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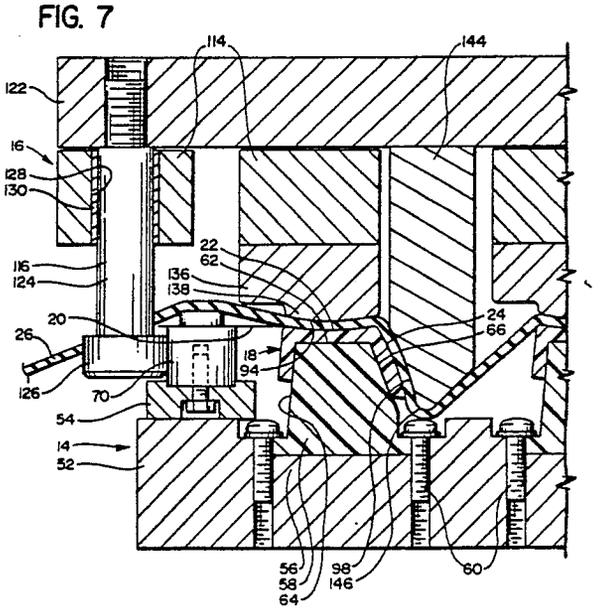
(54) Multisurface diffusion printing system and method.

(57) A printing apparatus to imprint images on the top surface and also on a forward side surface of a set of keycaps. A printing sheet with an overlying cushioning sheet is placed on the keycaps, and a first set of contact surfaces presses portions of the printing sheet against the top surfaces of the keycaps, after which a second set of contact surfaces presses other portions of the printing sheet against the forward side key cap surfaces. This arrangement accurately locates the images on the keycaps.

FIG. 7



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MULTISURFACE DIFFUSION PRINTING SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an apparatus and method for imprinting images or indicia on the keycaps of keyboards, and more particularly to the imprinting of such images on the top and on at least one side surface of the keycaps.

Background Art

There are various techniques for imprinting indicia or images on the keycaps of keyboards, with one method being a dry diffusion printing technique. This is accomplished by printing the mirror image of the indicia or image on a piece of paper and placing this indicia or image into contact with the surface of the keycap on which the printing is to take place. Then heat and pressure are applied against the paper to cause the dye material that forms the image to sublimate (sometimes called "contact sublimation") and migrate into the material forming the keycap, thus forming the image in a relatively durable form in the keycap.

One method of accomplishing this is disclosed in U.S. Patent 4,664,030--Siverson et al. In this system, there is provided a base member having a plurality of spring loaded pedestals on which the keys or keycaps to be imprinted are placed. A locator plate with openings to receive the keys is placed over the keys to keep these in a fixed position, and also to function as a heat shield. A sheet of transfer paper with the images thereon is located above the keys and in proper alignment therewith. U-shaped cuts or incisions are made around the areas of the images. There is a printing plate positioned above the keys and above the paper, and this has a plurality of protrusions, each of which has two surface portions, namely, a downwardly facing surface portion to engage the paper over a top surface of the key, and also a slanted surface portion to press parts of the paper downwardly against the slanted front surface of the key. The printing plate is attached to the bottom of a heated platen, and the platen with the printing plate is moved downwardly to press a rubber sheet against the transfer paper which in turn is pressed against the keys. Each of the protrusions presses a portion of the transfer paper into engagement with its related key so that one part of each portion of the transfer sheet engages the top surface of the key, while a second part of that portion of the transfer sheet engages the slanted surface portion of the key, so as to transfer one image to a top key surface and another to the front key surface.

Another system for transferring images from a sheet onto a set of keys is shown in U.S. 4,670,084--Durand. In this system, a resiliantly flexible membrane is positioned over the sheet on which the images are imprinted. There is a vacuum assembly to evacuate the area between the membrane and the bed which carries the keys in order to draw the membrane into pressurized engagement with the transfer sheet to press the transfer sheet against the keys. Then radiant heating elements are used to heat the membrane after the vacuum assembly has been actuated to transfer the dye on the sheet to the keys so as to imprint the images on the keys.

While the concurrent printing of images on multiple surfaces of the keys certainly has operatiional advantages, there is the accompanying problem of locating the transfer sheet throughout the operation in such a manner that these images are imprinted on the keys within reasonable close tolerances.

Accordingly, it is an object of the present invention to provide an apparatus and method by which images can be transferred to a plurality of surfaces of elements, such as keycaps, where the images are placed within relatively close tolerances. It is a further object to provide such an apparatus and method where the transfer operation can be accomplished in a manner to have a desirable balance of overall operating procedures.

SUMMARY OF THE INVENTION

The apparatus and method of the present invention is particularly adapted to imprint images on at least one key member of a keyboard (and desirably on a plurality of key members as part of a single operation), where a first image is imprinted on a top surface of the key member, and a second image is printed on a side surface of the key member, which in this exemplary embodiment is the front surface of the key member. This is done in a manner so that the first and second images are precisely located relative to the top and side surfaces.

The apparatus comprises a support means adapted to support at a predetermined key location at least one key member on which the images are to be imprinted, and in the preferred embodiment on a plurality of such key members.

There is a printing assembly which comprises

first and second printing components. The first printing component has a first contact surface (and desirably a plurality of contact surfaces) at a location corresponding to said key location (or locations) to come into pressing engagement with the top key member surface at the key location. A second printing component has a second contact surface (and desirably a plurality of such surfaces) at a location (or locations) corresponding to said key location (or locations) to come into pressing engagement with the side key member surface.

There is locating means to locate between said support means and said printing assembly a printing sheet having a surface region which has thereon related images at an image location corresponding to the key location. The sheet region has first and second sheet portions with the first and second images thereon respectively. In the exemplary embodiment there is a plurality of such regions for the plurality of keys.

There is an actuating means to bring said support means and said printing assembly into operating engagement where the printing assembly presses the printing sheet into engagement with the key member (or key members) in a manner that the first contact surface initially presses the first sheet portion into pressing engagement with the top key member surface, after which the second contact surface moves relative to the key member to move the second sheet portion into pressing engagement with the side key member surface.

Preferably, there is a flexible and stretchable cushioning sheet member positioned between the support means and the printing assembly in a manner that the first and second contact surfaces press the cushioning sheet member against the printing sheet to cause the sheet region (or regions) to come into engagement with the key member (or members).

Also, in the preferred form, there is heating means to heat said first and second printing components so that said first and second printing components in turn cause the sheet region and the key member to be heated to cause the images on the sheet member to be transferred to the key member.

In this preferred form of the apparatus, there is mounting means to which the first and second printing components are mounted in a manner so as to be movable relative to one another. The mounting means is arranged to be movable, relative to the support means, toward and away from the support means. The apparatus is arranged so that as the actuating means moves said mounting means toward the support means, the first printing component first comes into operating engagement with the key member (or members), after which the mounting means continues to move the second printing component into operating engagement with the key members. This is done in a manner that when the first printing component comes into operating engagement with the key members, the mounting means moves relative to the first printing component to bring the second printing component into operating engagement with the key members. In the specific configuration shown herein, the second printing component is mounted so as to remain stationary relative to said mounting means.

In the preferred configuration, there is spring means engaging the first printing component in a manner to urge the first printing component toward the key members. Thus, as the first printing component comes into operative engagement with the key members, the spring means continues to urge the first printing component into operating engagement with the key members as the mounting means continues to move the second printing component into operating engagement with the key members. Desirably, the spring means comprises compression spring means positioned between the first printing component and the mounting means.

