-process shadow mask in tension.

More particularly, retainer member 442 includes a rigid head portion 444 which is rounded at 446 to complementarily mate with groove 424b to sandwich mask edge 426 between head portion 444 and the interior of the groove. A leaf spring portion 48 extends from head portion 444 and is secured to the side of factory fixture frame by appropriate fastening means 450. Preferably, a plurality of the retainer members 442 are spaced longitudinally along groove means 424b along each side of the factory fixture frame. The leaf springs are effective to bias head portions 444 into groove 424b in the direction of arrow "C".

The operation of the mask-retaining means shown in Figure 32 is similar to the embodiment described above in relation to the mask-retaining means 430 of figure 31.

As disclosed in the aforementioned Figures 25-29 a-f, a tube is inserted in a groove with the resulting clamping force being established by deformation of the clamped tube due to the smaller cross-section of the groove relative to the tube. Such a system inherently is characterized by a high spring rate thus making the clamping force highly sensitive to dimensional variations as could arise from wear or manufacturing tolerances.

Relatively low spring rate requires substantial deflection to achieve a required load. As a result, a minor change in deflection due to wear does not significantly affect the magnitude of applied load.

As is known in the band brake art, increasing the wrap angle of a band around a curved surface results in a high tension rate between the leading and trailing ends of the band. This is effectively, a force multiplication device which, with respect to Figures 31 and 32, provides a high force reaction to the mask tension while requiring only a small clamping force at the distal end of the mask.

An advantage of wrap angle is to spread the clamping force over a larger surface area of the mask foil in order to minimize pinching forces which can cause local damage resulting in failure of the mask material at the clamping location.

As a result a very effective retention of a tensed mask is achieved with minimal damage to mask material and also minimal wear and minimal structural requirements for the clamping components.

Because the wrap angle is an exponential term in the force equation, increased wrap angles can result in very significant increases in force ratio.

Claims

1. A factory fixture frame (82) for mounting an in-process shadow mask (86) for use in the manufacture of a color cathode ray tube (20) having a flat faceplate (24) and a tensed foil shadow mask (50), said shadow mask (50) having a predetermined pattern of apertures therein and

said faceplate (24) having registration affording means (138A-138C) externally of the tube (20), said frame (82) including a generally rectangular frame means defining a central opening, indexing means (136A-136C) associated with said frame (82) and cooperable directly with the registration affording means (138A-138C) of an in-process faceplate (120), and means (88) for removably securing said shadow mask (86) in tension on said frame (82) across said frame opening whereby said frame (82) is adapted for temporarily mounting and conveying the in-process shadow mask (86) for processing by manufacturing machinery.

2. The device of claim 1, wherein said generally rectangular frame means (220) has peripheral receptacle means (224) substantially thereabout, and quick-release mechanical mask-retaining means (218,218') complementarily mating with said receptacle means (224) for temporarily and removably supporting an in-process shadow mask (222) in tension.

3. The device of claim 2, wherein said receptacle means comprise groove means (224) for receiving an edge of the shadow mask (222) and said quick-release mechanical mask-retaining means comprise spring-clip means (218,218') matingly receivable in said groove means (224).

4. The device of claim 2, wherein the receptacle means comprises peripheral groove means (224) in said factory fixture frame (220) for receiving an edge of the shadow mask (222), and said quick-release mechanical mask-retaining means comprises elongate means (218,218') extending lengthwise of and complementarily mating with said groove means (224) for temporarily and removably supporting the in-process shadow mask (222) in tension.

5. The device of claim 1, wherein said frame means (420) includes peripheral groove means (424b) in a side (440) of the fixture frame (420) for receiving an edge of the shadow mask (422), and spring-loaded mechanical mask-retaining means (442) complementarily mating with said groove means (424b) for temporarily and removably supporting an in-process shadow mask (422) in tension.

6. The device of claim 5, wherein said mask-retaining means comprises a unitary retainer member (442) having a head portion (444) complementarily mating with said groove means (424b) and a leaf spring portion (448) secured to the side of the fixture frame (420).

7. The device of claim 1, wherein said generally rectangular frame means (82) has a first side (84) and an opposed second side (118), and said indexing means includes at least first and second six-point indexing means (132A-132C, 136A-136C) disposed on at least one of said frame sides azimuthally rotated with respect to each other for indexed mating with complementary six-point indexing means (135A-135C) on said manufacturing machinery.

8. The device of claim 7, wherein the first side (84) of said frame (82) has six-point indexing means (132A-132C) for indexed mating first with complementary six-point indexing means (135A-135C) located on mask tensing and clamping means (96) in said machinery, and subsequently with indexing means (134A-134C) located on a lighthouse (122), and the second side (118) of said frame (82) has six-point indexing means (136A-136C) for indexed mating with complementary six-point indexing means (138A-138C) on an in-process faceplate (120).

9. The device of claim 1, wherein said indexing means comprises two related sets of six-point indexing means (132A-132C, 135A-135C and 136A-136C, 138A,138C), the first (132A-132C, 135A,135C) of said sets providing for transporting said frame into a gross position relative to an operation utilizing said tensed foil shadow mask (50), with the second (136A-136C, 138A-138C) of said sets providing for assuring absolute accuracy in positioning said frame during said operation utilizing said shadow mask (50).

10. A process for use in the manufacture of a color cathode ray tube (20) having a flat faceplate (24) and a tensed foil shadow mask (50), said process including the steps of providing a reusable, generally rectangular factory fixture frame (82) having releasable mask-retaining means (88), temporarily and removably supporting an in-process shadow mask (86) in tension on said frame (82) with said releasable mask-retaining means (88), providing an in-process faceplate (120) having indexing means (138A-138C) extending from the side thereof for registration with indexing means (136A-136C) extending internally from said factory fixture frame (82), providing a shadow-mask-supporting structure (48) and securing said structure to the screen-bearing surface (26) of said faceplace (24) on opposed sides of the

screen, affixing said in-process shadow mask (86) in tension to said supporting structure (48), and severing the combined mask-faceplate assembly (22) from said frame (82) thereby releasing said frame for reuse.

11. The process of claim 10 including the steps of providing on a first side (84) of the factory fixture frame (82) six-point indexing means (132A-132C) and, using said indexing means, registering said frame (82) and said mask (86) with a photoexposure lighthouse (122) having complementary six-point indexing means (134A-134C), providing on a second, on opposed side (118) of said frame (82) six-point indexing means (136A-136C), and registering said frame and said mask (86) with the means (88) for affixing said mask to the mask-supporting structure (48) on said faceplate.

12. The process of claim 10 including the steps of providing a factory fixture frame (220) with peripheral receptacle means (224) for mounting an in-process shadow mask (222), and temporarily and removably supporting the in-process shadow mask (222) in tension on said frame by quick-release mechanical mask-retaining means (218,218') mating with said receptacle means.

13. The process of claim 12, wherein said shadow mask (222) is heated and allowed to expand prior to being temporarily and removably supported on said frame (220).

14. The process of claim 13, wherein said shadow mask (222) is allowed to cool and shrink in tension while being temporarily and removably supported on said frame (220).

Patentansprüche

1. Fabrikgefertigter Befestigungsrahmen (82) zum Befestigen einer Produktionslochmaske (86) zur Verwendung bei der Herstellung einer Farbkathodenstrahlröhre (20), die mit einer flachen Frontscheibe (24) und einer gespannten Folienlochmaske (50) versehen ist, wobei die genannte Lochmaske (50) eine vorbestimmte Anordnung von Öffnungen aufweist und die genannte Frontscheibe (24) Paßgenauigkeit leistende Einrichtungen (138A-138C) außerhalb der Röhre (20) aufweist, wobei der genannte Rahmen (82) eine allgemein rechtwinklige Rahmeneinrichtung besitzt, die eine zentrale Öffnung definiert, dem genannten Rahmen (82) zugeordnete Feststelleinrichtungen (136A-136C), die auch direkt mit den Paßgenauigkeit leistenden Einrichtungen (138A-138C) einer Produktionsfrontscheibe (120) zusammenwirken können; ferner mit abnehmbaren Einrichtungen (88) zur Sicherung der Spannung der genannten Lochmaske (86) an dem genannten Rahmen (82) über die genannte Rahmenöffnung, wobei der Rahmen (82) derart angepaßt ist, um temporäre Befestigung und Übertragung der Produktionslochmaske (86) zum Verarbeiten durch Produktionsmaschinen zu gewährleisten.

2. Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die genannte allgemein rechtekkige Rahmeneinrichtung (220) dort im wesentlichen periphere Fassungseinrichtungen (224) aufweist sowie schnellauslösbare, mechanische Maskenhalteeinrichtungen (218, 218'), die ergänzend mit den genannten Fassungseinrichtungen (224) zusammenpassen, um temporär und abnehmbar eine Produktionslochmaske (222) unter Spannung zu halten.

3. Einrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die genannten Fassungseinrichtungen Nuteneinrichtungen (224) umfassen , um eine Ecke der Lochmaske (222) zu empfangen, und wobei die genannten schnellauslösbaren, mechanischen Maskenhalteeinrichtungen Federklammereinrichtungen (218, 218') umfassen, die zusammenpassend in den genannten Nuteneinrichtungen empfangen werden können.

4. Einrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Fassungseinrichtung in dem genannten fabrikgefertigten Befestigungsrahmen (220) eine periphere Nuteneinrichtung (224) besitzt, um eine Ecke der Lochmaske (222) zu empfangen, und wobei die genannte schnellauslösbare, mechanische Maskenhalteeinrichtung verlängerte Einrichtungen besitzt, die sich längs der genannten Nuteneinrichtung erstrecken und ergänzend mit dieser zusammenpassen, um temporär und abnehmbar die Produktionslochmaske (222) unter Spannung zu halten.

5. Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die genannte Rahmeneinrichtung (420) in einer Seite (440) des Befestigungsrahmens (420) eine periphere Nuteneinrichtung (424b) besitzt, um eine Ecke der Lochmaske (422) zu empfangen, und daß eine unter Federspannung stehende mechanische Maskenhalteeinrichtung (442) ergänzend mit der genannten Nuteneinrichtung (424b) zusammenpaßt, um temporär und abnehmbar eine Pro-

duktionslochmaske (422) unter Spannung zu halten.

6. Einrichtung nach Anspruch 5, dadurch gekennzeichnet, daß die Maskenhalteeinrichtung ein unitäres Halteglied (442) mit einem Kopfteil (444) umfaßt, das ergänzend mit der genannten Nuteneinrichtung (424b) zusammpaßt sowie einen Blattfederteil (448), der an die Seite des Befestigungsrahmens (420) angebracht ist.

7. Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die allgemein rechteckige Rahmeneinrichtung (82) eine erste Seite (84) sowie eine entgegengesetzte zweite Seite (118) umfaßt, und wobei die genannte Feststelleinrichtung wenigstens eine erste und zweite sechsfachige Feststelleinrichtung (132A-132C, 136A-136C) besitzt, die an wenigstens einer der Rahmenseiten angeordnet sind, im Verhältnis zueinander azimutal gedreht, um festgestellt mit der sechsfachen Feststelleinrichtung (135A-135C) an der genannten Produktionsmaschine zusammenzupassen.

8. Einrichtung nach Anspruch 7, dadurch gekennzeichnet, daß die erste Seite (84) des genannten Rahmens (82) eine sechsfache Feststelleinrichtung (132A-132C) umfaßt, um erstens festgestellt mit der ergänzenden sechsfachen Feststelleinrichtung (135A-135C) zusammenzupassen, die sich auf der die Maske spannenden und klammernden Einrichtung (96) in genannter Maschine befindet, und folgend mit der Feststelleinrichtung (134A-134C), die sich auf einer Scheibenröhre (122) befindet, zusammenzupassen, und daß die zweite Seite (118) des genannten Rahmens (82) eine sechsfache Feststelleinrichtung (136A-136C) aufweist, um festgestellt mit der ergänzenden sechsfachen Feststelleinrichtung (138A-138C) auf einer Produktionsfrontscheibe (120) zusammenzupassen.

9. Einrichtung aus Anspruch 1, dadurch gekennzeichnet, daß die Feststelleinrichtung zwei in Bezug stehende Sets von sechsfachen Feststelleinrichtungen (132A-132C, 135A-135C und 136A-136C, 138A-138C) umfaßt, wobei das erste (132A-132C, 135A-135C) der genannten Sets für den Transport des genannten Rahmens in eine Gesamtposition, in Bezug auf eine Betriebsart, die die genannte unter Spannungs stehende Folienlochmaske (50) verwendet, wobei das zweite (136A-136C, 138A-138C) der genannten Sets dafür sorgt, daß absolute Genauigkeit bei der Positionierung des genannten Rahmens während der genannten Betriebsart, die die genannte Lochmaske (50) verwendet, sichergestellt ist.