Also, in the preferred configuration, the first and second printing components comprise first and second platen means, respectively. The first platen means is provided with opening means, and contact members of the second printing component are arranged to extend through the opening means when the second printing component is in operating engagement with the key members, so that the second contact members can move relative to the first platen means while extending through said opening means.

The arrangement of the first and second contact members is such that these are spaced laterally from one another. The first and second contact surfaces are, in the operative engaging position, aligned with the top and side key member surfaces, respectively.

In the method of the present invention, an apparatus is provded as described above. The first contact surfaces are caused to come into operative engagement with the first sheet portions to cause these to be pressed into firm engagement with the top key surfaces, after which the second contact surfaces are caused to come into pressing engagement with the second sheet portions so as to press these against the second key member surfaces. In this manner, the first contact surfaces properly maintain the position of the first sheet portions so that the second sheet portions are then caused to come into engagement with the second key member surfaces within sufficiently close tolerances.

Other features of the present invention will become apparent from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of the apparatus of the present invention;

FIG. 2 is an isometric exploded view showing the component parts of the printing assembly of the present invention;

FIG. 3 is an isometric view showing a portion of the support structure for the keycaps on which the images are to be imprinted, with a portion of the transfer sheet being mounted above the keycaps;

FIG. 4 is a plan view showing a portion of the transfer sheet bearing the images which are to be imprinted;

FIGS. 5, 6 and 7 are sectional views taken along a vertical plane of a portion of the apparatus, with FIG. 5 showing the contact elements of the printing assembly about to come into operative engagement with the keycaps, with FIG. 6 showing the first contact elements coming into pressing engagement with the top surfaces of the keycaps, and with FIG. 7 showing the printing assembly in full engagement with the keycaps, where the second contact elements are in pressing engagement with the slanted forward side surfaces of the keycaps;

FIG. 8 is a plan view of a portion of a modified form of the printing sheet utilized in the system of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The apparatus 10 of the present invention comprises a base support structure 12 to which are mounted a key carrying assembly 14 and a printing assembly 16. The key carrying assembly 14 supports a plurality of keycaps or keys 18 at predetermined key locations and in this particular embodiment also locates a printing sheet 20 above the keys 18. The printing assembly 16 is of particular significance in the present invention, and this functions to press certain areas of the printing sheet 20 into engagement with the top surfaces 22 and front surfaces 24 of the keys 18. In this particular embodiment, there is provided an intermediate flexible load transfer or cushioning sheet 26 which is pressed by the printing assembly 16 into engagement with the printing sheet 20.

To describe the apparatus 10 more particularly, the base support frame 12 comprises a stationary bottom base plate 28 and a stationary top plate 30 which are rigidly interconnected by a plurality of vertical guide posts 32 located at the corners of the plates 28 and 30. The key carrying assembly 14 comprises a carrying frame 34 which in turn comprises upper and lower plates 36 and 38, respectively, rigidly interconnected by vertically aligned side plates 40. These two plates 36 and 38 are provided with through openings which receive the posts 32 in a close tolerance fit so that the carrying frame 34 can move upwardly and downwardly along the posts 32 in a manner to remain accurately positioned relative to the base support structure 12.

The vertical movement of the key carrying assembly 14 is accomplished in this particular embodiment by a wedge-like actuator 41 comprising a wedge member 42 having a lower contact surface 44 and an upper slanted contact surface 46, with these surfaces 44 and 46 engaging, respectively, a lower roller 48 mounted to the base plate 28 and an upper roller 50 mounted to the lower side of the lower plate 38 of the carrying frame 34. A suitable actuator (not shown for ease of illustration) moves the wedge member 42 laterally to raise or lower the carrying frame 34 and the rest of the key carrying assembly 14. It is to be understood that other mechanisms can be used to raise or lower the carrying assembly 14, and also that the key carrying assembly 14 can remain stationary while the printing assembly 16 would be vertically movable. Alternatively, both assemblies 14 and 16 could be made movable.

With reference to Fig. 3, the key carrying assembly 14 further comprises a carrying tray 52 which, of itself, is or may be conventional. This tray 52 is mounted to the top surface of the upper plate 36 and could remain fixedly attached thereto or be removable from the upper plate 36 so that trays 52 having different patterns of key locations could be used. In the event that a different pattern of key location is used, this would, of course, require a corresponding modification of the printing assembly 16. In the event that the tray 52 is removably placed on the plate 36, then a plurality of trays could be used, with one tray 52 being loaded with keys 18, while another tray 52 with keys 18 thereon is actually operating in the apparatus 10 to have the keys 18 imprinted. In the event that the tray 52 is made removable, suitable guide means or locating means are provided to ensure that the tray 52 (and therefore the keys 18 mounted thereto) is accurately positioned.

As shown herein, the tray 52 comprises a surrounding frame 54 across which extends a plate portion 56. A plurality of individual pedestals 58 made of a relatively rigid plastic material are fixably and accurately mounted to the plate portion 56 by screws 60 or by some other suitable means. Each pedestal 58 has its top and side surfaces contoured to fit within rather close tolerances the inside surfaces of a related keycap or key 18 which is mounted to that pedestal 58. Thus, as shown

herein, each pedestal 58 has a horizontal top surface 62, a nearly vertical back surface 64, and a slanted front surface 66, with these surfaces 62-66 matching corresponding interior surfaces of the keys 18. The respective lateral surfaces 67 of the pedestals 58 and the keys 18 are likewise made in a matching configuration. Depending upon the particular configuration of the key, the top, front, back and lateral surfaces could could be made with different slopes. As shown in Fig. 3, the top pedestal surface 62 can be made with an opening 68 to receive a matching protrusion or locating member in the downwardly facing surface of the key 18.

To locate and support the printing sheet 20, the surrounding frame 54 is provided with a plurality of upwardly extending locating pins 70. In the particular configuration shown herein, each locating pin 70 has an upwardly stepped configuration, having a lower cylindrical portion 72 of a larger diameter and an upper cylindrical portion 74 of a reduced diameter. The printing sheet 20 is provided with a plurality of locating holes 76 at spaced perimeter locations on the sheet 20, and these fit on the upper cylindrical portions 74 of the pins 70 so as to rest on the upwardly facing surfaces of the lower cylindrical pin portions 72. In other configurations it is possible that the locating holes 76 could be provided at other locations, such as having a row of locating holes 76 positioned along the center of the priting sheet 20.

With reference to Fig. 4, there is shown a portion of a printing sheet 20 which is provided with a plurality of image areas 82. Each image area 82 has a first image area portion 84 bearing a dye material in the form of a mirror image of the image or symbol which is to be imprinted on the top surface 22 of a related key 18, and also a second image area portion 86 which bears a mirror image which is adapted to be imprinted on the front surface 24 of a related key 18.

Each image area 82 has three sides thereof at least partially perforated along separation lines in a U-configuration, with the perforation line forming the base of the U being designated 88 and the perforation lines defining the legs of the U being designated 90. The perforation line 88 extends adjacent to the second image area portion 86, while the two perforation lines 90 extend along opposite lines of the image area portions 84 and 86. These perforation lines 88 and 90 beter enable the image area 82 of the transfer sheeet to be deflected into proper engagement with the top and front surfaces 22 and 24 of the keys 18.

As indicated previously, the structure and function of the printing assembly 16 is significant in the present invention. In terms of function, the printing assembly 16 can be considered as having a first component or subassembly 92 which provides a plurality of first contact surfaces 94 which are arranged to come into operative engagement with the top surfaces 22 of the keys 18. There is a second component or subassembly 96 having a plurality of second contact surfaces or contact surface areas 98 to come into contact with a side surface of the key 18, and in this particular arrangement come into contact with the front surfaces 24 of the keys 18. As will be disclosed more fully hereinafter, the second component or subassembly 96 is capable of independent movement relative to the first component or subassembly 92 in a manner that the first contact surfaces 94 are able to first come into firm operating engagement with the top of surfaces 22 in a manner to firmly press the first image area portions 84 into firm engagement with the top key surfaces 22, after which the second component or subassembly 96 brings the second contact surfaces 98 into operative engagement so that the second image area portions 86 are then brought into engagement with the front key surfaces 24. It has been found that this arrangement enables the image areas 82 to be accurately located relative to the key surfaces 22 and 24 so that the images 84′ and 86′ of each image area 82 are located within reasonably close tolerances to the key surfaces 22 and 24.

This printing subassembly 16 is mounted to a mounting plate 100 which has a plurality of openings 102 to receive the aforementioned guide posts 32. In addition, the mounting plate 100 has a plurality of other through openings 104 to receive therein threaded studs 106 which extend downwardly through the mounting plate 100 and are fixedly attached to the top plate 30 of the base support structure 12. Each stud 106 is provided with upper and lower locating nuts 108 and 110 to enable the mounting plate 100 to be accurately positioned. Extending downwardly from the bottom surface of the mounting plate 100 are two vertically aligned side plates 112 which engage opposite edges of the aforementioned cushioning sheet 26, for example by means attaching bolts 113. This sheet 26 is approximately one-sixteenth of an inch thick and is made of a suitable rubber or elastomeric material. The sheet 26 extends over the entire array of the keys 18, and when contacted by the aforementioned contact surfaces 94 and 98 of the printing assembly 16 transmits a more uniform pressure or force against the paper image areas 82 and the key surfaces 22 and 24.

The first component or subassembly 92 of the printing assembly 16 comprises a movable platen or plate 114 which is mounted to the aforementioned mounting plate 100 in a manner to be vertically movable relative to the plate 100. More particularly, there are a number of studs 116 (see Fig. 2) having threaded ends 118 which fit into match-

ing sockets 120 formed in a stationary platen 122. These studs 116 also have a vertical cylindrical shank portion 124 with an expanded lower head 126, and this shank portion 124 extends through a matching opening 128 (see Fig. 5-7) in the platen or plate 114. As shown in Figs. 5 through 7, each opening 128 can be provided with a bushing 130 to enable the platen 114 to move vertically along the shank portions 124 of the studs 116 toward and away from the mounting plate 100 and the platen 122. A number of compression springs 132 are positioned in sockets 134 at corner locations of the platen 122, and also at other locations across the face ofthe platen 122, to urge the lower movable platen 114 downwardly against the heads 126 which limit further downward movement of the platen 114. By properly selecting the location and the strength of the springS 132, the force exerted at the contact surfaces 94 can be controlled more closely so that the proper pressure is applied against the printing sheet 20. In addition, sockets 134a (see Fig. 1) are formed in the movable platen 114 to receivethe lower ends ofthe springs 132.

Mounted to the lower surface of the movable platen 114 are a plurality of contact bars 136, each bar 136 having a plurality of downwardly protruding contact elements 138, with each contact element 138 having a related one of the first contact sufaces 94. Each contact surface 94 is made with a moderate convex curve so as to match the moderate concave curvature of the top surface 22 of each key.

The second component or subassembly 96 of the printing assembly 116 comprises the aforementioned stationary platen 122 which is removably mounted to the mounting plate 100 at a fixed location. This could be accomplished, for example, by a dovetail slide connection, three of which are shown at 140 fitting into slots 142 in the platen 122 (see Fig. 1). Fixably mounted to, and extending downwardly from, the lower surface of the stationary platen 122 are a plurality of second contact bars 144. Each of these bars 144 has a related second contact surface 98 and extends lengthwise along a location corresponding to a related row of keys 18. The extreme lower end portion of each bar 144 is, in transverse section, formed as a rounded nose portion 146, and also has an upwardly slanting surface 148 which slants upwardly in a direction away from the contact surface 98. While the stationary platen 122 is shown as being mounted directly to the plate 100, it is to be understood that an intermediate mounting plate could be attached to the plate 100 and the platen 122 attached by the dovetail connection 140-142 to this intermediate plate.

The movable platen 114 has a plurality of elongate, slot-like through openings 150 having length and width dimensions moderately greater than corresponding length and width dimensions of related contact bars 144 so that these contact bars can extend through these openings 150.

The aforementioned compressions springs 132 are mounted in their related sockets 134 in the stationary platen 122 and in the sockets 134a in the movable platen 114 so that the springs 132 can be compressed entirely within the sockets 134 and 134a. This permits the first lower platen 114 to move upwardly into contact with the upper stationary platen 122, and the significance of this will be discussed later in the description of the operation of the present invention.

To describe the operation of the present invention, initially, the carrying frame 34 of the key carrying assembly 14 is in its lower position, as shown in Fig. 1. A plurality of keys 18 are placed on the pedestals 58. The pedestals 58 are desirably mounted on a removable tray 52, and the keys 18 can be placed on these pedestals 58 at a location away from the apparatus 10, with the tray 52 then being moved into position on the upper plate 36 of the frame 34. Alternatively, the caps can be placed directly on the pedestals 58 at the location of the apparatus 10. Suitable attaching means can be provided to accurately position the tray 52 on the plate 36.

With the keys 18 in place, the printing sheet 20 which matches the array of keys 18 is placed on top of the tray 52, this being accomplished by fitting the locating holes 76 of the printing sheet 20 on the matching upper protrusions 74 of the locating pints 70. As indicated previously, this accurately locates the various image areas 82 over corresponding keys 18. The intermediate load transfer blanket or sheet 26 is positioned between the printing assembly 16 and the printing sheet 20 by attaching the side edges of the sheet or blanket 26 to the aforementioned mounting plates 112.

The platen 122 is heated to a suitable operating temperature (e.g., typically between 350 to 525 degrees F) so that the contact surfaces 98 are brought to the same appropriate operating temperature (e.g., between about 350 to 525 degrees F). In the present embodiment, this is conveniently accomplished through electric heating, with resistance heating rods being placed through openings provided in the stationary platen 122 (or in openings in an intermediate plate between the platen 122 and the plate 100, if such an intermediate plate is provided).

To bring the contact surfaces 94 to the proper temperature, resistance heating rods are placed in the movable platen 114 and in the contact bars 136. As illustrated in Fig. 5, this is desirably accomplished by forming a circular opening 152, with one semi-circular half of this opening 152 being

formed at the lower surface of the plate 114, and the other semi-circular half of this opening 152 being formed in the adjacent bar 136. Then the resistance heating element 154 is placed in this circular opening 152. It has been found that this arrangement provides an optimized heating pattern so that contact surfaces 148 can be maintained at the desired operating temperature within rather close tolerances. Further, the proximity of the bars 136 with the contact surfaces 98 also assist in maintaining these contact surfaces 98 at the proper operating temperature. It is to be understood, however, that other forms of heating could be used, and since these alternative forms are well known in the prior art, they will not be described herein.

After the platens 114 and 122 are brought to the desired operating temperature, the carrying frame 34 is moved upwardly by means of the actuating wedge member 42. To describe how the printing assembly 16 functions in cooperation with the key carrying assembly 14 to accomplish the ends of the present invention, reference is now made to Figs. 5 through 7. As can be seen in Fig. 5, the carrying frame 34 has moved upwardly so that the contact surfaces 94 are just about to press the intermediate load transfer sheet 26 against the printing sheeet 20 which in turn will press against the top key surfaces 22, and the lower end nose portions 146 of the second contact bars 144 are likewise coming closer to the engagement position.