10. Verfahren zur Verwendung bei der Herstellung einer Farbkathodenstrahlröhre (20), die eine flache Frontscheibe (24) sowie eine unter Spannung stehende Folienlochmaske (50) umfaßt, wobei das genannte Verfahren die Schritte zur Bereitstellung eines wiederverwendbaren, allgemein rechteckigen Fabrikbefestigungsrahmens (82) mit einer auslösbaren Maskenhalteeinrichtung (88) enthält, die temporär und abnehmbar eine Produktionslochmaske (86) unter Spannung auf dem genannten Rahmen (82) mit auslösbaren Maskenhalteeinrichtungen (88) hält, und ferner eine Produktionsfrontscheibe (120) bereitstellt, die eine Feststelleinrichtung (138A-138C) umfaßt, die sich von der Seite aus erstreckt, um Paßgenauigkeit mit der Feststelleinrichtung (136A-136C) zu erreichen, die sich innen von dem genannten fabrikgefertigten Befestigungsrahmen (82) erstreckt, und eine Konstruktion zum Tragen der Lochmaske (48) bereitstellt sowie diese genannte Konstruktion an die Schirmlagerfläche (26) der genannten Frontscheibe (24) befestigt, und zwar an entgegengesetzten Seiten des Schirms, wobei die genannte Produktionslochmaske (86) unter Spannung an die Tragekonstruktion (48) befestigt wird und den kombinierten Masken-Frontscheiben-Zusammenbau (22) von dem genannten Rahmen (82) trennt und dabei den Rahmen zur Wiederverwendung auslöst.

11. Verfahren nach Anspruch 10, einschließlich der Schritte für das Bereitstellen einer sechsfachen Feststelleinrichtung (132A-132C) an einer ersten Seite (84) des fabrikgefertigten Befestigungsrahmens (82) und, unter Verwendung der genannten Feststelleinrichtung, den genannten Rahmen (82) und die Maske (86) mit einer Bildbelichtungsscheibenröhre (122), die eine ergänzende sechsfache Feststelleinrichtung (134A-134C) aufweist, in Paßgenauigkeit zu bringen, und an einer zweiten, entgegengesetzten Seite (118) des Rahmens (82), eine sechsfache Feststelleinrichtung (136A-136C) bereitzustellen, sowie den Rahmen und die Maske (86) in Paßgenauigkeit mit der Einrichtung 1 (88) zur Befestigung der Maske an die Konstruktion zum Tragen der Lochmaske (48) an der genannten Frontscheibe zu bringen.

12. Verfahren nach Anspruch 10, einschließlich der Schritte zur Bereitstellung eines fabrikgefertigten Befestigungsrahmens (220) mit peripherer Fassungseinrichtung (224) zum Befestigen ei-

ner Produktionslochmaske (222), und wobei temporär und abnehmbar eine Produktionslochmaske (222) an dem genannten Rahmen unter Spannung zu halten, und zwar durch eine schnellauslösbare, mechanische Maskenhalteeinrichtung (218, 218'), die mit der genannten Fassungseinrichtung zusammenpaßt.

13. Verfahren nach Anspruch 12, dadurch gekennzeichnet, daß die genannte Lochmaske (222) erwärmt wird und sie sich, bevor sie temporär und abnehmbar an dem genannten Rahmen (220) befestigt wird, erweitern kann.

14. Verfahren nach Anspruch 13, dadurch gekennzeichnet, daß die genannte Lochmaske (222) sich unter Spannung abkühlen und zusammenziehen kann, während sie temporär und abnehmbar an dem genannten Rahmen (220) befestigt ist.

Revendications

1. Châssis de fixation usine (82) destiné à monter un masque perforé en cours de process (86) en vue d'une utilisation lors de la fabrication d'un tube à rayons cathodiques couleur (20) comportant une plaque avant plane (24) et un masque perforé en feuille tendu (50), ledit masque perforé (50) présentant un motif prédéterminé d'ouvertures en son sein et ladite plaque avant (24) comportant un moyen de réalisation de repérage (138A-138C) externe au tube (20), ledit châssis (82) incluant un moyen de châssis de forme générale rectangulaire définissant une ouverture centrale, un moyen d'indexage (136A-136C) associé audit châssis (82) et pouvant coopérer directement avec le moyen de réalisation de repérage (138A-138C) d'une plaque avant en cours de process (120), et un moyen (88) pour immobiliser de façon amovible ledit masque perforé (86) en tension sur ledit châssis (82) au travers de l'ouverture dudit châssis d'où il résulte que ledit châssis (82) est conçu pour monter et convoyer de façon temporaire le masque perforé en cours de process (86) en vue de son traitement par l'équipement de fabrication.

2. Dispositif selon la revendication 1, dans lequel ledit moyen de châssis de forme générale rectangulaire (220) comporte un moyen de réceptacle périphérique (224) sensiblement à proximité et un moyen de retenue de masque mécanique à libération rapide (218, 218') qui s'adapte de façon complémentaire audit moyen de réceptacle (224) pour supporter de façon temporaire et amovible un masque perforé en cours de process (222) en tension.

3. Dispositif selon la revendication 2, dans lequel ledit moyen de réceptacle comprend un moyen de gorge (224) destiné à recevoir un bord du masque perforé (222) et ledit moyen de retenue de masque mécanique à libération rapide comprend un moyen de pince à ressort (218, 218') qui peut être reçu de façon adaptée dans ledit moyen de gorge (224).

4. Dispositif selon la revendication 2, dans lequel le moyen de réceptacle comprend un moyen de gorge périphérique (224) ménagé dans ledit châssis de fixation usine (220) pour recevoir un bord du masque perforé (222) et ledit moyen de retenue de masque mécanique à libération rapide comprend un moyen allongé (218, 218') qui s'étend sur la longueur dudit moyen de gorge (224) et qui s'adapte de façon complémentaire à ce dit moyen de gorge pour supporter de façon temporaire et amovible le masque perforé en cours de process (222) en tension.

5. Dispositif selon la revendication 1, dans lequel ledit moyen de châssis (420) inclut un moyen de gorge périphérique (424b) ménagé dans un côté (440) du châssis de fixation (420) pour recevoir un bord du masque perforé (422) et un moyen de retenue de masque mécanique chargé par ressort (442) qui s'adapte de façon complémentaire audit moyen de gorge (424b) pour supporter de façon temporaire et amovible un masque perforé en cours de process (422) en tension.

6. Dispositif selon la revendication 5, dans lequel ledit moyen de masque comprend un élément de retenue unitaire (442) comportant une partie de tête (44) qui s'adapte de façon complémentaire audit moyen de gorge (424b) et une partie de ressort à lame (448) qui est fixée au côté du châssis de fixation (420).

7. Dispositif selon la revendication 1, dans lequel ledit moyen de châssis de forme générale rectangulaire (82) comporte un premier côté (84) et un second côté opposé (118) et ledit moyen d'indexage inclut au moins des premier et second moyens d'indexage à six points (132A-132C, 136A-136C) qui sont disposés sur au moins l'un desdits côtés de châssis et qui sont tournés de façon azimutale l'un par rapport à l'autre pour s'adapter de façon indexée à des moyens d'indexage à six points complémentaires (135A-135C) prévus sur ledit équipement de fabrication.

8. Dispositif selon la revendication 7, dans lequel le premier côté (84) dudit châssis (82) comporte un moyen d'indexage à six points (132A-132C) destiné à s'adapter de façon indexée tout d'abord à des moyens d'indexage à six points complémentaires (135A-135C) prévus sur un moyen de pression en tension de masque (96) situé dans ledit équipement et ensuite à des moyens d'indexage (134A-134C) prévus sur un projecteur de lumière (122) et le second côté (118) dudit châssis (82) comporte des moyens d'indexage à six points (136A-136C) destinés à s'adapter de façon indexée à des moyens d'indexage à six points complémentaires (138A-138C) prévus sur une plaque avant en cours de process (120).

9. Dispositif selon la revendication 1, dans lequel ledit moyen d'indexage comprend deux jeux connexes de moyens d'indexage à six points (132A-132C, 135A-135C et 136A-136C, 138A, 138C), le premier (132A-132C, 135A, 135C) desdits jeux assurant le transport dudit châssis selon une position grossière par rapport à une opération qui utilise ledit masque perforé en feuille tendu (50), le second (136A-136C, 138A-138C) desdits jeux étant prévu pour assurer une précision absolue du positionnement dudit châssis pendant ladite opération qui utilise ledit masque perforé (50).

10. Procédé destiné à être utilisé lors de la fabrication d'un tube à rayons cathodiques couleur (20) comportant une plaque avant plane (24) et un masque perforé en feuille tendu (50), ledit procédé incluant les étapes de fourniture d'un châssis de fixation usine réutilisable de forme générale rectangulaire (82) comportant un moyen de retenue de masque libérable (88), de support de façon temporaire et amovible d'un masque perforé en cours de process (86) en tension sur ledit châssis (82) à l'aide dudit moyen de retenue de masque libérable (88), de fourniture d'une plaque avant en cours de process (120) comportant un moyen d'indexage (138A-138C) s'étendant depuis son côté en vue d'un repérage à l'aide d'un moyen d'indexage (136A-136C) s'étendant de façon interne depuis ledit châssis de fixation usine (82), de fourniture d'une structure de support de masque perforé (48) et de fixation de ladite structure sur la surface porteuse d'écran (26) de ladite plaque avant (24), sur des côtés opposés de l'écran, de fixation dudit masque perforé en cours de process (86) en tension sur ladite structure de support (48) et de séparation de l'assemblage masque-plaque avant combiné (22) dudit châssis (82) d'où la libération dudit châssis en vue de sa réutilisation.

11. Procédé selon la revendication 10, incluant les étapes de fourniture, sur un premier côté (84) du châssis de fixation usine (82), de moyens d'indexage à six points (132A-132C) et d'utilisation desdits moyens d'indexage, de repérage dudit châssis (82) et dudit masque (86) par rapport à un projecteur de lumière de photoexposition (122) comportant des moyens d'indexage à six points complémentaires (134A-134C), de fourniture sur un second côté opposé (118) dudit châssis (82) de moyens d'indexage à six points (136A-136C) et de repérage dudit châssis et dudit masque (86) à l'aide du moyen (88) destiné à fixer ledit masque à la structure de support de masque (48) sur ladite plaque avant.

12. Procédé selon la revendication 10, incluant les étapes de fourniture d'un châssis de fixation usine (220) muni d'un moyen de réceptacle périphérique (224) pour monter un masque perforé en cours de process (222) et de support de façon temporaire et amovible du masque perforé en cours de process (222) en tension sur ledit châssis par un moyen de retenue de masque mécanique à libération rapide (218, 218') qui s'adapte audit moyen de réceptacle.

13. Procédé selon la revendication 12, dans lequel ledit masque perforé (222) est chauffé et amené à se dilater avant d'être supporté de façon temporaire et amovible sur ledit châssis (220).

14. Procédé selon la revendication 13, dans lequel ledit masque perforé (222) est amené à refroidir et à se rétrécir en tension tout en étant supporté de façon temporaire et amovible sur ledit châssis (220).

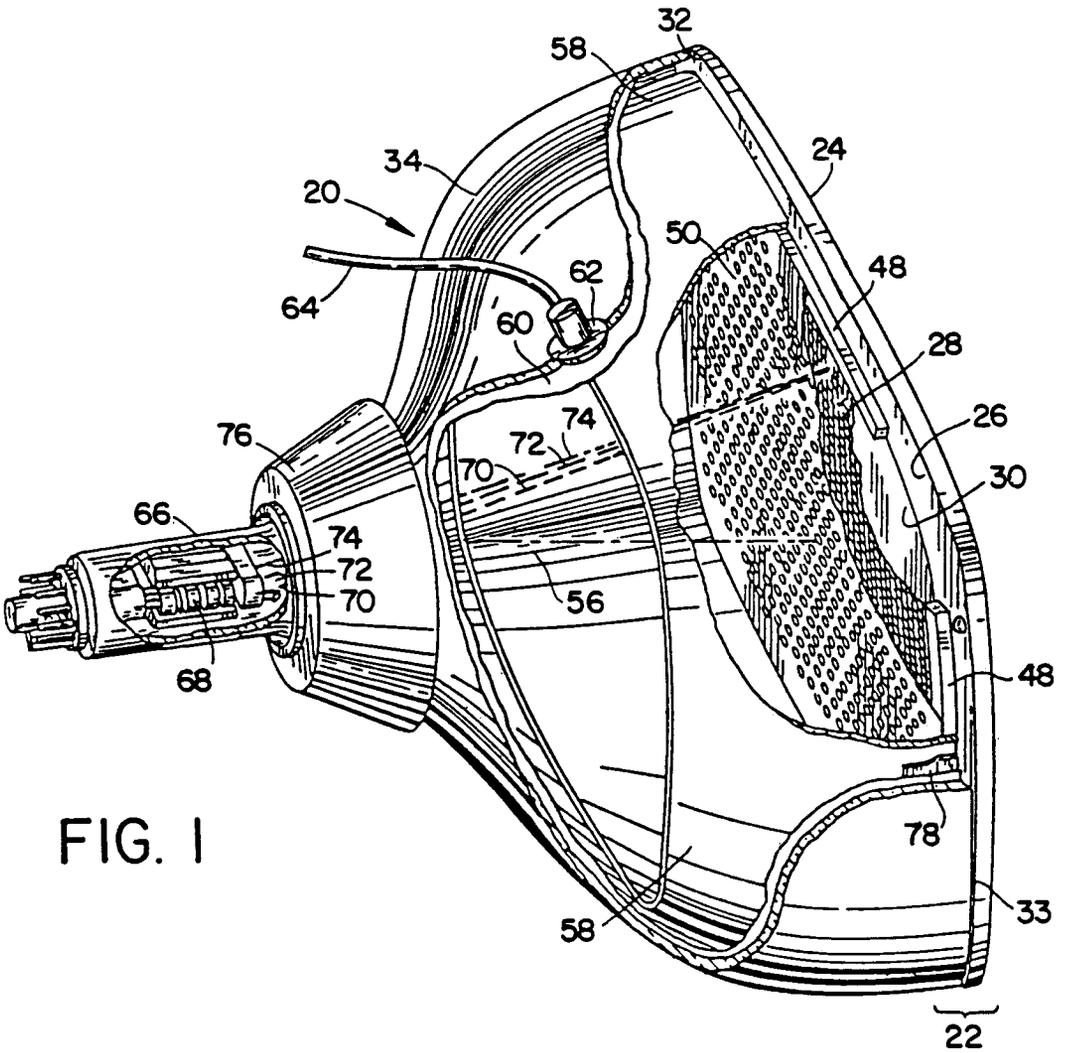

32
58
34
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48
64
62
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58
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FIG. 1