As the carrying frame 34 moves further upwardly to the position of Fig. 6, the first contact surfaces 94 press portions of the load transfer sheet 26 against the first area portions 84 of the image areas 82 of the printing sheet 20 so that these sheet portions 84 become pressed against top key surfaces 22. The force which these contact surfaces 94 exert is dependent upon the strength and location of the compression springs 132. These springs 132 are arranged so that this force is sufficient so that the contact surfaces 94 press the sheet portions 84 against the top key surfaces 22 with sufficient firmness so that these sheet portions 84 remain properly located and positioned against the top key surfaces 22 through the remainder of the process while the contact surfaces 94 remain in their engaging position.

As the carrying frame 32 continues to move further upwardly, as illustrated in Fig. 7, the engagement of the keys 18 causes the movable platen 114 to move further upwardly toward the platen 122. At the same time, the relative motion between the platen 114 and the second contact bars 144 results in the nose portions 146 of the bars 144 pushing the intermediate load transfer sheet 26 downwardly relative to the keys 18, until the contact surfaces 98 of these bars 144 act through adjacent portions of the load transfer sheet 26 to cause these to come into pressing engagement where the second image area portions 86 of the printing sheet 20 become pressed against the front key surfaces 24. It has been found that the action ofthese contact surfaces 94 and 98 is such that there is created at most relatively minor frictional engagement between the cushioning sheet 26 and the printing sheet 20 which might tend to shift the printing sheet 20. More specifically, as the contact surfaces 94 press the adjacent portions of the sheet 26 into firm engagement with the image areas 84 to cause these to engage the key surfaces 22, these cushioning sheet portions adjacent to the contact surfaces 94 remain relatively stationary through the rest of the process. Then, as the nose portions 146 push the cushioning sheet 26 further downwardly, there is a stretching action of those portions of the cushioning sheet 26 that are immediately forward of the location of the contact surfaces 94. As the nose portions 146 of the bars 144 move toward their lower limits of travel, the image portions 86 of the printing sheet 20 become deflected downwardly. However, at this time, the frictional engagement between the image portions 86 and the cushioning sheet 26 is relatively small. Then, as the nose portions 146 of the bars 144 reach their extreme lower level of travel, the cushioning sheet portions adjacent the surface portions 98 bring the sheet image portions 86 into firm engagement with the key surfaces 24. However, there is by this time little, if any, tendency for the cushioning sheet portions adjacent the image areas 86 to slide over the printing sheet portions 86 or to cause any displacement of these printing sheet image portions 86. The net effect is that the two printing sheet image portions 84 and 86 become positioned against the key surfaces 22 and 24 within very close tolerances for accurate location of the images.

With the platen 114 in the position of Fig. 7, the compression springs 132 become totally compressed in their respective sockets 134 and 134a and the platen 114 comes into engagement with the platen 122. Thus, at this stage of the operation, the pressure or force against the key surfaces 22 and 24 depends primarily on the force exerted by the actuating mechanism through the wedge member 42.

With the printing assembly 16 being in pressing operative engagement with the keycaps 18, as described above, the heat transmitted from the contact surfaces 94 and 98 causes the dye material forming the images 84a and 86a to sublimate, and also heats the adjacent surface areas of the keys 18. The dye material migrates into the upper and front surfaces 22 and 24, respectively, of the keys 18 so that these images are imprinted into the material adjacent these surfaces 22 and 24. After

about 60 seconds, the carrying frame 34 is lowered, and the printing sheet 20 is removed. Another set of keycaps 18 is placed on the pedestals 58, and a second printing sheet 20 is positioned over the keys 18. Then the same process is repeated in the manner described above.

A modified form of the printing sheet 20 is illustrated in Fig. 8, where a small portion of the modified printing sheet, designated 20a, is shown in an enlarged scale. Adjacent portions of two image areas 82a are shown, with each of these image areas 82a having the before mentioned perforation lines, designated 88a and 90a, of a U-shaped configuration.

Located between each adjacent pair of side perforation lines 90a of two adjacent image areas 82a is an elongate paper strip 160. This strip 160 is formed with a plurality of transverse perforation lines 162 at spaced intervals along the length of the strip 160. These perforation lines 162 are arranged in an alternating pattern, with half of these perforation lines 162 extending from one of the perforation lines 90a, and the other half extending from the other perforation line 90a, and with each perforation line 162 overlapping adjacent perforation lines 162, but not extending all the way to the opposite line 90a. During the operation of the present invention, when the aforementioned bars 144 come into engagement with the transfer sheet 26 (as shown in Fig. 7), the image areas 82a of the printing sheet 20a break loose from the remainder of the sheet along their separation lines 88a and 90a. At the same time, the intermediate strips 160 become stretched. With the arrangement of the alternatively positioned separation lines 162 along the length of each strip 160, the effect is that the strip 160 separates along these separation lines 162 so that this strip 160 is able to elongate.

To compare this to the alternative arrangement shown in Fig. 4, the strip between adjacent image areas 82 simply breaks at some location along its length. The arrangement shown in Fig. 8 permits the strip 160 to elongate in a more predictable pattern.

In the preferred embodiment shown herein, the dye material in the image areas 82 actually sublimates (goes from a solid state directly to a gaseous state) so that the dye material then migrates into the surface portions of the keys 18. It is to be understood, however, that within the broader scope of the present invention, other printing techniques could be used.

It is to be recognized that various modifications could be made to the system described herein without departing from the basic teachings of the present invention. For example, the manner in which the relative motion is obtained between the two subassemblies 92 and 96 of the printing assembly 16 and the carrying frame 34 could be varied. Other possible modifications would be apparent to those skilled in the art, and it is to be understood that these could be made without departing from the scope of the present invention.

Claims

1. A printing apparatus particularly adapted to imprint images on at least one key member, where a first image is imprinted on a top surface of each of said key members and a second image is imprinted on at least one side surface of each of said key members, said apparatus comprising:

a. a support means adapted to support at each predetermined key loction a key member on which the images are to be imprinted;

b. a printing assembling comprising:

1) a first printing component having first contact surfaces at locations corresponding to each of said key locations to come into pressing engagement with the top key member surfaces at each of said key locations;

2) a second printing component having second contact surfaces at locations corresponding to each of said key locations to come into pressing engagement with the side key member surfaces;

c. locating means to locate beween said support means and said printing assembly a printing sheet having a sheet region having thereon related images at image locations corresponding to said key locations, with said sheet region having first and second sheet portions with said first and second images thereon, respectively;

d. actuating means to bring said support means and said printing assembly into operating engagement where said printing assembly presses the printing sheet into engagement with the key members in a manner that the first contact surfaces intially presses the first sheet portions into pressing engagement with the top key member surfaces, after which said second contact surfaces moves relative to the key member to move said second sheet portion into pressing engagement with the side key member surfaces.

2. The apparatus according to claim 1, wherein there is a flexible and stretchable cushioning sheet member positioned between said support means and said printing assembly in a manner that said first and second contact surfaces press said cushioning sheet member against said printing sheet to cause said sheet region to come into engagement with each of said key members.

3. The apparatus according to claim 1, wherein there is heating means to heat said first and second printing components so that said first and

second printing components in turn cause said sheet region and said key members to be heated to cause the images on said sheet member to be transferred to said key member.

4. The apparatus according to claim 1, 2 or 3, wherein there is a mounting means to which said first and second printing components are mounted in a manner so as to be movable relative to one another, said mounting means being arranged to be movable, relative to said support means, toward and away from said support means, said apparatus being arranged so that as said actuating means moves said mounting means toward said support means, said first printing component first comes into operating engagement with said key members, after which said mounting means continues to move said second printing component into operating engagement with said key members.

5. The apparatus according to claim 4, wherein said first printing component is arranged to be movable relative to said mounting means, in a manner that when said first printing component comes into operating engagement with said key members, said mounting means moves relative to said first printing component to bring said second printing component into operating engagement with said key members.

6. The apparatus according to claim 5, wherein said second printing component is mounted so as to remain stationary relative to said mounting means.

7. The apparatus according to claim 4 or 5, wherein there is spring means operatively engaging said first printing component in a manner that said first printing component is urged toward said key members, so that as said first printing component comes into operative engagement with said key members, said spring means continues to urge said first printing component into operating engagement with said key members as said mounting means continues to move said second printing component into operating engagement with said key members.

8. The apparatus as recited in claim 7, wherein said spring means comprises compression spring means positioned between said first printing component and mounting means.

9. The apparatus according to claim 1, wherein:

a. said printing assembly further comprises a mounting member which is movable toward and away from said support means;

b. said first printing component comprises first platen means to which a plurality of first contact members are mounted, with said first contact member having said first contact surfaces, said first platen means being movable toward and away from said mounting member;

c. said second printing component comprising second platen means, with said first platen means being mobable relative to said second platen means;

d. said apparatus being arranged so that as said mounting member moves toward said support means so as to bring said first printing component into operating engagement with said key members, further movement of said mounting member causes movement of said second printing component relative to said first printing component so as to bring said second contact surfaces into operating engagement with said key members.

10. The apparatus according to claim 9, wherein said first platen means is provided with opening means, and said second printing component has a plurality of contact members which are arranged to extend through said opening means when said second printing component is in operating engagement with said key members, in a manner that said second contact members can move relative to said first platen means while extending through said opening means.

11. The apparatus as recited in claim 10, wherein there is spring means operatively engaging said first platen means to urge said first platen means into operating engagement with said key members, and movement of said mounting member toward said key members after the first contact members are in operating engagement with said key members causes said spring means to maintain said first contact surfaces in firm operating engagemetn with the first key member surfaces.

12. The apparatus as recited in claim 11, wherein said spring means comprises at least one compression spring mounted between said first platen means and said support member.

13. The apparatus as recited in claim 9, wherein the first contact members have said contact surfaces positioned in said operating position so as to be in alignment with said top key member surfaces, and said second printing component comprises a plurality of second contact members, spaced laterally from, and movable relative to, said first contact members, with said second contact members having said second contact surfaces slanted relative to said first contact surfaces so as to be in substantial alignment with said side key member surfaces as said second contact surfaces come into operating engagement with said side key member surfaces.

14. A method for imprinting images on at least one key member, where first images are imprinted on top surfaces of each of said key members and second images are imprinted on side surfaces of each of said key members, said method comprising:

a. supporting at each predetermined key location a key member on which the images are to be imprinted;

b. providing a printing assembling comprising:

1) a first printing component having first contact surfaces at locations corresponding to each of said key locations to come into pressing engagement with the top key member surfaces at said key locations;

2) a second printing component having second contact surfaces at locations corresponding to each of said key locations to come into pressing engagement with the side key member surfaces;

c. locating between said key members and said printing assembly a printing sheet having a plurality of sheet regions having thereon related images at image locations correspondign to each of said key locations, with said sheet regions having first and second sheet portions with said first and second images thereon, respectively;

d. bringing said printing assembly into opera ting engagement with said key members so that said printing assembly presses the printing sheet into engagement with the key members in a manner that each of said first contact surfaces intially presses the first sheet portions into pressing engagement with top key member surfaces, after which each of said second contact surface are moved relative to the key members to move said second sheet portions into pressing engagement with the side key member surfaces;

15. The method according to claim 14, further comprising positioning flexible and stretchable cushioning sheet members between said support means and said printing assembly in a manner that said first and second contact surfaces press said cushioning sheet members against said printing sheet to cause said sheet region to come into engagement with said key member:

16. The method according to claim 14, further comprising heating said first and second printing components so that said first and second printing components in turn cause said sheet regions and said key members to be heated to cause the images on said sheet members to be transferred to said key members.

17. The method according to claim 14, wherein there is provided a mounting means to which said first and second printing components are mounted in a manner so as to be movable relative to one another, said method further comprises moving said mounting means, relative to said key member, toward said key members in a manner that as said mounting means moves toward said support means, said first printing component first comes into operating engagement with said key members, after which said mounting means continues to move said second printing component into operating engagement with said key members.

18. The method according to claim 17, wherein said first printing component is arranged to be movable relative to said mounting means, said method further comprising, when said first printing component comes into operating engagement with said key members, moving said moutning means moves relative to said first printing component to bring said second printing component into operating engagement with said key members.

19. The method according to claim 18, wherin said second printing component is mounted so as to remain stationary relative to said mounting means.

20. The method according to claim 18, further comprising utilizing spring means to operatively engage said first printing component in a manner to urge said first printing component toward said key members, so that as said first printing component comes into operative engagement with said key members, said spring means continues to urge said first printing component into operating engagement with said key members as said mouting means continues to move said second printing component into operating engagement with said key members.

21. The method according to claim 20, wherein said spring means comprises compression spring means positioned between said first printing component and said mounting means.

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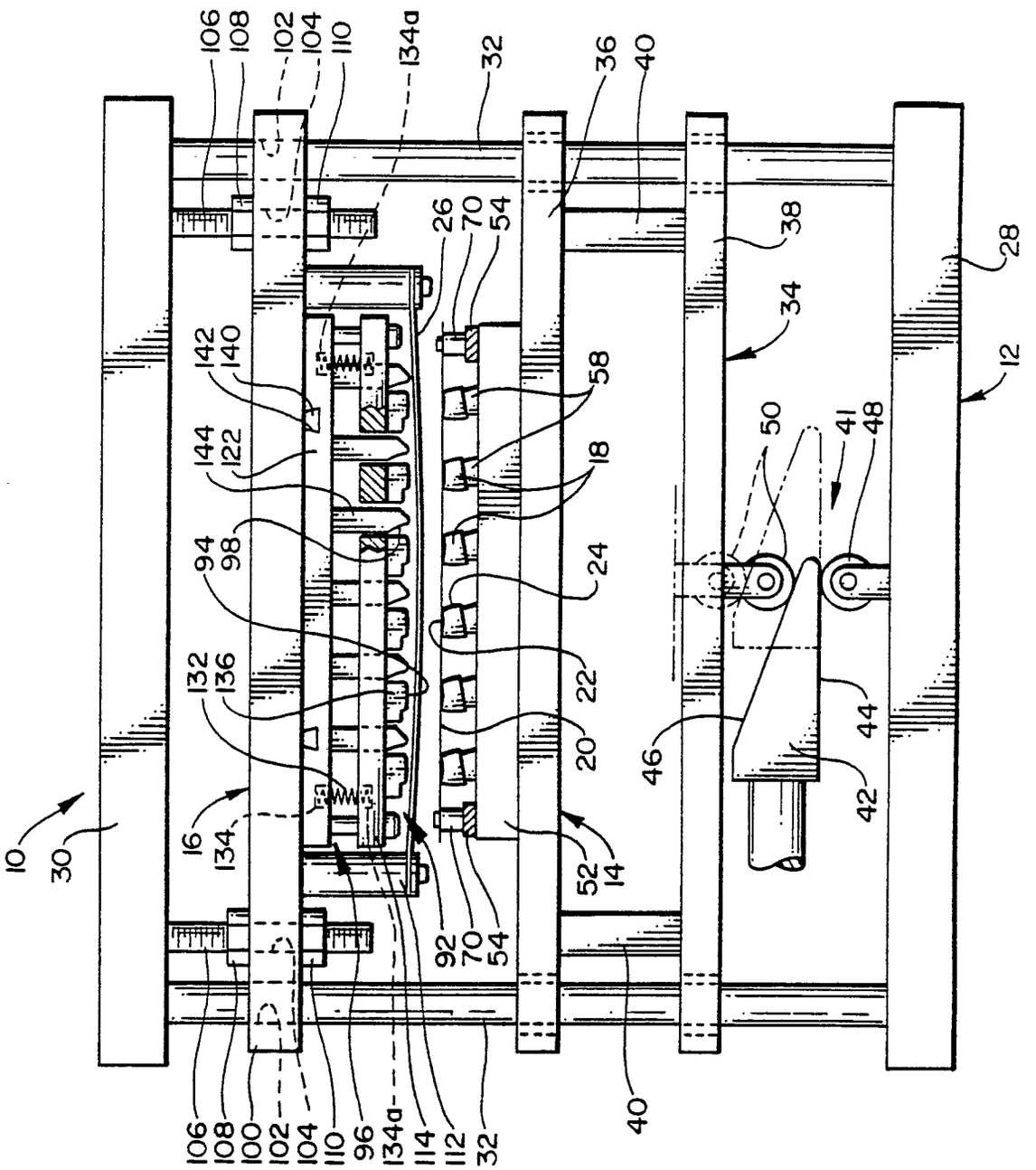
FIG. 1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32
40