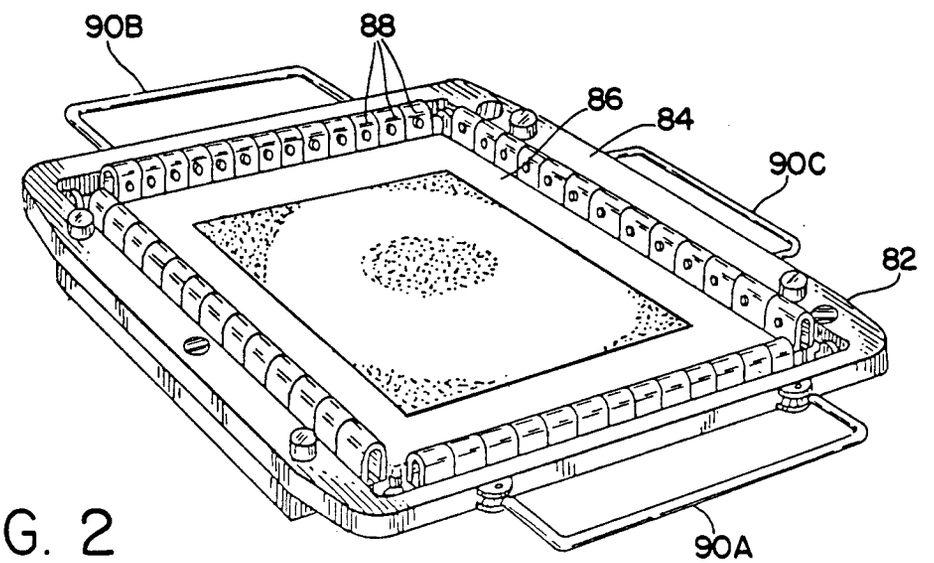

90B
88
86
84
90C
82
90A

FIG. 2

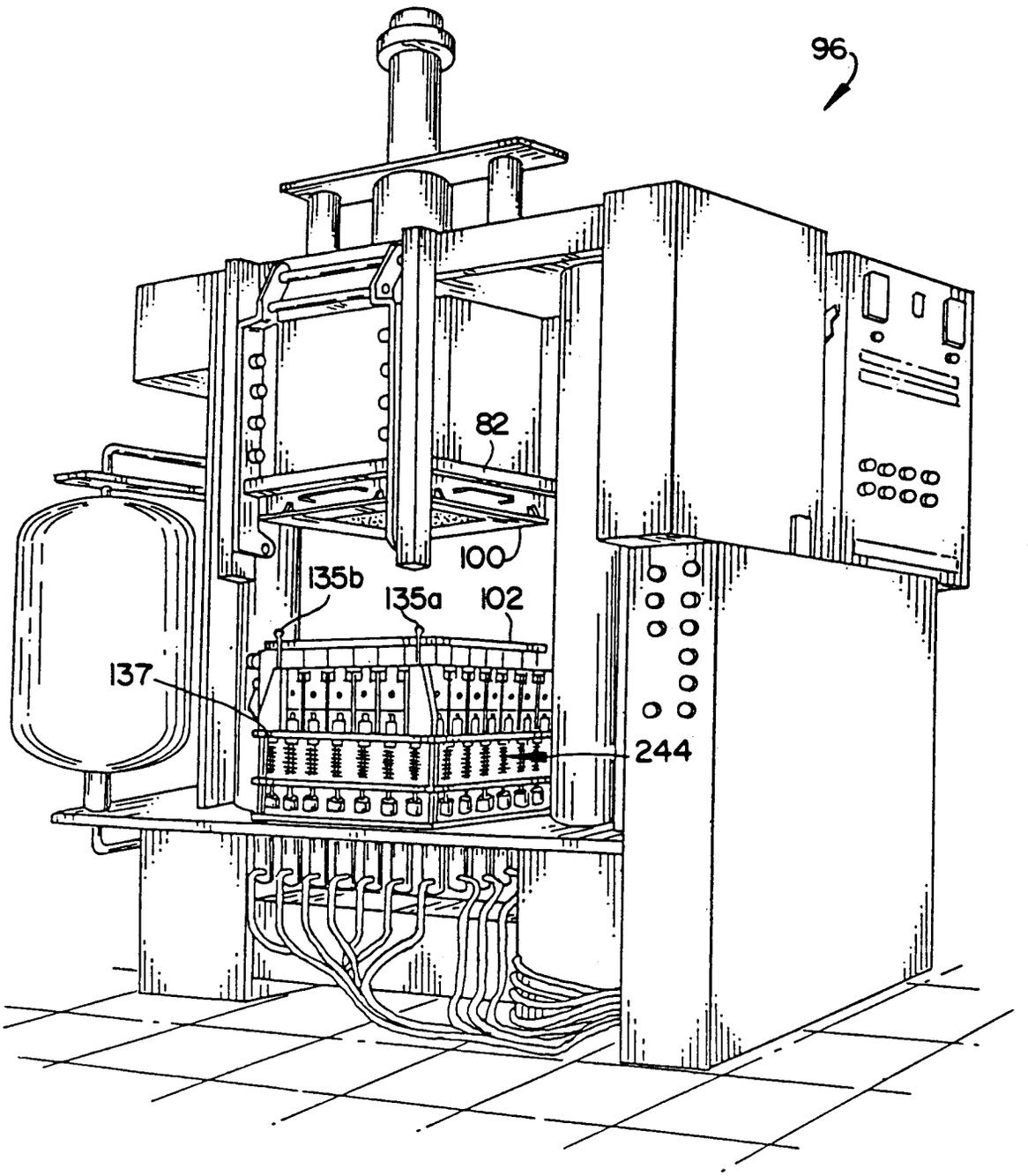


FIG. 3

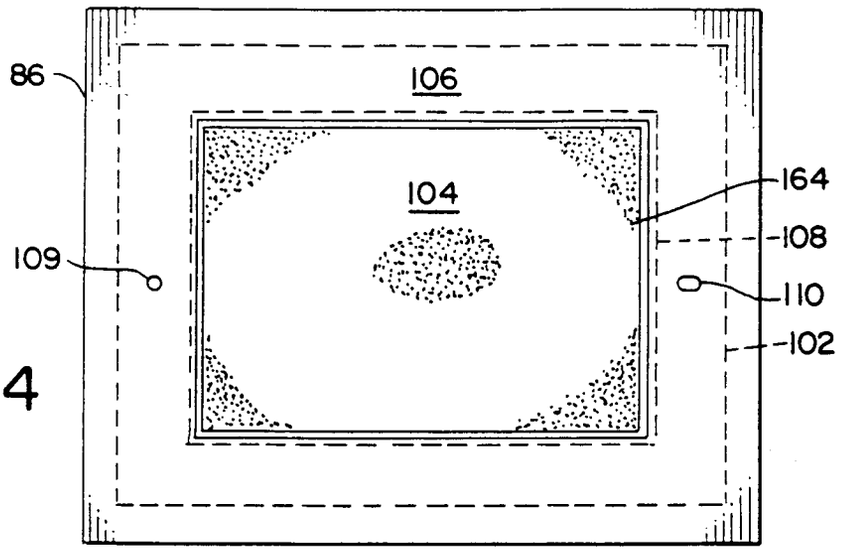


FIG. 4

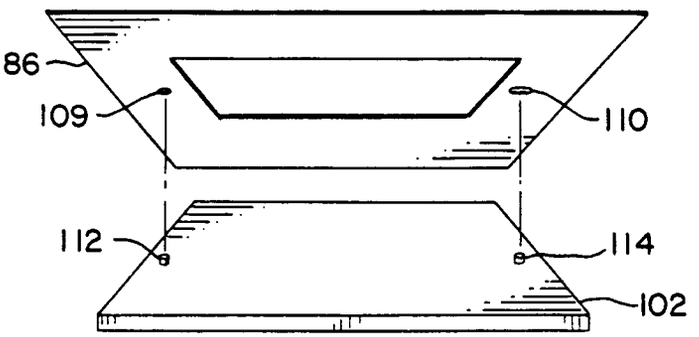


FIG. 5

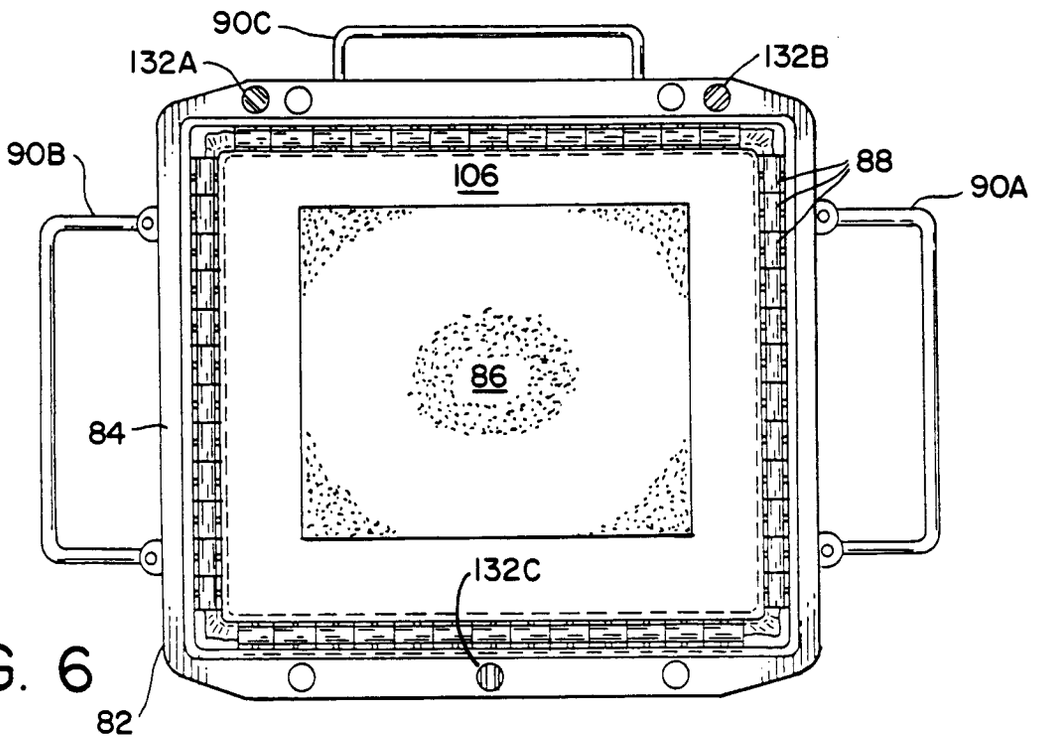


FIG. 6

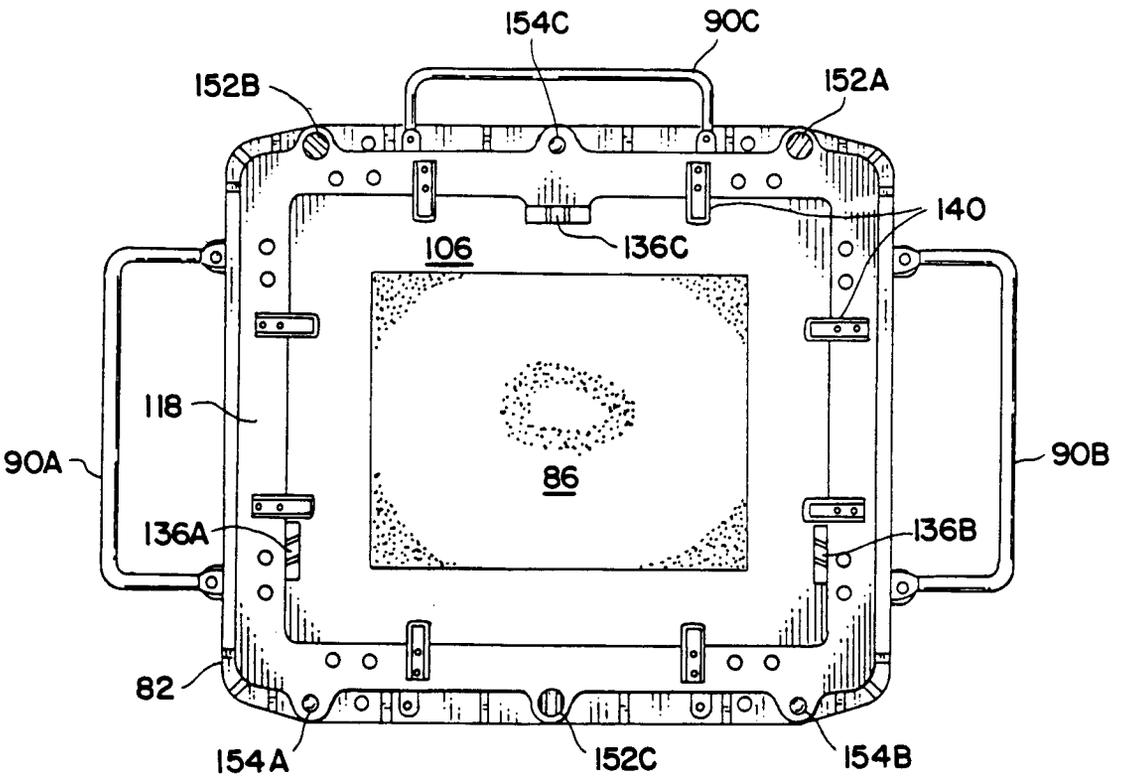

154C
90C
152B
152A
140
106
136C
118
90A
90B
86
136A
136B
82
154A
152C
154B

FIG. 7

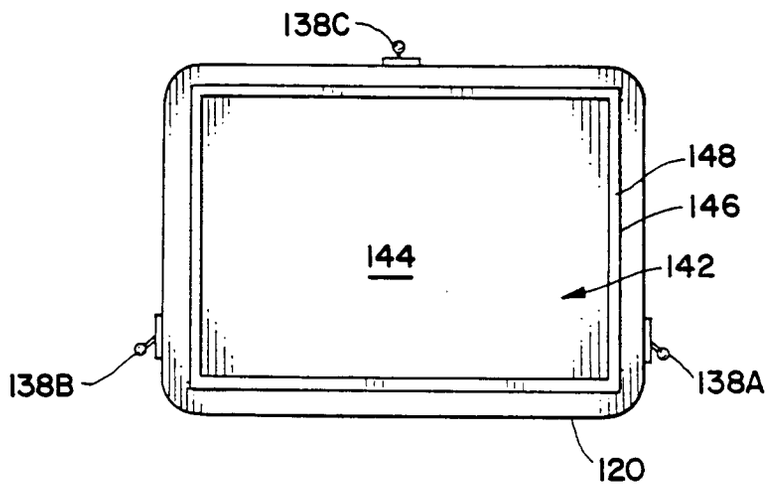

138C
148
146
144
142
138B
138A
120

FIG. 9

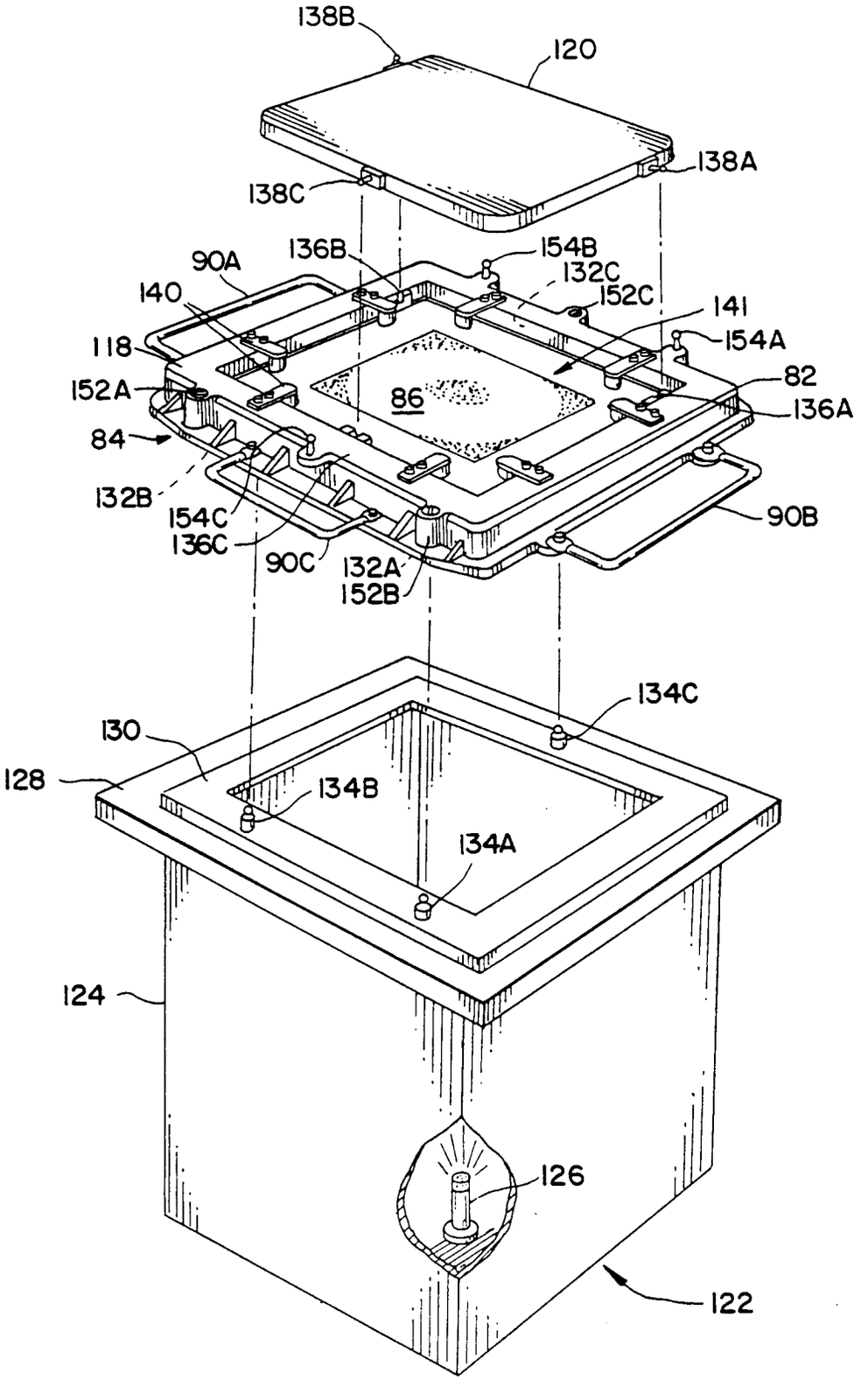

138B
120
138A
138C
136B
154B
90A
132C
140
152C
141
118
154A
82
152A
86
136A
84
132B
90B
154C
136C
90C
132A
152B
134C
130
128
134B
134A
124
126
122