FIG. 2

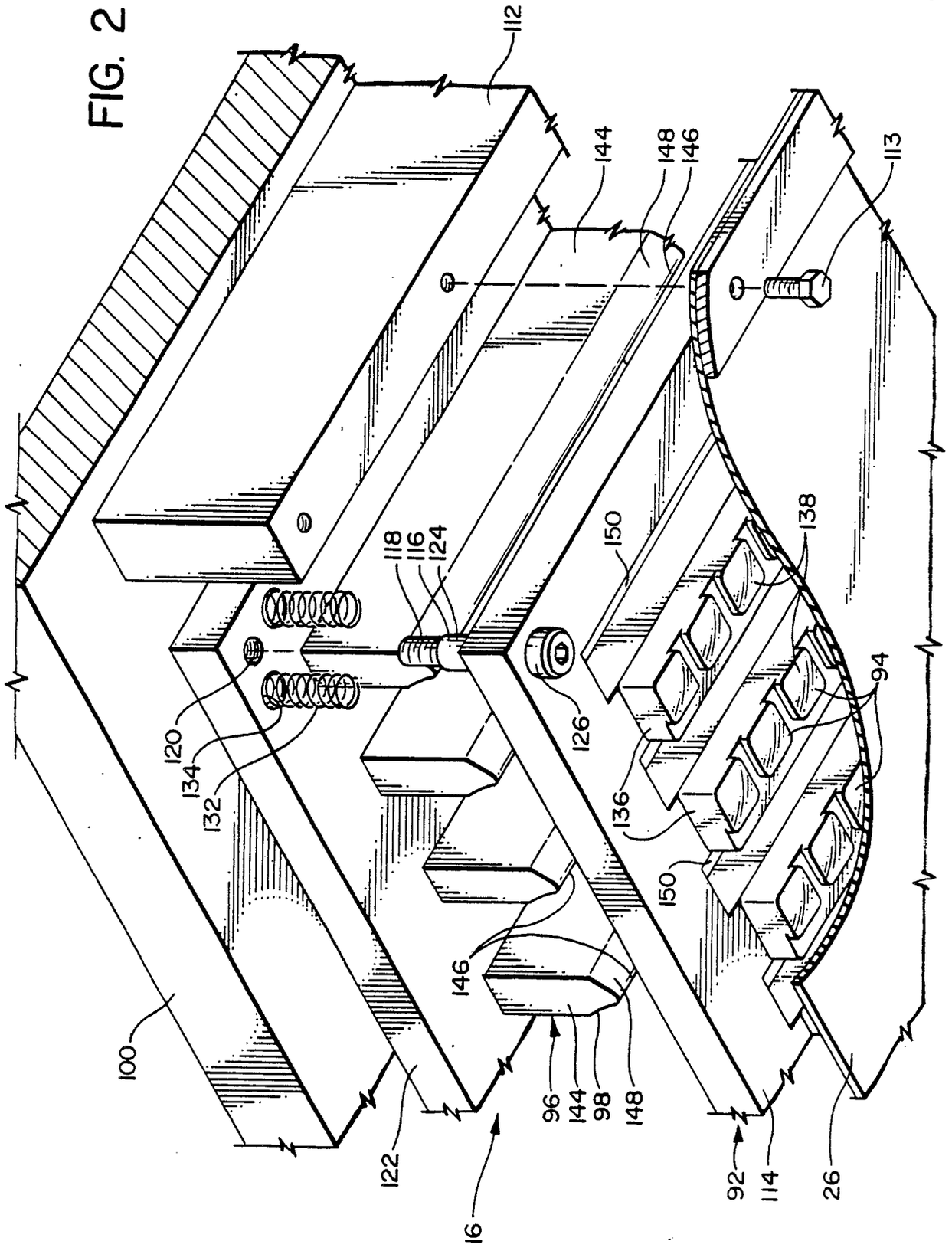
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FIG. 3

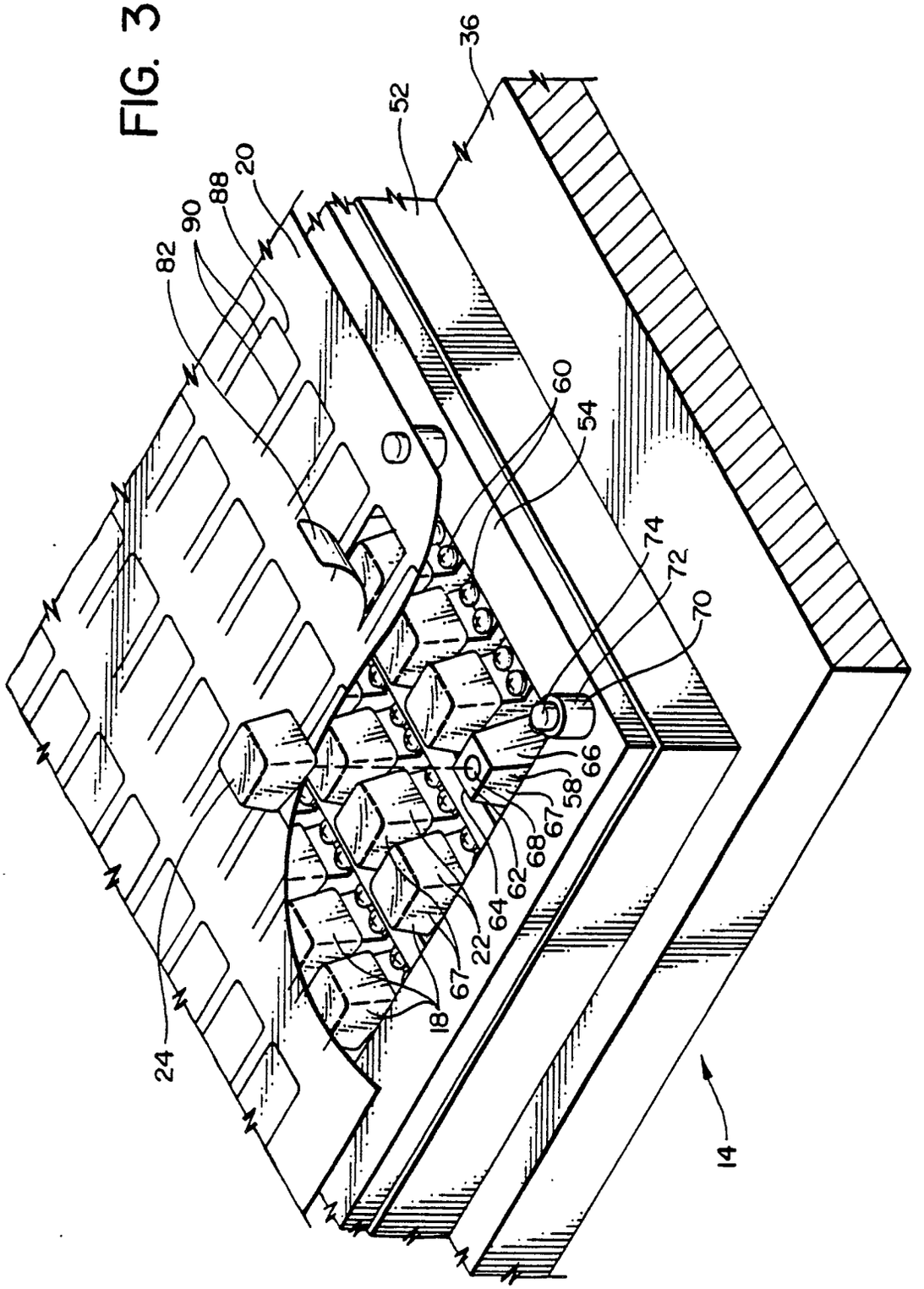
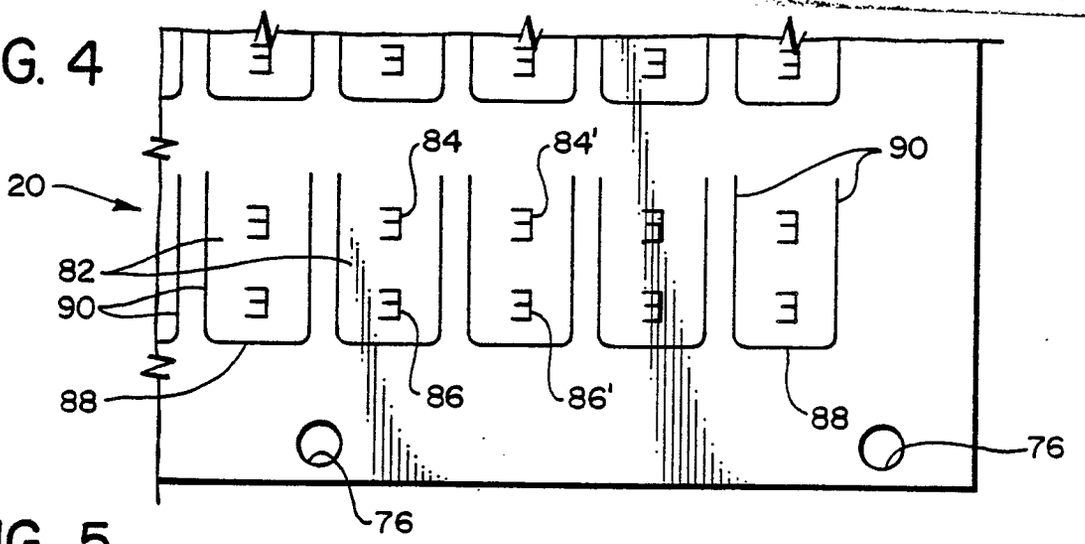


FIG. 4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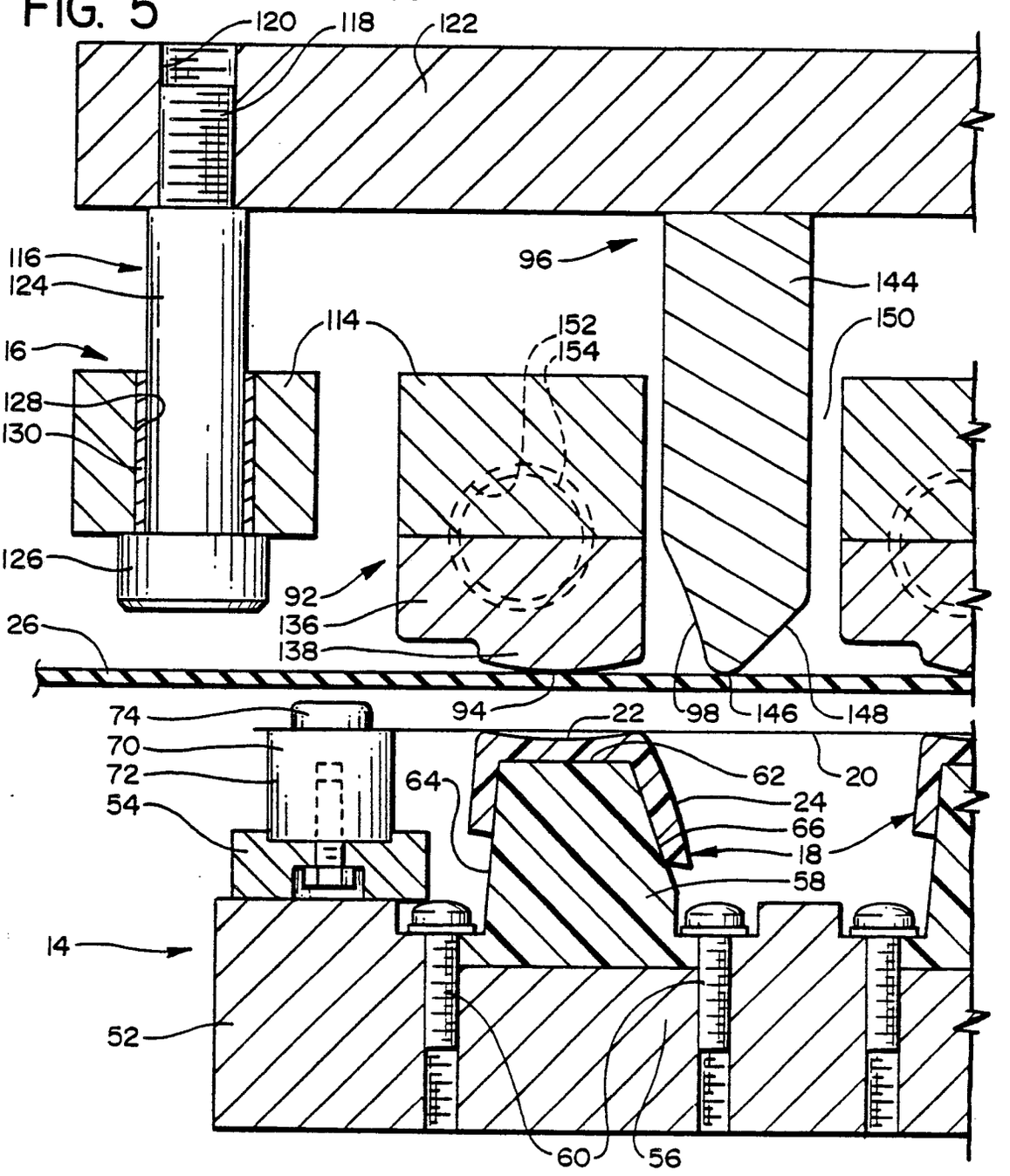
76