FIG. 8

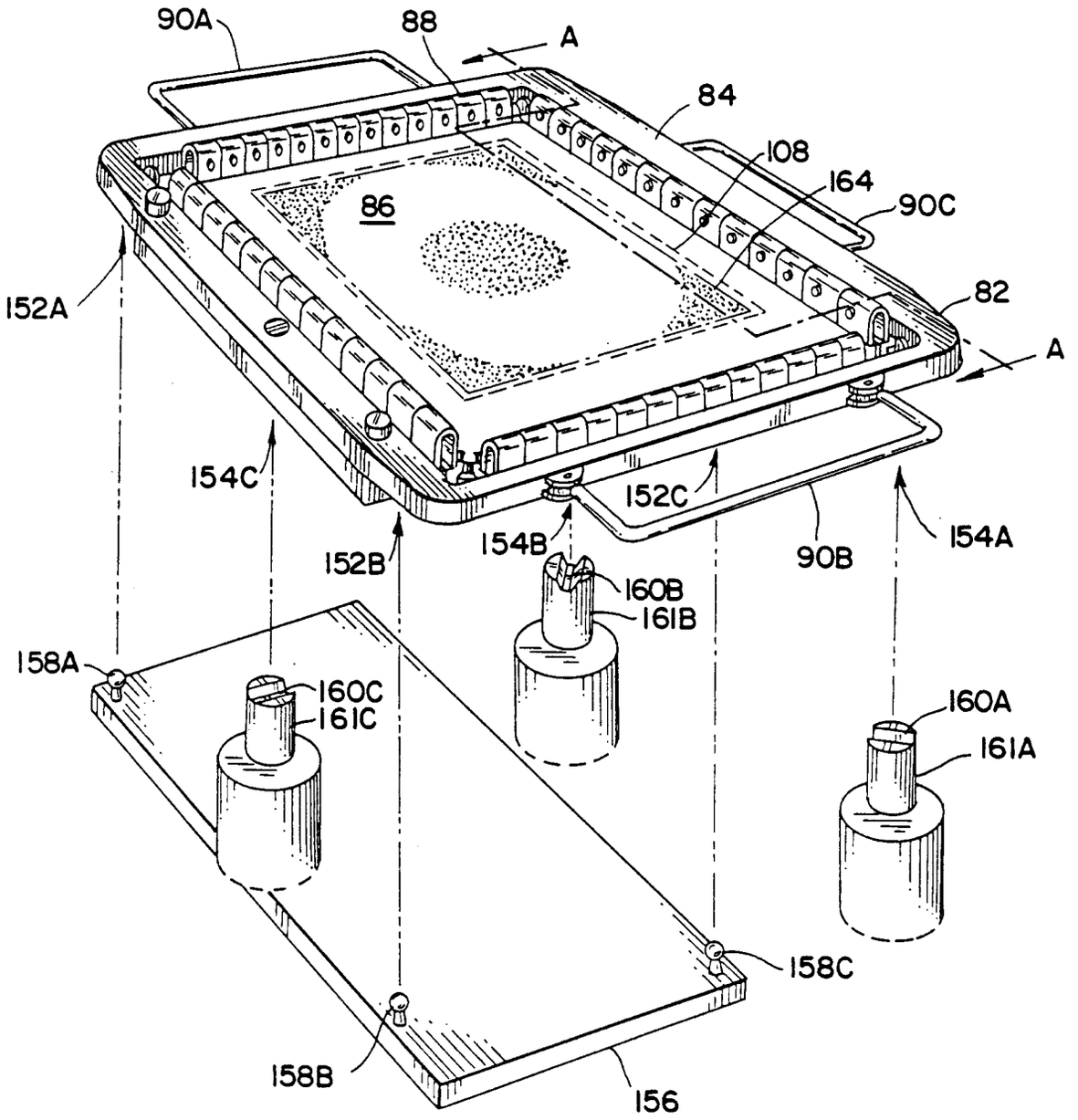

90A
88
A
84
108
164
90C
86
82
152A
A
154C
152C
154B
152B
90B
154A
160B
161B
158A
160C
161C
160A
161A
158C
158B
156

FIG. 10

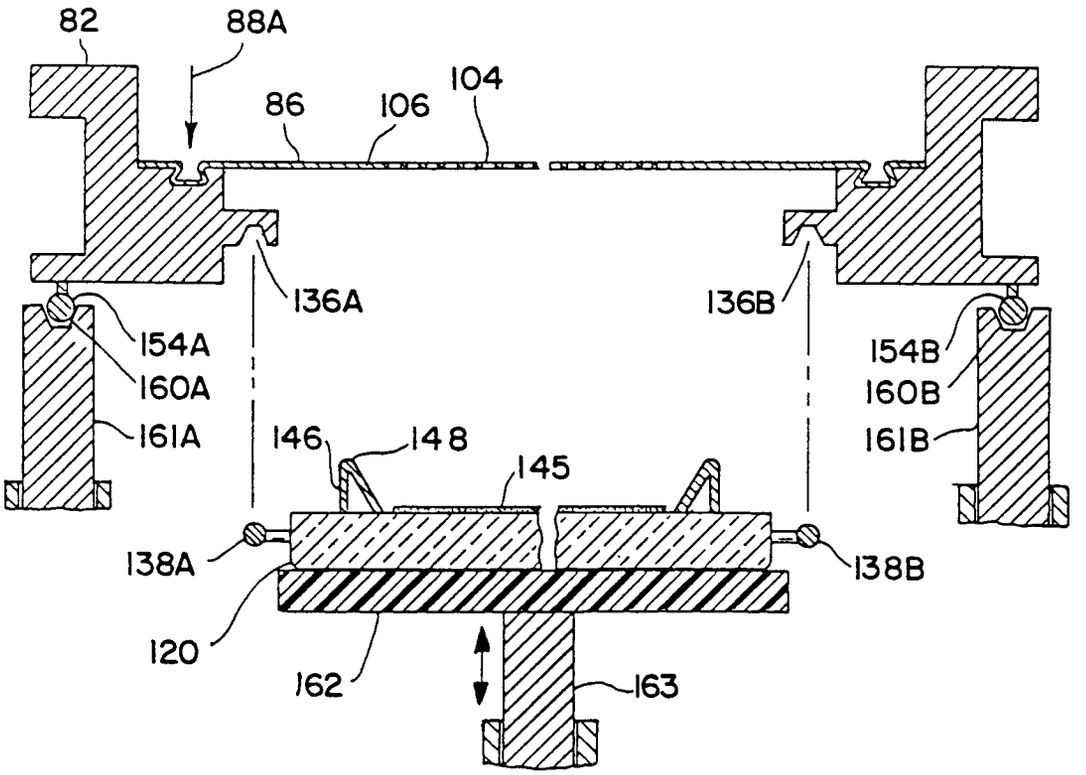


FIG. 11A

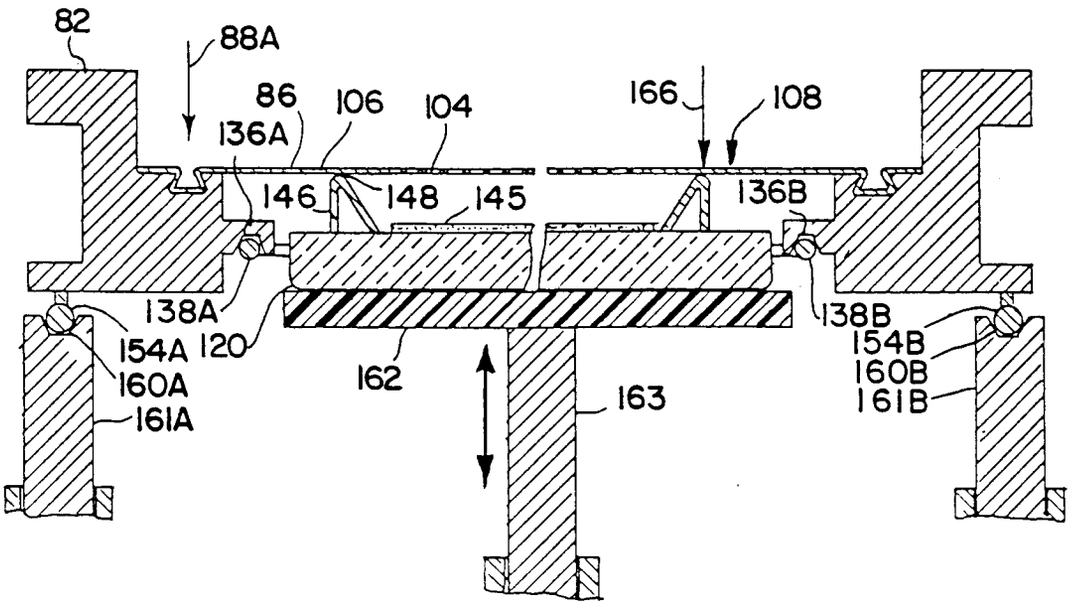


FIG. 11B

FIG. 12

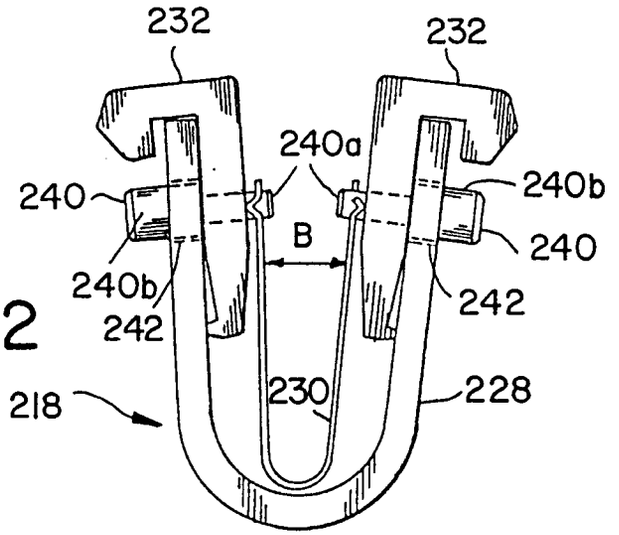


FIG. 13

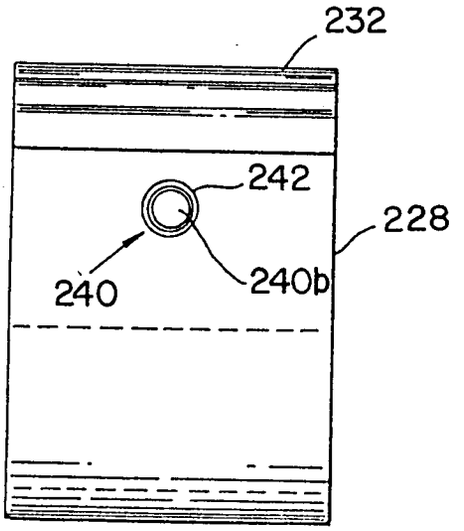


FIG. 14

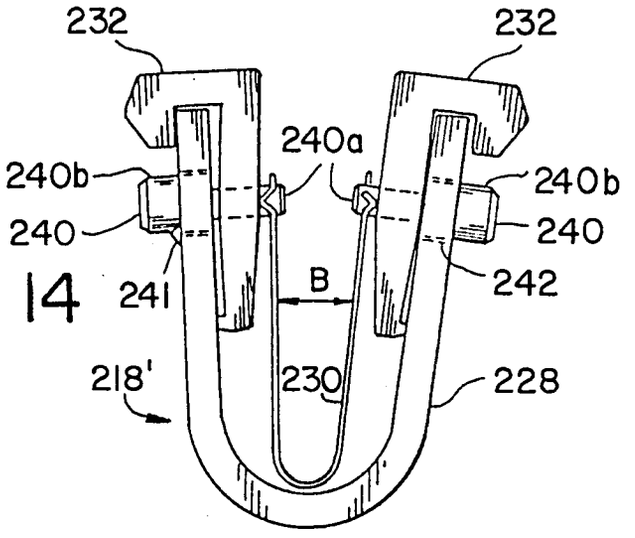


FIG. 15

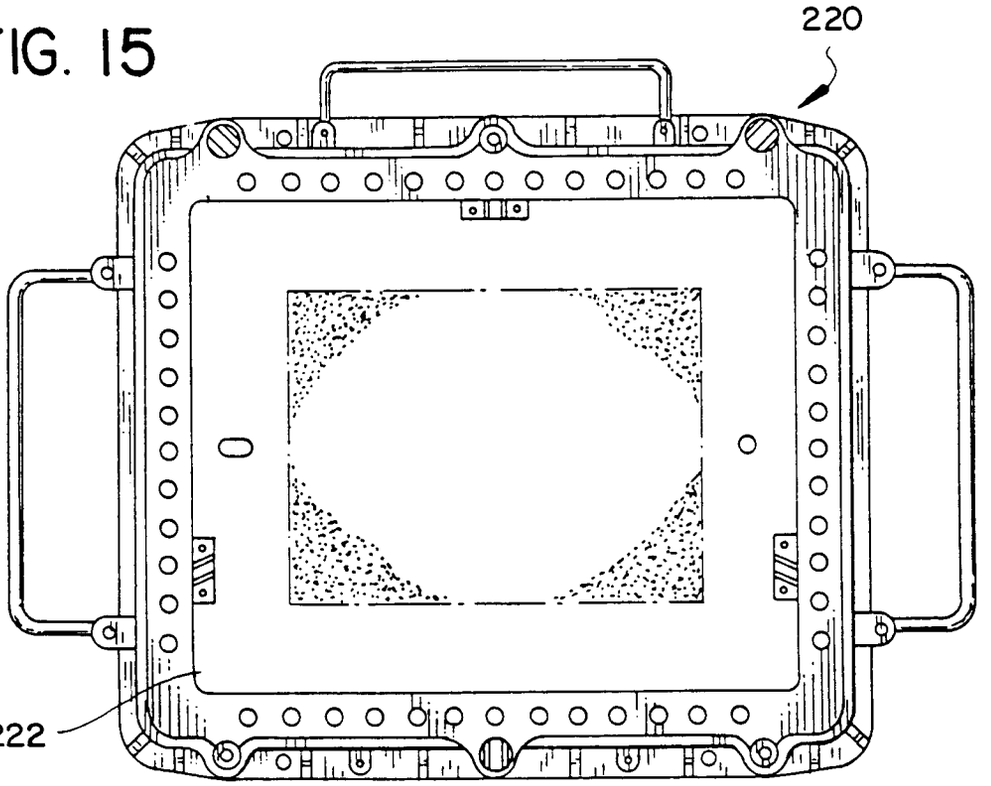
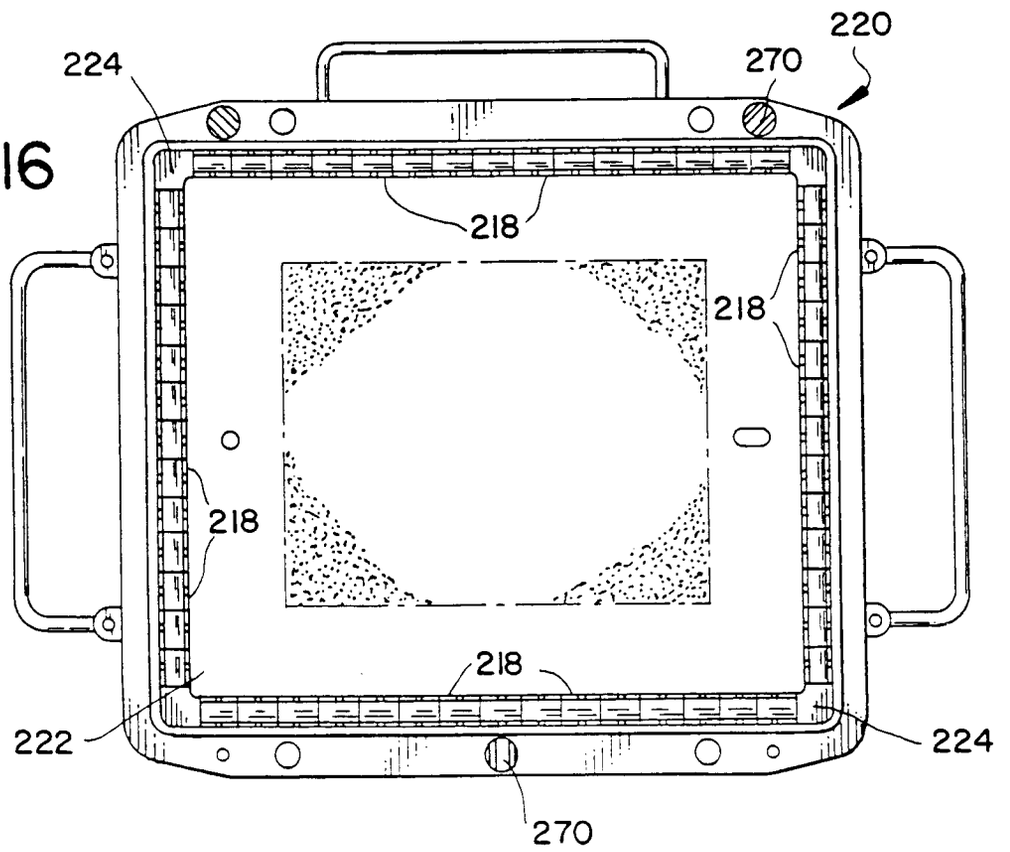