FIG. 5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202750.1

FIG. 6

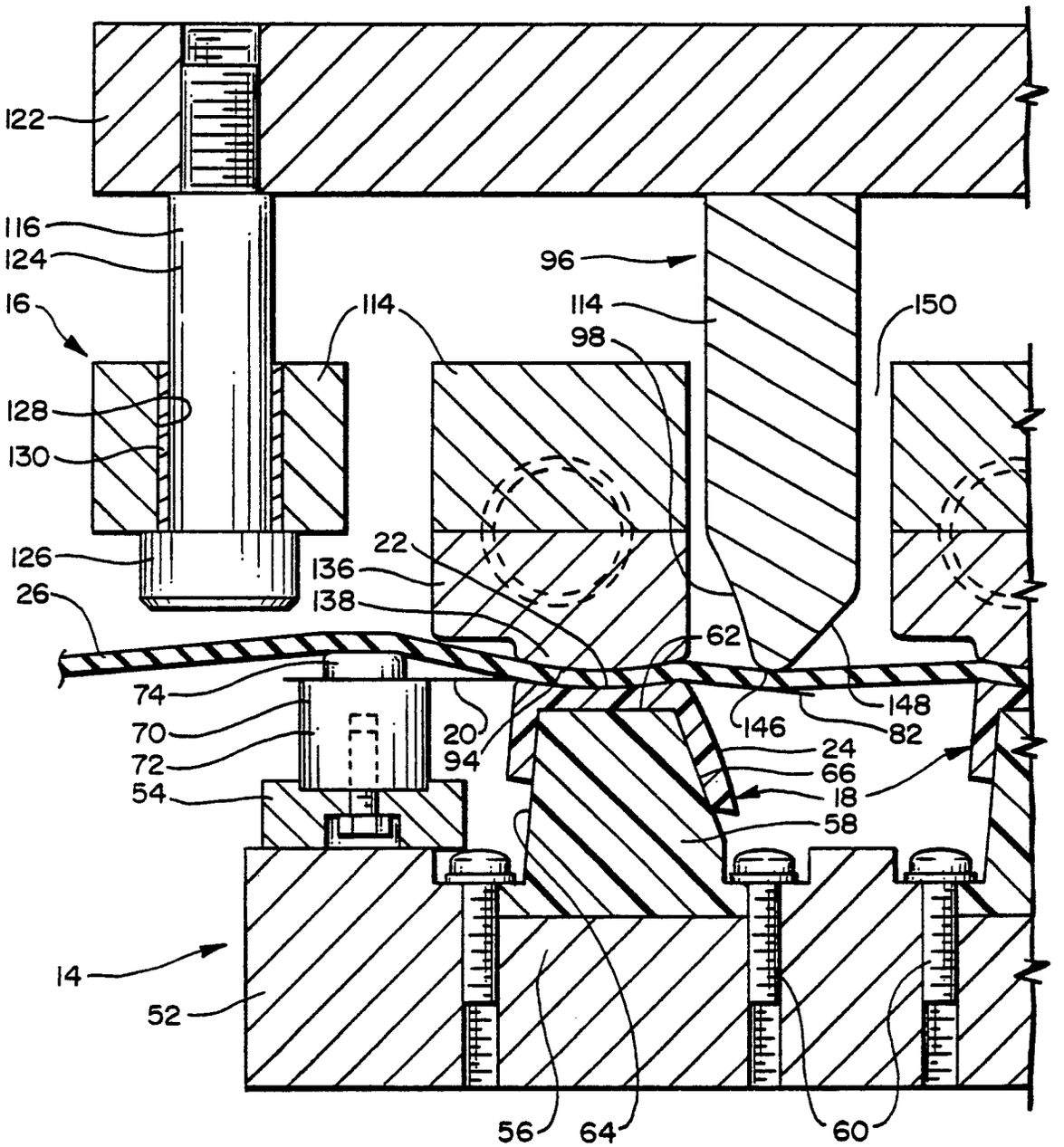

FIG. 7

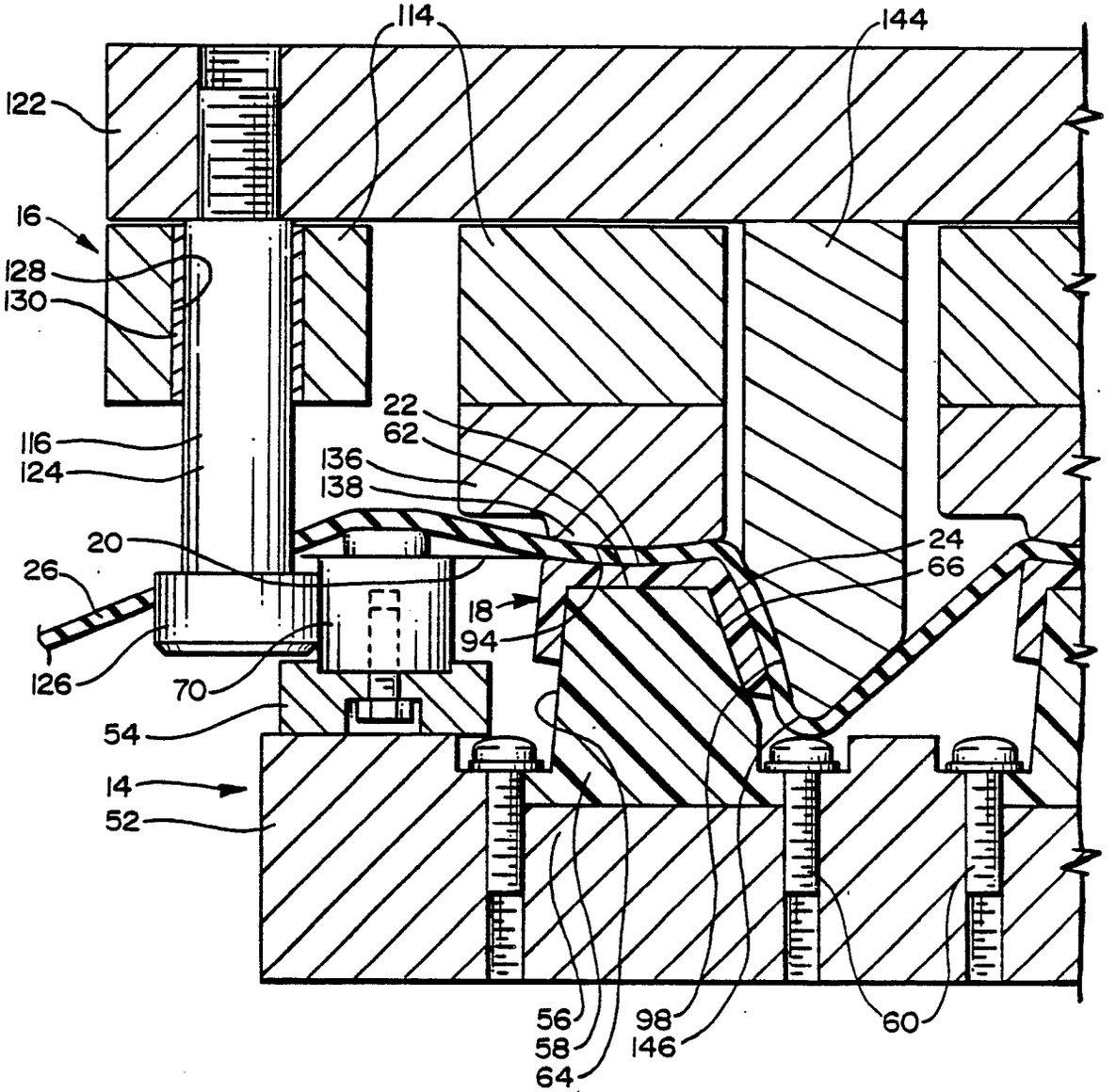

FIG. 8