FIG. 16



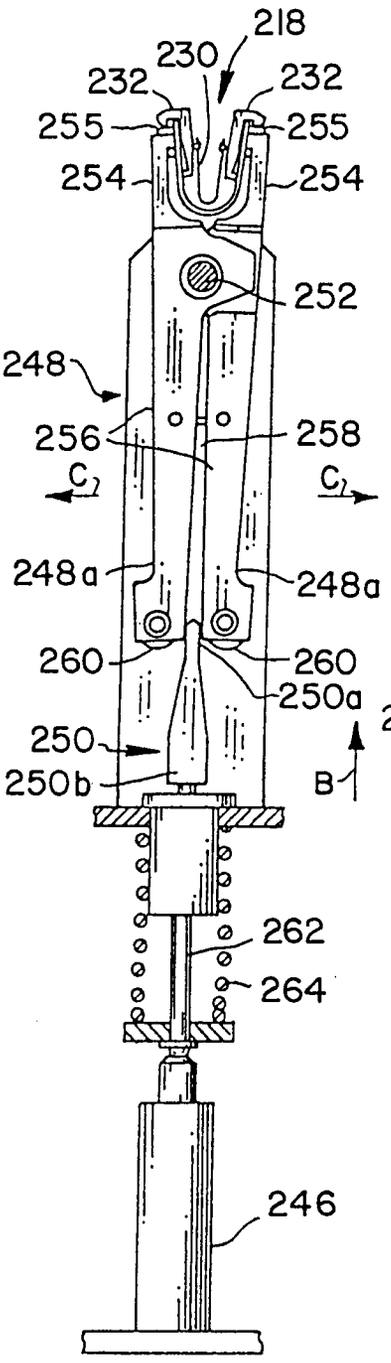

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230
232
232
255
255
254
254
252
248
256
258
C1
C1
248a
248a
260
260
250a
250
250b
B
262
264
246

FIG. 17

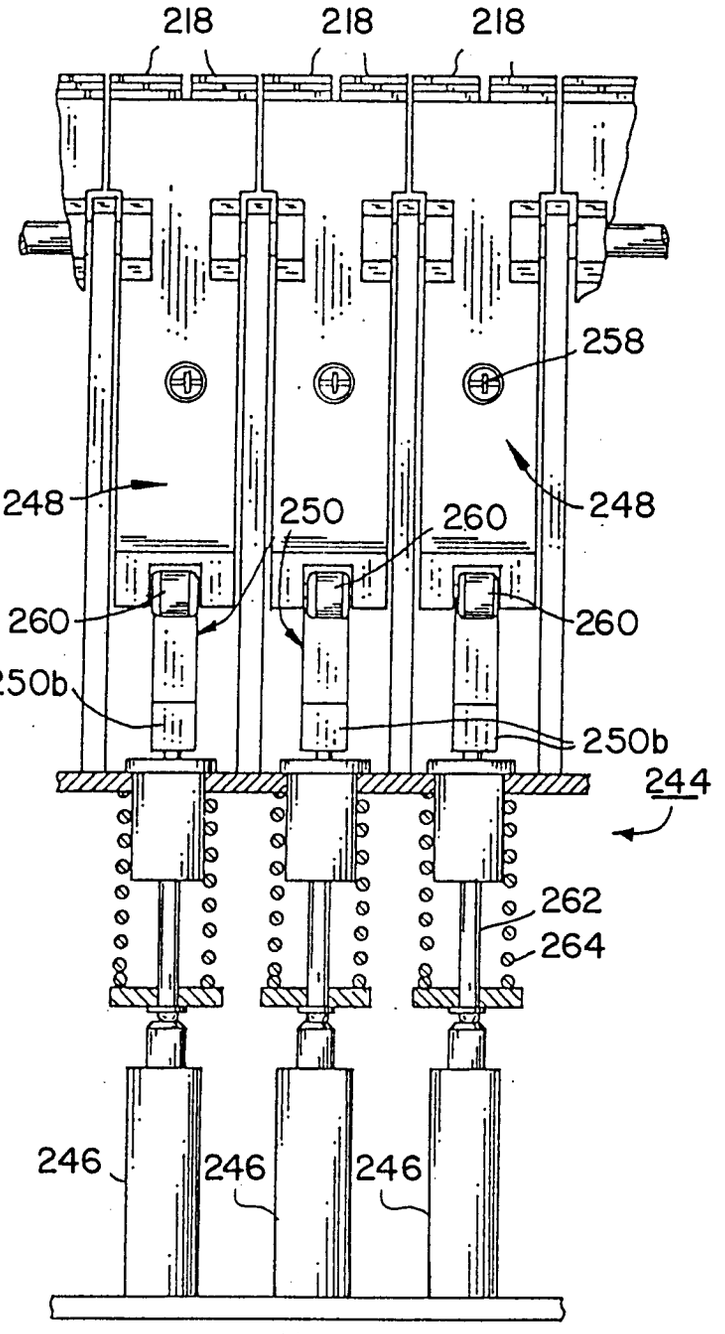

218
218
218
258
248
248
250
260
260
260
250b
250b
244
262
264
246
246
246

FIG. 18

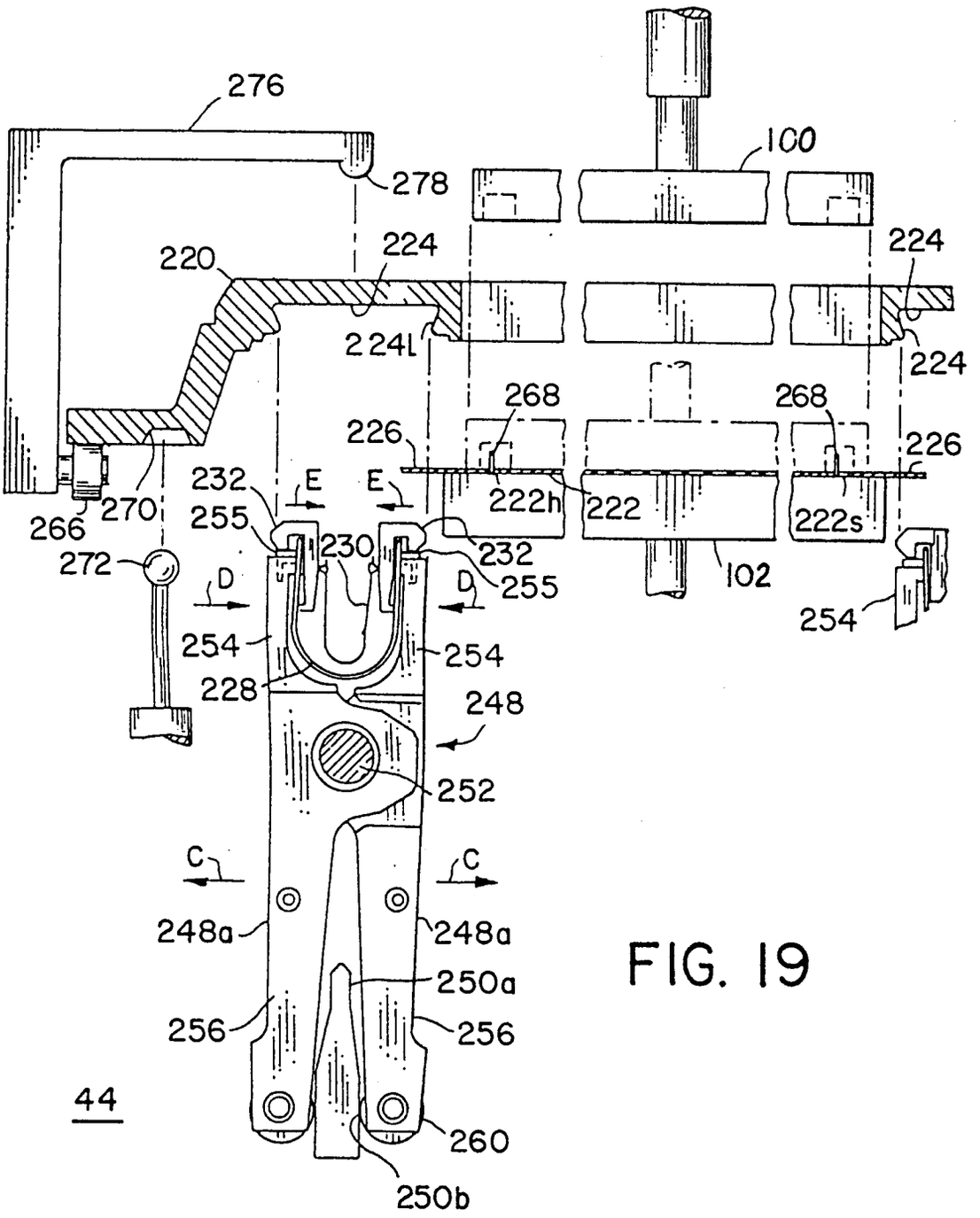

276
278
100
220
224
224
224l
224
268
268
226
226
232
E
E
255
222h
222
222s
230
232
266
270
272
D
D
255
102
254
254
254
228
248
252
C
C
248a
248a
250a
256
256
260
44
250b

FIG. 19

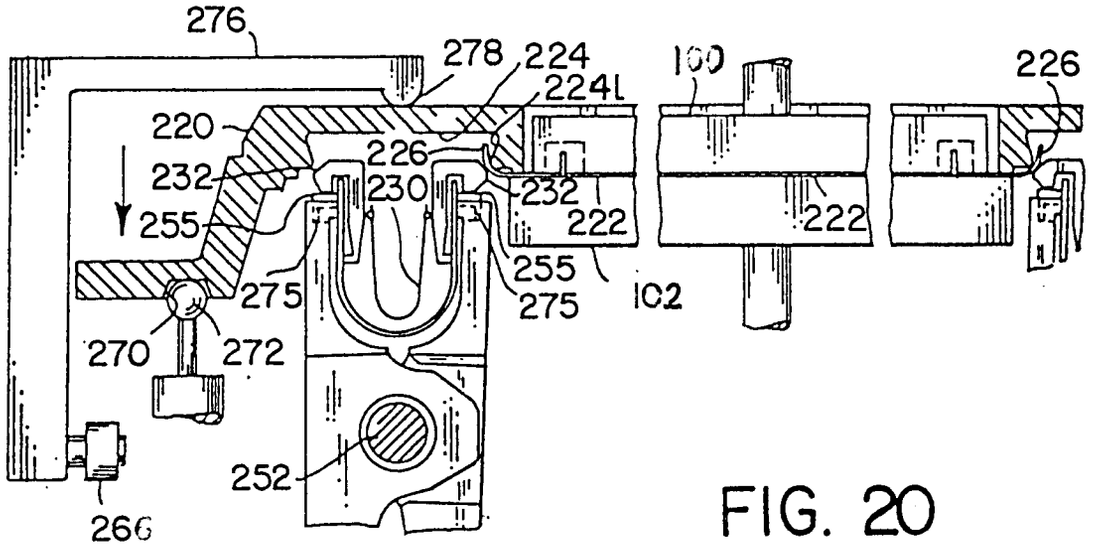

276
278
224
224L
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226
220
226
232
230
232
222
255
222
255
275
102
275
270
272
252
266

FIG. 20

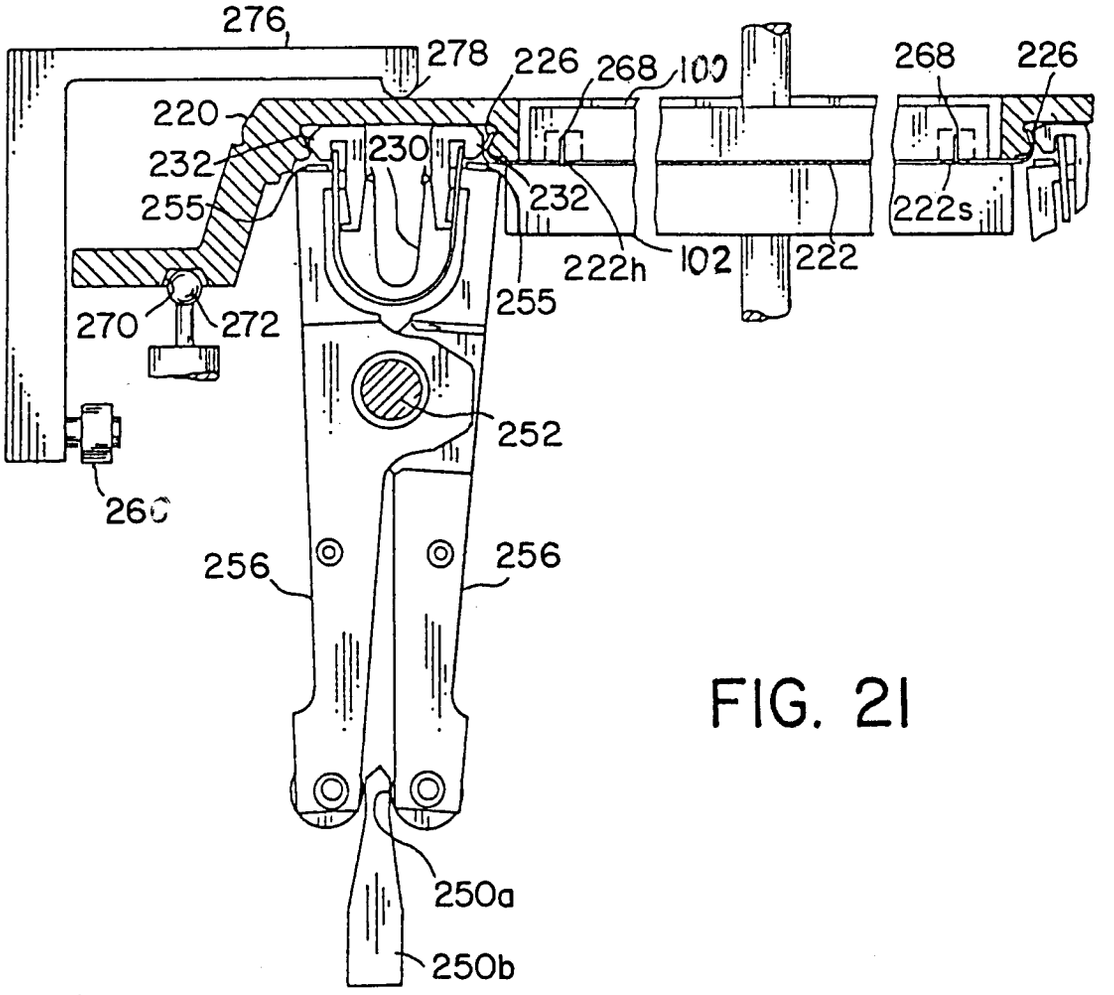

276
278
226
268
100
268
226
220
230
232
232
255
222s
222h
102
222
255
270
272
252
260
256
256
250a
250b

FIG. 21

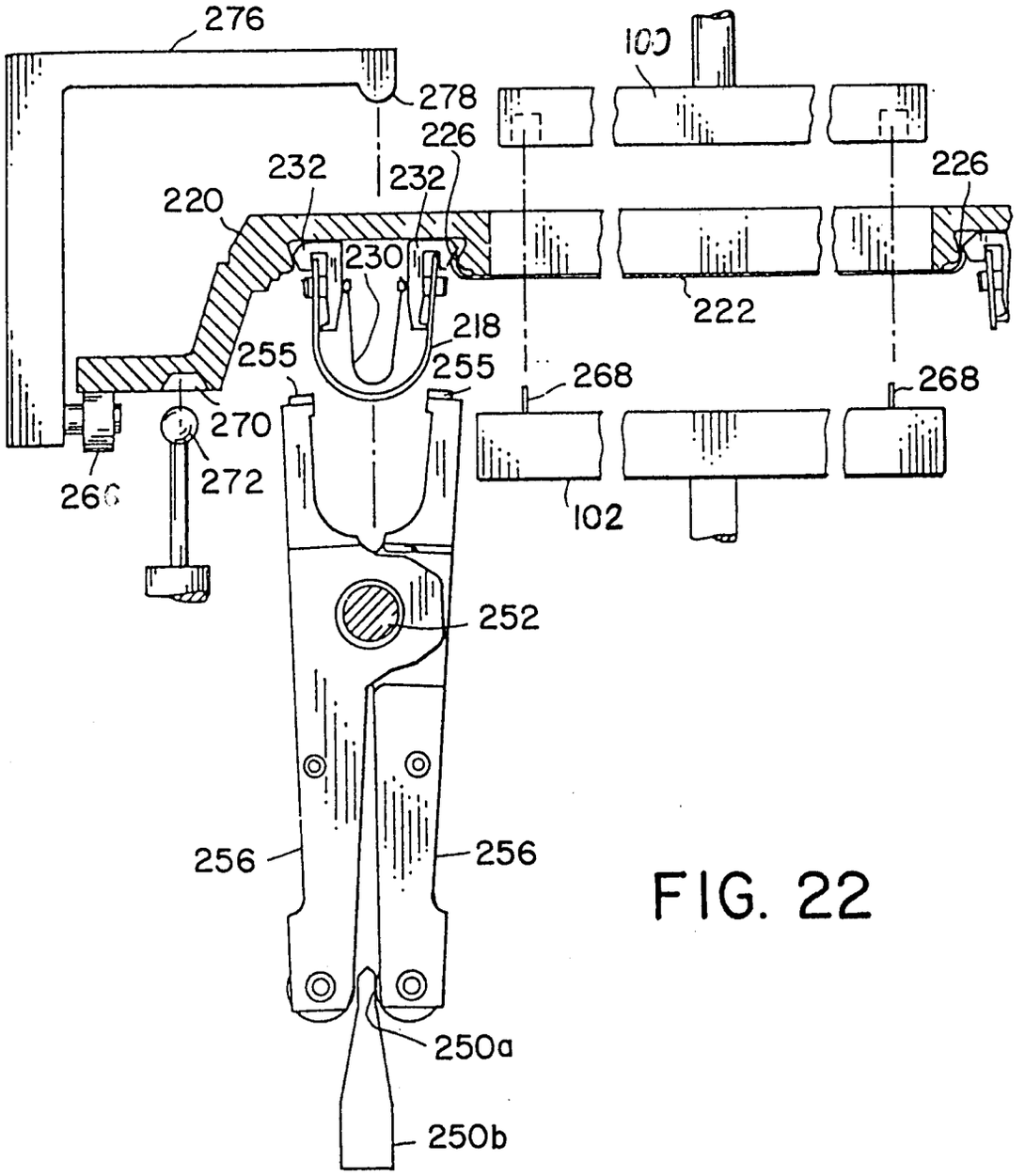

276
278
100
226
232
232
220
226
230
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218
255
255
268
268
270
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266
102
252
256
256
250a
250b

FIG. 22

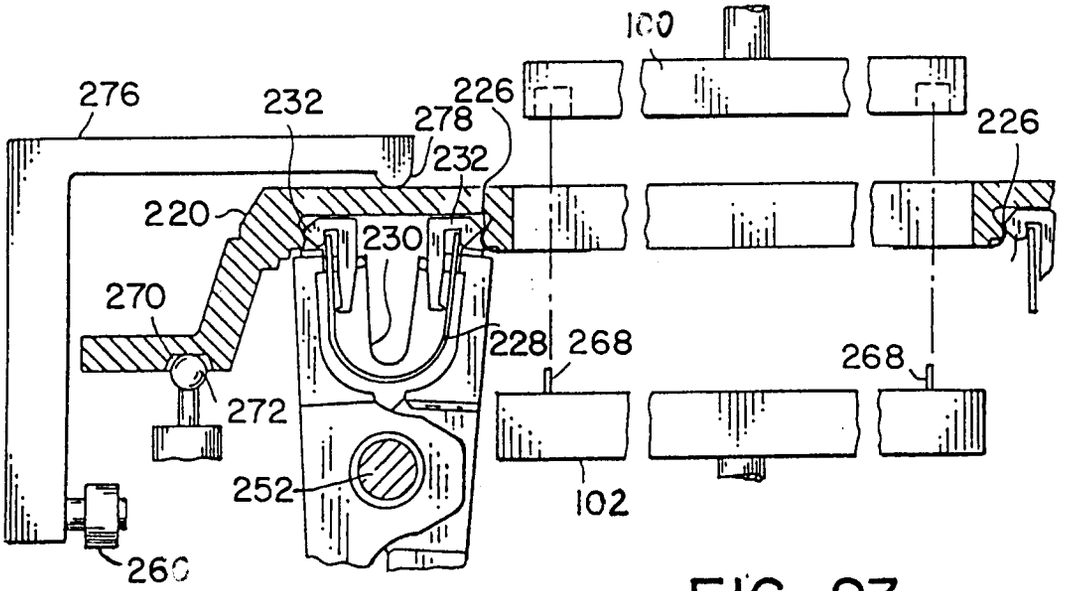

100
276
232
278
226
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226
220
230
270
228
268
268
272
252
102
260

FIG. 23

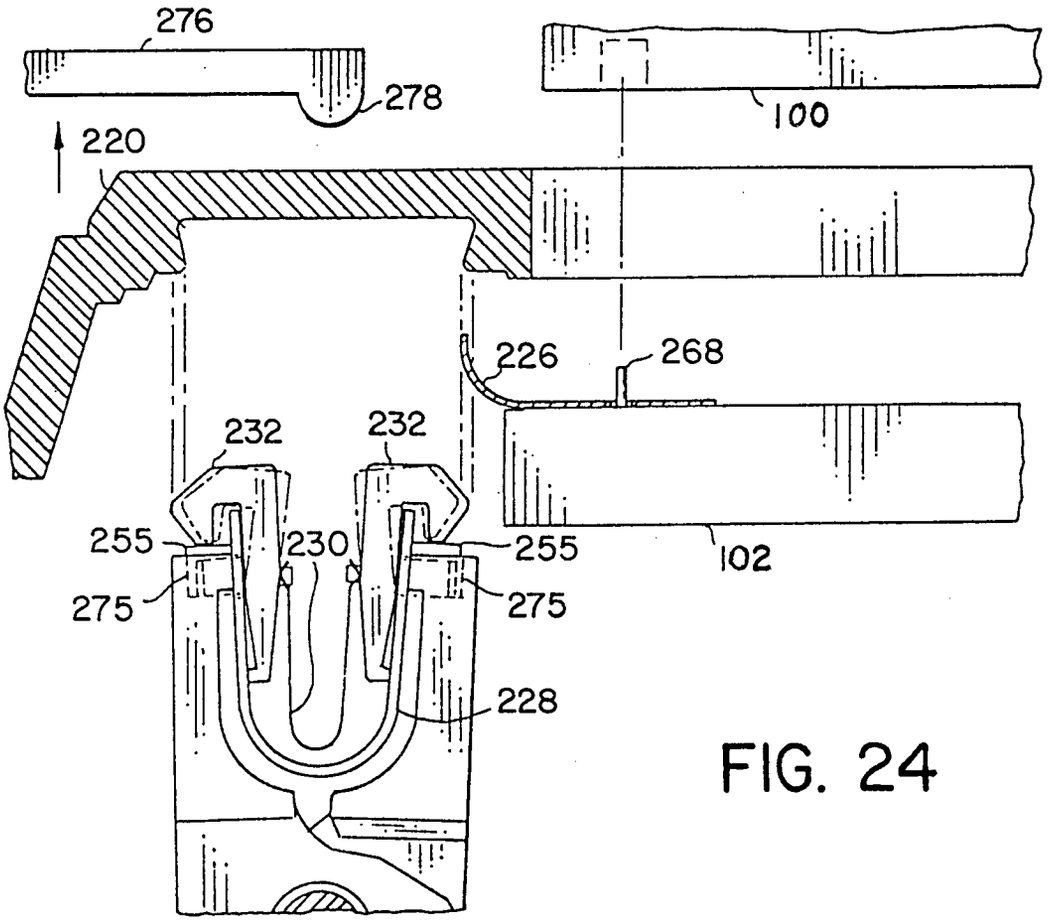

276
278
100
220
226
268
232
232
255
230
255
102
275
275
228

FIG. 24

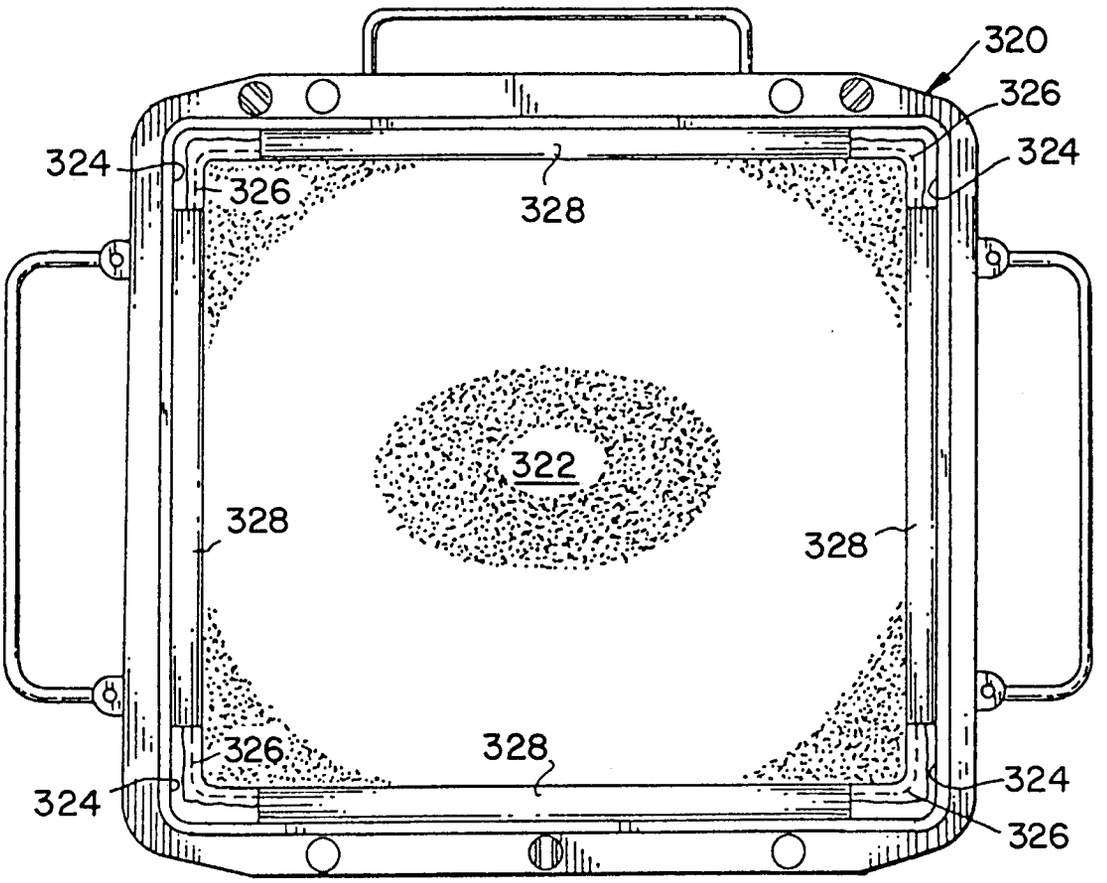


FIG. 25

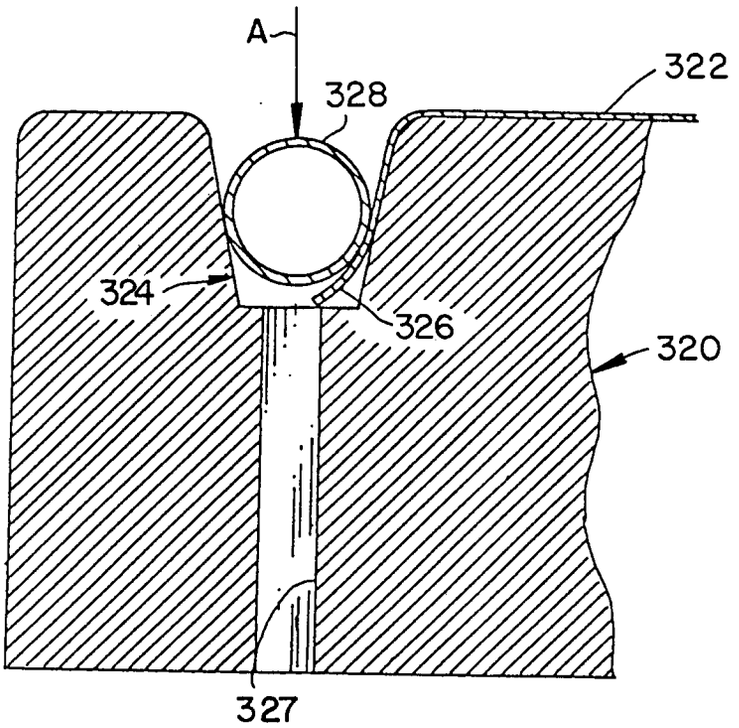


FIG. 26

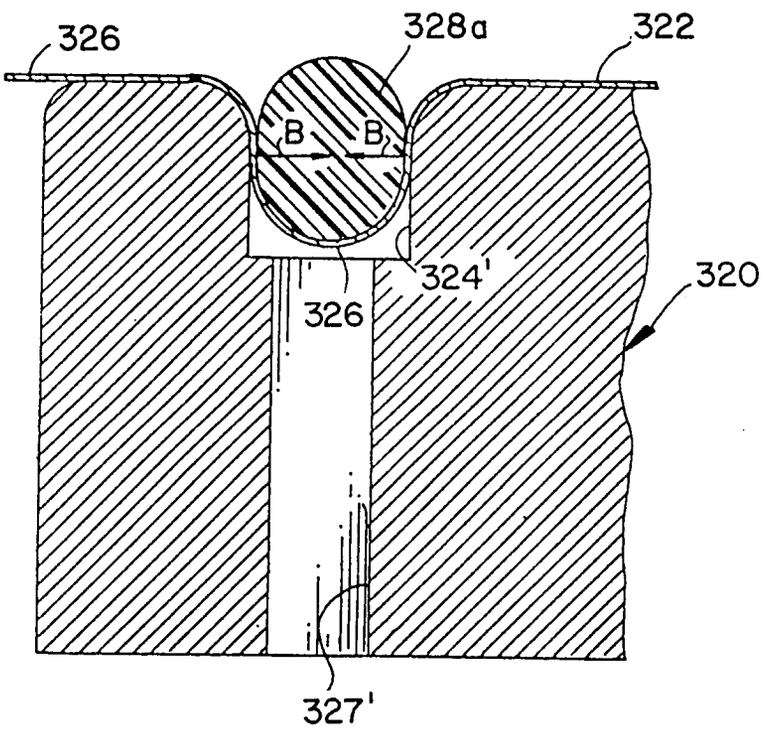


FIG. 27

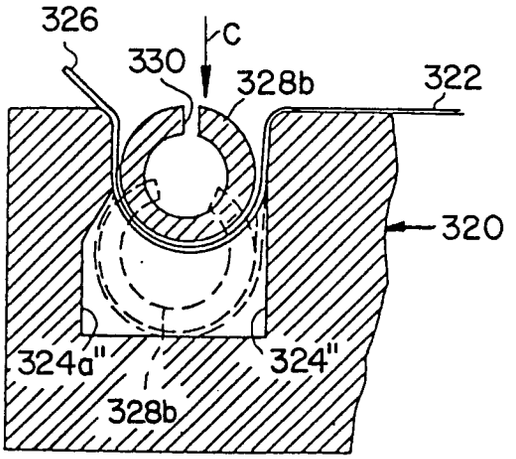


FIG. 28

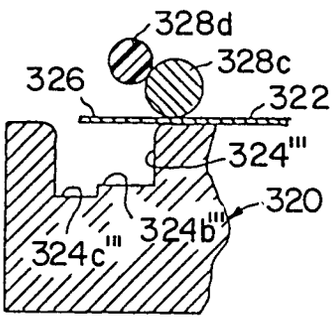


FIG. 29A

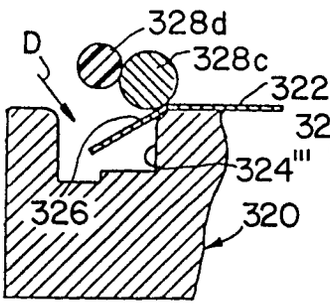


FIG. 29B

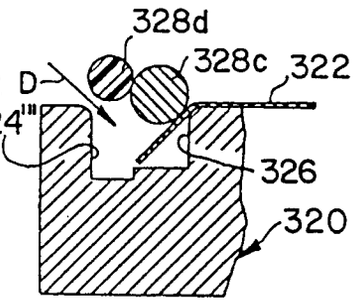


FIG. 29C

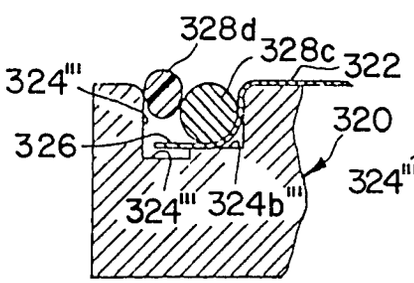


FIG. 29D

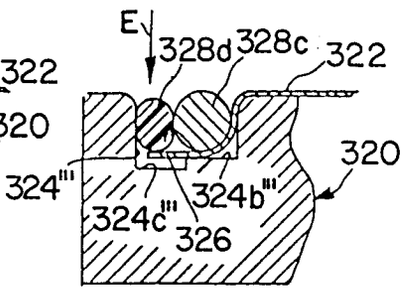


FIG. 29E

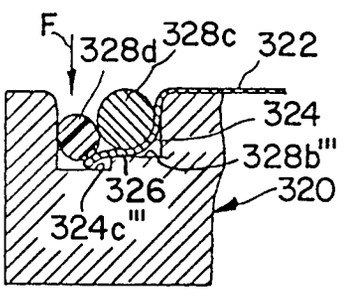


FIG. 29F

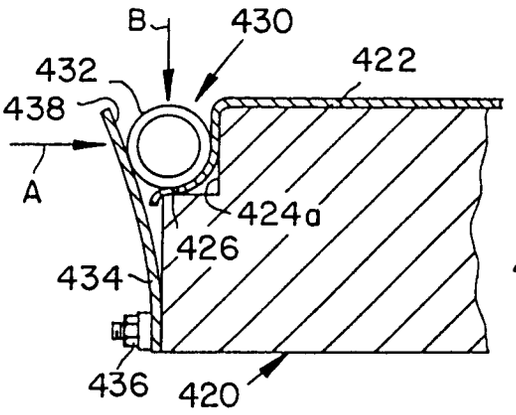


FIG. 31

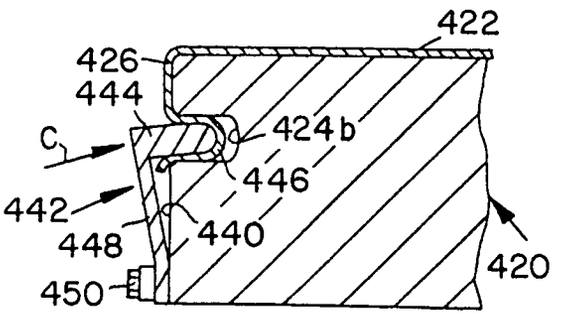


FIG. 32

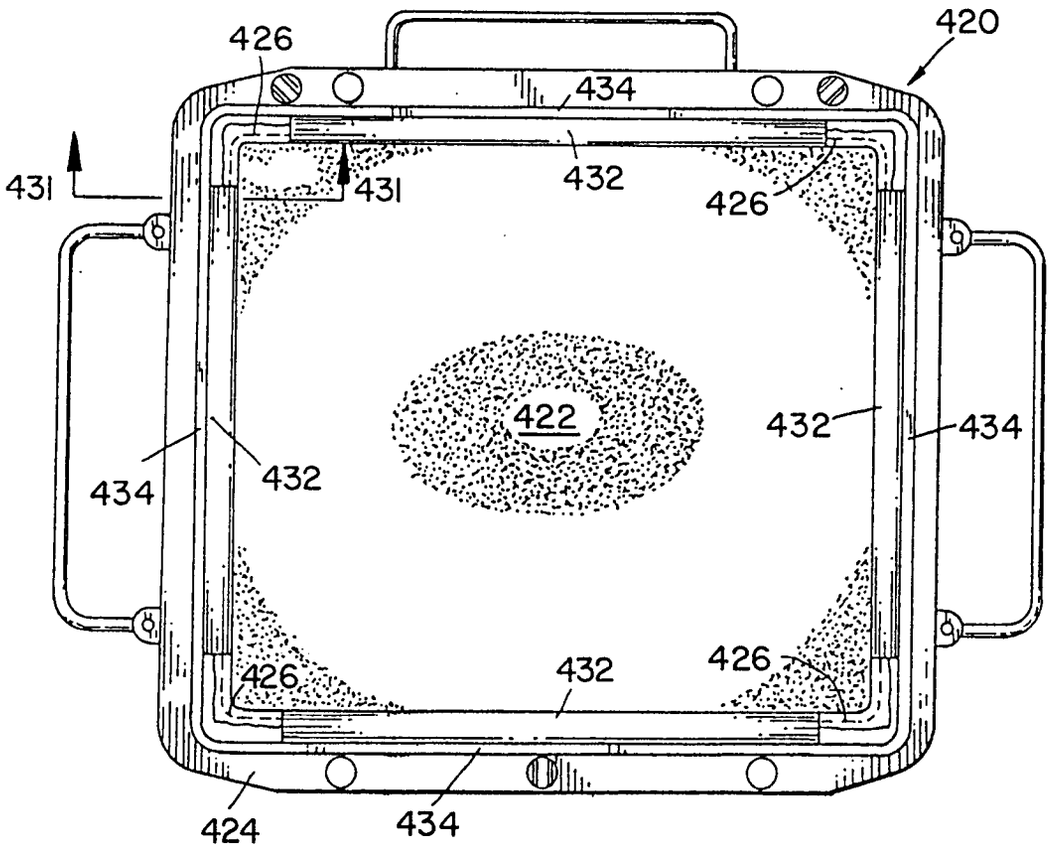


FIG. 30